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ECONOMIC AND SCIENTIFIC POLICY

Economic and Monetary Affairs

Employment and Social Affairs

Environment, Public Health and Food Safety

**Industry, Research and Energy**

Internal Market and Consumer Protection

# Mapping Smart Cities in the EU

STUDY

EN

2014

Mapping Smart Cities in the EU


DIRECTORATE GENERAL FOR INTERNAL POLICIES

**POLICY DEPARTMENT A: ECONOMIC AND SCIENTIFIC POLICY**

# Mapping Smart Cities in the EU

## STUDY

**Abstract**

This report was commissioned to provide background information and advice on Smart Cities in the European Union (EU) and to explain how existing mechanisms perform. In exploring this, a working definition of a Smart City is established and the cities fitting this definition across the Member States are mapped. An analysis of the objectives and Europe 2020 targets of Smart City initiatives finds that despite their early stage of development, Smart City objectives should be more explicit, well defined and clearly aligned to city development, innovation plans and Europe 2020 in order to be successful.

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## DISCLAIMER

# CONTENTS

# LIST OF ABBREVIATIONS

| | |
|---|---|
| **ASC** | Amsterdam Smart City |
| **BZFC** | Barcelona Zona Franca Consortium |
| **CAPEX** | Capital expenditure incurred to create future benefit |
| **CIP** | Competitiveness and Innovation Programme |
| **$CO_2$** | Carbon dioxide |
| **EC** | European Commission |
| **ECO** | Smart Economy |
| **ENV** | Smart Environment |
| **EU** | European Union |
| **FI-PPP** | Future Internet Public–Private Partnership |
| **FP7** | Framework Programme 7 |
| **GDP** | Gross domestic product |
| **GOV** | Smart Government |
| **IAB** | Impact Assessment Board |
| **ICT** | Information and communication technology |
| **ITRE** | Industry Research and Energy Committee |
| **LED** | Light emitting diode |
| **LIV** | Smart Living |
| **MDDA** | Manchester Digital Development Agency |
| **MOB** | Smart Mobility |
| **MWh** | Megawatt hour |
| **NiCE** | Networking Intelligent Cities for Energy Efficiency |
| **PEO** | Smart People |
| **PPP** | Public–private partnership |
| **PSP** | Policy Support Programme |
| **R&D** | Research and development |
| **SET** | Science, engineering and technology |
| **SMETMC** | Small and medium-sized enterprise |
| **UK** | United Kingdom |
| **USA** | United States of America |

# LIST OF TABLES

# LIST OF FIGURES

# EXECUTIVE SUMMARY

## Background

This report is commissioned by ITRE, the European Parliament's Industry Research and Energy Committee, inter alia to provide context for the European Innovation Partnership on Smart Cities and Communities.

**Whereas more than half of the world's population live in cities, this rises to over two thirds in EU28 and the proportion is growing.** High density city populations increase strains on energy, transportation, water, buildings and public spaces, so solutions need to be found which are 'smart', i.e. both highly efficient and sustainable on the one hand, as well as generating economic prosperity and social wellbeing on the other. This is best achieved by mobilising all of a city's resources and coordinating its actors using new technologies and forward looking joined-up policies.

## What is a Smart City?

**Information and communications technology (ICT) is a key enabler for cities to address these challenges in a 'smart' manner.** In this report, a Smart City is one with at least one initiative addressing one or more of the following six characteristics: Smart Governance, Smart People, Smart Living, Smart Mobility, Smart Economy and Smart Environment. ICT links and strengthens networks of people, businesses, infrastructures, resources, energy and spaces, as well as providing intelligent organisational and governance tools. Thus, we can define a Smart City as follows:

**Box 1: Working definition of a Smart City**

'A Smart City is a city seeking to address public issues via ICT-based solutions on the basis of a multi-stakeholder, municipally based partnership'.

## Mapping Smart Cities across the EU-28

Examining EU28 cities with at least 100,000 residents, 240 (51%) have implemented or proposed Smart City initiatives. Although almost half of European Smart Cities have 100,000 to 200,000 inhabitants, this is only 43% of this size category, whilst almost 90% of cities over 500,000 inhabitants are Smart Cities. This is very clearly a large city phenomenon, with such cities each having a large number of Smart City initiatives compared to smaller cities. However, in just half of European Smart Cities are such initiatives actually being piloted or implemented, with the rest only at planning stage so still relatively immature. **There are Smart Cities in all EU-28 countries, but these are not evenly distributed. Countries with the largest numbers are the UK, Spain and Italy, although the highest percentages are in Italy, Austria, Denmark, Norway, Sweden, Estonia and Slovenia. Smart City initiatives are spread across all six characteristics, but most frequently focus on Smart Environment and Smart Mobility.** Geographically, there is also a fairly even spread, although Smart Governance projects are mainly seen in the Older Member States of France, Spain, Germany, the UK, Italy and Sweden. Also noteworthy is that some characteristics typically occur in combination, such as Smart People and Smart Living.

## Success of Smart Cities initiatives vis-à-vis their objectives

**Box 2: Two definitions of 'success' employed in this study**

**Successful initiatives:** observable indicators through the life cycle of the initiative: attracting wide support, having clear objectives aligned to policy goals and current problems, producing concrete outcomes and impacts, being imitated or scaled.

**Successful cities**: having meaningful objectives (aligned with Europe 2020 and actual outcomes) covering a mix of policy targets and characteristics; having a balanced portfolio of initiatives; attaining maturity (on our scale); actively joining in Smart City networks

These definitions were applied to a representative sample of 50 Smart City initiatives across 37 cities, taking account of city size, geographic location, initiative characteristics, objectives, stakeholders and governance, funding, and achievements. An analysis of this sample identified five main types of objective: Smart City neighbourhood units; testbed micro infrastructures; intelligent traffic systems; resource management systems and participation platforms.

Because more than two-thirds of sampled Smart City projects remain in the planning or pilot testing phases, the numbers of mature successful initiatives remain relatively low. **However, our analysis shows that successful projects (i.e. which meet their objectives and contribute to the attainment of Europe 2020 goals) are those with clear objectives, goals, targets and baseline measurement systems in place from the outset.** Strong governance, a sound business case and a benefit realisation framework also appear to be needed. Having a strong local government partner as a key strategic player and co-founder is typically very important. **Successful projects also tend to be embedded in a comprehensive city vision. Public–private partnerships (PPPs) are highly important, especially where the private partners bring in developer expertise, finance and technology capabilities, as is the involvement of citizens and other end-users.**

## Success of Smart Cities vis-à-vis Europe 2020 targets

The sample also yielded a subset of 20 cities for more in-depth research on the inputs and processes occurring across initiatives within a single city. City data were displayed on dashboards showing their socio-economic and ICT indicators; funding, stakeholder and resource investments; objectives and expected impacts. Data on each city's initiatives was also aligned to the Europe 2020 targets related to employment, R&D, energy, education and poverty. Most (90%) of the sample cities have initiatives that focus on Europe 2020 energy targets, directly or indirectly. One-quarter of the sample's initiatives address employment targets, and over one-third aim to improve social inclusion and reduce poverty. Only two of the cities have an initiative that directly aims to increase the R&D capacity of a city, although these do have the potential to increase private sector investment in R&D and innovation.

## Boosting Smart City initiatives: solutions and good practice

Further analysis of each city's alignment to Europe 2020 targets, and taking account of how they perform in the context of their country's national priorities and political and socio-economic circumstances, led to the selection of **the six most successful cities for further in-depth analysis: Amsterdam (the Netherlands), Barcelona (Spain), Copenhagen (Denmark), Helsinki (Finland), Manchester (UK) and Vienna (Austria).**

In each of these, a number of initiatives were assessed in order to identify the factors that led to their success, showing that most of the solutions focus on transport, mobility and Smart Governance, revealing in all eight main generic solutions in these areas, including building technologies.

Notably, almost all solutions are expected to recover their costs in the short to medium term. Cross-analysis also pointed to a number of good practices, each related to three important factors for successful Smart Cities and the deployment of solutions: a clear vision; the involvement of citizens, representatives and local businesses; and efficient processes (Table 1).

**Table 1 : Factors for successful Smart Cities**

| Factors for success | Description |
|---|---|
| Vision | The study makes clear that inclusion and participation are important targets for successful Smart City programmes to avoid the polarisation between the urban elite and low income areas. |
| People | The case studies highlight the inspiring leaders ('city champions') behind many successful initiatives. Citizens should be empowered through active participation to create a sense of ownership and commitment, and it is important to foster participative environments that facilitate and stimulate business, the public sector and citizens to contribute. |
| Process | The creation of a central office that acts as go-between for Smart City ideas and initiatives, drawing in diverse stakeholders, is of vital importance and allows coordination of ideas, projects, stakeholders and beneficiaries. Local level coordination can also be important for uptake, to ensure the integration of solutions across the portfolio of initiatives. For example, many municipalities insist that information about public services be provided as 'open data'. This allows individuals and companies to process and recombine these and other available data in order to create useful resources for the public, for example real-time traffic information. It is important for cities to participate in networks to share knowledge and experiences, therefore promoting their own initiatives as well as learning from others and laying the foundations for future collaboration. |

### Scaling strategies

The potential to scale up to EU level (through expanding existing projects, replicating or seeding new projects) was also assessed for each of the five main types of objective mentioned above, and all have some potential. Some types (e.g. testbed micro infrastructures and intelligent traffic systems) were designed to be scaled.

In others (e.g. Smart City neighbourhood units and resource management systems) the scaling potential is limited by a high degree of local specificity. **We also found that initiatives involving the participation of international commercial technology providers were better able to benefit from scaling, and this is enhanced by inter-city cooperation.**

From this analysis we distinguish a range of 'scaling strategies' including *replication* (repeating initiatives and Smart City strategies in other locales), *scaling* (increasing the number of participants, resource allocation, geographic footprint or offering services more widely) and *ecosystem seeding* (using Smart City initiatives as the basis for an adaptive network of interacting initiatives). We found that different project types benefit from different scaling strategies and, in so doing, face different obstacles. Moreover, the strategies pose different risks (e.g. a failure to sustain progress or adverse side-effects such as market failure or displacement of alternative strategies). One approach is to collect good processes and practices to create pan-European 'Smart City services'.

There are several possible models for this including a service provider organisation; a dedicated 'angel' support programme; and a cloud-based model providing specific services including for example Smart City app stores and ecosystem support.

**Four broad findings** regarding the wider dissemination of Smart City initiatives emerge. First, the **potential for expanding the scale of existing projects** (adding participants or areas**) or creating duplicate projects in other areas can be reinforced by strong governance, sustained sponsorship and the right stakeholder mix**. Second, **citizens are important stakeholders** in 'Smart Neighbourhoods' and 'participation platform' initiatives, so should have strategic roles in development and execution. Third, the **participation of a private company (ideally national or pan-European) as a key player alongside the city authorities and local firms can provide an institutional base for scaling**, although this can also risk the accumulation of too much market power in such companies. Fourth, **cooperation among cities to create common Smart City platforms for large-scale development and testing is needed**.

## Recommendations

The recommendations that emerge from this analysis can be grouped into five categories as shown in Table 2.The recommendations in the first group are aimed at improving the knowledge base for and providing lessons for European policy. The second group concerns the design of initiatives and city-level action plans. Third, recommendations are provided concerning governance and to facilitate learning and scaling. The fourth group of recommendations is aimed at measures other than direct support that can be used to stimulate Smart City development. Finally, the fifth group of recommendations are designed to create conditions conducive to the scaling and extension of the most promising Smart City approaches.

**Table 2 : Our recommendations and the groups they are intended for**

| Recommendation | Intended for |
|---|---|
| **Understanding Smart Cities: research and evaluation** | |
| Detailed panel of longitudinal case studies with city-level funding and outcome data | DGCNECT, DG JRC |
| Standardised evaluation and assessment methods to measure success at internal, city and European level for impact assessment and benchmarking | The European Commission (EC) and Impact Assessment Board (IAB) |
| Develop methods and structures for a needs assay of the city's performance against relevant targets and presentation scorecards | Collective effort led by existing Smart City clusters[1] |
| **Designing Smart City initiatives and strategies** | |
| Mandate specialised impact assessment guidelines for Smart City strategies and initiatives to include: SMART objectives, issues of timing and uncertainty, and assessment of experimental variation | Funding bodies,[2] IAB, Smart City clusters |
| Promote local modularity for early-stage initiatives | Funding bodies, Smart City clusters; additional specific funding from EC, local government stakeholders |
| Facilitate exit and change of participation during the latter stages of an initiative | Funding bodies, Smart City clusters, local government stakeholders |
| Structural conditionality in funding for Smart City initiatives | Funding bodies |
| Specific design procedure for structuring Smart City initiative components | IAB, Smart City clusters, local government stakeholders (as monitoring hosts) |
| **Smart City governance** | |
| European-level Smart City platform with brokerage or intermediary functions | EC |
| Privileged or low-cost access to existing infrastructures | Local government stakeholders, infrastructure operators, national regulatory agencies |
| Mandatory multi-stakeholder governance with lay users represented and on integrated project teams | Funding bodies and government authorities and participants |
| Encourage industry-led public–private partnership consortia | Funding bodies and government authorities and participants |

[1] To include for example Concerto, Civitas, Covenant of Mayors, Green Digital Charter.
[2] To include European, Member State and local funding sources.

| Recommendation | Intended for |
|---|---|
| **Supporting the development of Smart Cities** | |
| Use demand-side measures to stimulate demand for city-based 'Smart solutions' | Member State and local government procurement agencies, Horizon 2020, service users, standards bodies, national regulatory agencies |
| Selective use of regulatory forbearance and/or pro-competitive sourcing | Procurement agencies, national regulatory agencies, European Parliament |
| **From Smart Cities to a Smarter Europe: replication, scaling and ecosystem seeding** | |
| Periodic assessment of scalability potential and identification of instruments and activities to optimise pan-European dissemination of good practices and solutions | EC (platform), IAB (guidelines), local authority participants |
| Include Smart Cities as a future internet public–private partnership (PPP) use case or involve Smart City stakeholders in large-scale pilots, standards bodies, etc. | Future Internet Public–Private Partnership (FI-PPP), Horizon 2020, EC (supporting standards body engagement with additional specific funding) |
| Expand support for Smart Cities and Communities – European Innovation Partnership | EC |
| Additional resources for Smart City translation and transfer | EC, Member States |
| Create and encourage Smart City-specific new intellectual property ownership rights and contract forms | EC, Council, Parliament; possible WIPO |

# 1. INTRODUCTION

## 1.1. Aims and objectives of the study

This report was commissioned by the European Parliament's Industry, Research and Energy Committee, to provide background information and advice to their members on Smart Cities in the EU and to explain how existing mechanisms perform, in particular vis-à-vis the targets of EU 2020

## 1.2. Methodology

We have taken a conventional approach to the study with a strong emphasis on desk research. We followed this with in-depth analysis to provide an actual, accurate and objective picture of current patterns and trends, and an understanding of the factors contributing to the success of Smart City initiatives that are at the basis of a Smart city. Smart city initiatives are a subset of actions that contribute to the definition of a Smart City (see Chapter 2). Based on these insights, we identify examples of good practice and formulate recommendations for future interventions that could influence developments in Smart Cities and their contribution to the objectives of Europe 2020.

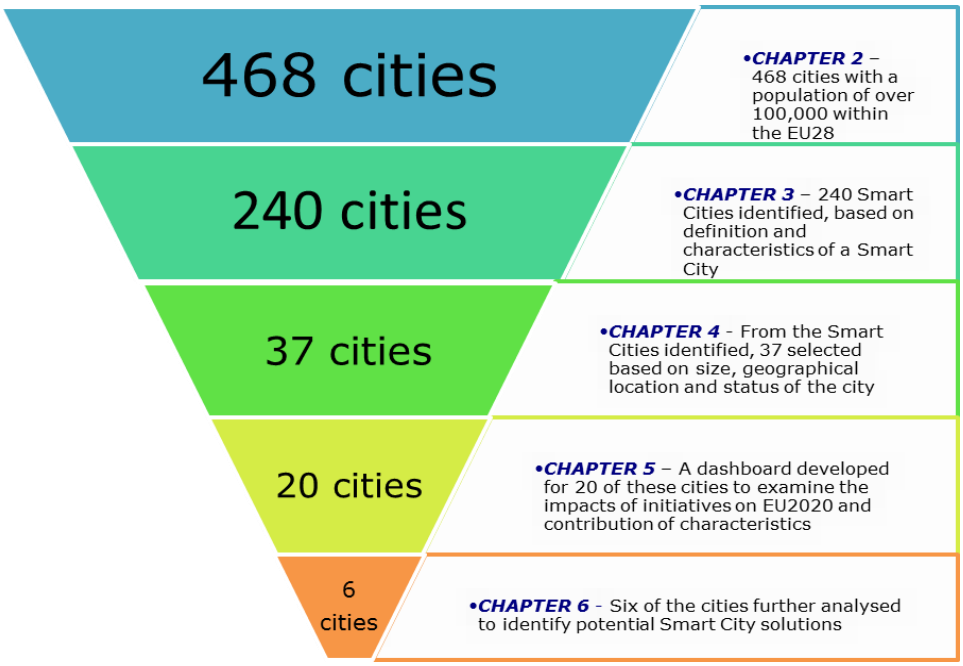
Initially, we considered the 468 cities in the EU-28 with 100,000+ residents. Data on these cities were obtained from the *UN Demographic Yearbook 2009–2010*.[3] Each of the cities was examined using online sources of information (such as local government and Smart City project websites) cited in the relevant literature.[4] Through this process, we assessed the level of Smart City activity present in each selected city.

On the basis of this initial analysis, we identified 240 cities in the EU-28 with significant and verifiable Smart City activity. These cities are mapped in Chapter 3. From this group, we took a sample of 50 Smart City initiatives across 37 cities. Within this sample, we analysed the stakeholders, funding and scalability of the initiatives (see Chapter 4). To explore the relationship between Smart Cities and Europe 2020, we collected relevant evidence into a structured dashboard but restricted the sample of cities used in the dashboard to 20 because of current data limitations (see Annex 10). We then conducted a quantitative analysis of the alignment between the Smart City initiatives in the sample of 20 Cities and Europe 2020 targets (see Chapter 5). The analysis itself is based on the alignment between the objectives and characteristics of each city's portfolio of projects, and the relevant Europe 2020 objectives. This analysis takes into account the differential importance of the various targets (actual vs. desired outcomes). The implications for assessing the motivations and interests of key stakeholders are also recognised. Finally we focus on a range of innovative deployment strategies in the top six performing Smart Cities in order to identify cross-cutting themes and potentially replicable Smart City solutions (see Chapter 6).

Figure 1 illustrates how the sample of cities evolves across the chapters of the report.

[3] http://unstats.un.org/unsd/demographic/products/dyb/dyb2009-2010.htm.
[4] For a detailed discussion of these resources please refer to Section 3.1.

**Figure 1: Sampling hierarchy of cities investigated in the report**




### 1.2.1. Limitations and caveats

Determining the level of success for a city, in relation to its 'Smartness', is limited by the availability of data and the status of Smart City initiatives in the EU. A lack of publicly available information may mean that some cities are excluded from this study, or that their Smart City activity may be under-reported. This 'selection' effect may be correlated with the characteristics and success of initiatives. For instance, the most mature initiatives, and those that address the most obvious and easily measureable targets, are likely to be over-represented in the samples included in this report. For this reason, we adjust our measure of success to reflect the maturity and nature of the projects considered. Additionally, some cities may over-emphasise the current level of activity. Where possible, therefore, we have attempted to validate data produced by the cities and/or countries in which they are located by looking beyond national data sources.

**Smart City initiatives are a new approach to tackling a range of emerging problems associated with urbanisation. Therefore, measuring success at city level is complicated by the relative immaturity of most Smart City initiatives and the difficulty of linking initiatives to particular socio-economic issues or a particular system within a city.**

To address these issues, we have framed success in this report by the portfolio of Smart City initiatives in a given city and their objectives aligned with wider socio-economic goals, such as the targets of Europe 2020.

## 1.3. Structure of this report

Chapter 2 provides a working definition of a Smart City and the type of Smart City Initiatives included in this report. Chapter 3 describes and maps current initiatives being undertaken within and across the Member States of the EU. Chapter 4 analyses the success of Smart Cities by their own objectives and Chapter 5 assesses their contributions to the Europe 2020 targets; both chapters consider the relationship between components and characteristics and seeks to determine how this may contribute to success. Chapter 6 provides analysis of case study examples of successful Smart Cities and identifies good practice. Finally, Chapter 7 provides our conclusions and recommendations.

# 2. THE DEFINITION OF A SMART CITY AND ITS CHARACTERISTICS

**KEY FINDINGS**

- There are many definitions of Smart Cities. Some focus on ICT as a technology driver and enabler, while broader definitions include socio-economic, governance and multi-stakeholder aspects such as the use of social participation to enhance sustainability, quality of life and urban welfare.
- In any case, a Smart City is quintessentially enabled by the use of technologies (especially ICT) to improve competitiveness and ensure a more sustainable future by symbiotic linkage of networks of people, businesses, technologies, infrastructures, consumption, energy and spaces.
- In this study, **a Smart City is a city seeking to address public issues via ICT-based solutions on the basis of a multi-stakeholder, municipally based partnership. These solutions are developed and refined through Smart City initiatives**, either as discrete projects or (more usually) as a network of overlapping activities.
- More concretely, the strategies and initiatives of a Smart City must include at least one of the following characteristics (objectives and/or modes of operation): Smart Governance, Smart People, Smart Living, Smart Mobility, Smart Economy and Smart Environment. These characteristics constitute the ends for which stakeholders participate in a Smart City initiative (e.g. to solve an environmental issue).
- The means by which those ends are achieved include a range of components: technologies; material, financial, organisational and knowledge inputs; processes; and norms or standards. These components may already be present or may be created specifically for use in Smart City initiatives.
- Components therefore provide the building blocks of Smart City initiatives and comprise three types: technological, human and institutional.

## 2.1. Background

The world's urban population is expected to double by 2050.[5] By 2030, six out of every ten people will live in a city and by 2050 this figure will run to seven out of ten.[6] In real terms, the number of urban residents is growing by nearly 60 million people every year. As the planet becomes more urban, cities need to become smarter.

**Major urbanisation requires new and innovative ways to manage the complexity of urban living**; it demands new ways to target problems of overcrowding, energy consumption, resource management and environmental protection.

It is in this context that **Smart Cities emerge not just as an innovative *modus operandi* for future urban living but as a key strategy to tackle poverty and inequality, unemployment and energy management.**

[5] World Health Organization (2013).
[6] Ibid.

Despite the current wave of discussion and debate on the value, function and future of Smart Cities,[7] as a concept it resists easy definition. At its core, **the idea of Smart Cities is rooted in the creation and connection of human capital, social capital and information and Communication technology (ICT) infrastructure in order to generate greater and more sustainable economic development and a better quality of life.** Smart Cities have been further defined along **six axes** or dimensions:[8]

- Smart Economy
- Smart Mobility
- Smart Environment
- Smart People
- Smart Living
- Smart Governance

The coordination of policies along these dimensions reflects the positive feedback between city development and urbanisation; cities attract people while the availability of populations and infrastructure facilitates economic and societal development. But this feedback alone and the growth to which it gives rise are not sufficient to produce the hoped for benefits, as the problems associated with the uncontrolled growth of the mega-cities amply demonstrate.[9] The linkages between economic, societal and environmental development are not scalable as cities expand and are difficult to predict precisely, let alone control. Their beneficial evolution must therefore be facilitated by a combination of framework conditions and information and communications infrastructures. In this way a platform is provided on which governments, businesses and citizens can communicate and work together, and track the evolution of the city.

In the global profile of urban development, the Smart City is emerging as an important basis for future city expansion. **Europe's global competitors among the emerging economies are pursuing large Smart City programmes.** India is planning to spend EUR 66 billion developing seven Smart Cities along the Delhi–Mumbai Industrial Corridor[10] using a mixture of public–private partnerships (80%) and publicly funded trunk infrastructure investment (20%). China too is pursuing a Smart Cities strategy as part of its efforts to stimulate economic development and eradicate poverty. As poverty in China is largely a rural phenomenon, the programme seeks to attract rural workers to Smart Cities, which can then serve as giant urban employment hubs.[11]

As of March 2012, this strategy, based in transforming existing cities, involved at least 54 Smart City projects totalling EUR 113 billion.

The government in South Korea set up a Smart Korea IT Plan in 2010 which aimed to interconnect and enhance the ubiquitous infrastructure which has been developed through the u-strategy. The aim is connect physical infrastructure, including broadband internet and RFID technology with a range of devices, software, platforms and network technologies. Examples of implementation include customised service portals for citizens and businesses.

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[7] See Walravens and Ballon (2013), Chourabi et al. (2012), Caragliu, Del Bo and Nijkamp (2009).
[8] Smart Cities, Ranking of European Medium-Sized Cities, http://www.smart-cities.eu/
[9] These problems occur in the developing world (e.g. Nigeria) and the emerging economies of China, India and Brazil. See e.g. Desmet and Rossi-Hansberg (2013).
[10] Jerath (2011).
[11] Assessment based on comments by Alejandro Melchor III, Director of the Smarter Philippines programme. See Melchor III (2012).

Japan are using ICT to address a range of issues including the impact of a rapidly aging society on health care, energy shortages and environmental challenges, and public safety.[12] Other emerging countries are developing Smart Cities from the ground up;[13] some countries, such as Armenia, are now branding their whole country as a 'Smart Country'.[14]

Europe does not face the problems of rural poverty or runaway mega-city development on the same scale as China or India, but the Smart City idea is nonetheless highly relevant. **It will be necessary to harness the power of Smart Cities in order to compete effectively with rival global economies.** Moreover, experience with Smart City development can help Europe to assist developing countries in managing mega-city development in ways that improve their welfare, reduce the risk of exported problems and help them to become better trading partners for Europe. Most importantly, Europe has its own particular need for Smart City thinking. The openness and connectivity of the European Single Market have allowed its cities to become hubs for the creative economy, technological and societal innovation, welfare enhancement and sustainable development. They do this by drawing on resources (human or otherwise) throughout Europe and the globe and returning ideas, income and other benefits. This complex ecosystem is robust and resilient, but it faces serious challenges, including economic and societal inequality, environmental change and profound demographic transition. Other changes, including increased mobility and greater access to information, may both help and hinder this development. These developments directly affect[15] the sustainability[16] and the pan-European contributions of urban environments; they may be turned to advantage[17] by Smart City initiatives.

In view of the challenges associated with growing European urbanisation, as well as the wider agenda to tackle economic recovery poverty, unemployment and environmental damage, **the Europe 2020 strategy[18] incorporates a commitment[19] to promote the development of Smart Cities throughout Europe and to invest in the necessary ICT infrastructure and human and social capital development.** Smart Cities may play a part[20] in helping to meet the targets set out in Europe 2020 by adopting scalable solutions that take advantage of ICT technology to increase effectiveness, reduce costs and improve quality of life.

The current debate over the definition of Smart City 'success' required careful analysis. As most current discussion of Smart Cities is framed in terms of the six axes mentioned above, the simplest approach would be to equate success with demonstrated activity across the full range of these dimensions.

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[12] http://www.europarl.europa.eu/RegData/etudes/etudes/join/2013/507481/IPOLIMCO_ET(2013)507481EN.pdf

[13] For example, Putrajaya in Malaysia, New Songdo City in South Korea and King Abdullah Economic City in Saudi Arabia.

[14] For smart initiatives at the countryside (see e.g. http://en.vorweggehen.de/energy-efficiency/an-intelligent-network-conquers-the-countryside) and some conferences themed around scaling the SC idea to country level in Armenia (http://uite.org/en/news/15-smart-country-for-smart-people) and Australia (http://symposium.net.au/australia-its-time-to-be-the-smart-country/).

[15] Nijkamp and Kourtit (2013).

[16] This includes economic, societal, environmental and cultural sustainability; see Dempsey et al. (2011).

[17] Common challenges can serve as a catalyst for collective innovation; can sustain cooperation over time; and can directly produce 'solutions' capable of re-use, adaptation and extension.

[18] European Commission (2013).

[19] See European Commission (2011c).

[20] As discussed below, this involves serving as incubators for new ideas and approaches; supporting sustainable development within their boundaries; providing direct and indirect assistance to other cities and less-urbanised areas; and catalysing the formation of networks of cooperation and communities of interest capable of the joined-up thinking needed to attain these targets and realise the broader objectives of Europe 2020.

However, this approach ignores the differing nature and severity of the problems cities face, the presence or absence of existing initiatives and infrastructures, and the critical need effectively to engage and involve a suitable range of stakeholders.[21]

The focus and balance of the Smart City ought, in principle, to reflect the specific challenges faced by the city and the priorities and capabilities of those involved. Moreover, **the success of a Smart City depends on the depth and effectiveness of targeted improvement within each area or initiative and on the coherence or balance of the portfolio of initiatives across the city.**[22] From this perspective, we chose to talk about an 'ideal' Smart City, which allows us to distinguish the Smart City as an ideal model from the current state of the city and the initiatives through which it intends to become 'Smart'. This approach also facilitates mapping Smart Cities in the EU in a way that provides a more textured profile of the individual cities and the scope of activity across the region. Furthermore, our approach allows us to capture the particular strengths and weaknesses of a given city in a more illuminating way, by incorporating the individual profile, background, national agenda and underpinning strategies of each Smart City into the assessment of its overall achievement. Box 1 explains how we measure successful initiatives and cities.

**Box 1: Definitions of successful initiatives and successful cities**[23]

**Successful initiatives:** observable indicators through the life cycle of the initiative: attracting wide support, having clear objectives aligned to policy goals and current problems, producing concrete outcomes and impacts, being imitated or scaled.

**Successful cities:** having meaningful objectives (aligned with Europe 2020 and actual outcomes) covering a mix of policy targets and characteristics; having a balanced portfolio of initiatives; attaining maturity (on our scale); actively joining in Smart City networks.

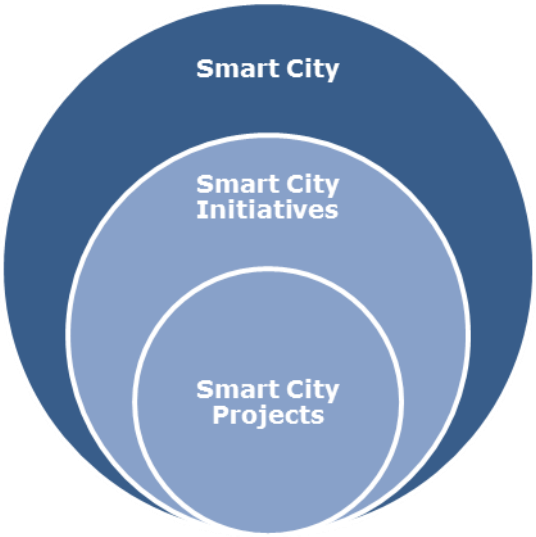
Smart City projects, therefore, are a sub-category of Smart City Initiatives which in turn are a sub-category of Smart Cities (as outlined in Figure 2 below).

[21] In order to provide direct benefits, the Smart City activities must be 'followed up' by others in the city and those with whom they trade or interact.

[22] This should both reflect and contribute to the generation of a Smart community of interest based around a holistic appreciation of the issues confronting the city (in itself and in its European context).

[23] Note that the relative immaturity of many initiatives means that the number that can be classified as successful drops as the cycle progresses, and that the sample becomes less representative.

**Figure 2 : The relationship between projects, initiatives and cities**




Smart Cities comprise a portfolio of initiatives, with different (though often overlapping) focal areas, modalities, participants and constituencies. As distinct from ideal Smart Cities, actual Smart Cities are more process than outcome.

Many initiatives are still in the design or early implementation phase, and their ultimate outcomes and impacts cannot be accurately or definitively assessed.

The approach taken here goes from the individual initiatives to the city level. We borrow from impact assessment practice[24] in following the development path or intervention logic of the Smart City trajectory. When considering the design and implementation of individual initiatives we consider a range of questions: **Are the objectives relevant, appropriate and aligned with broader city development objectives? Does the initiative address problems of importance to the city in question? Is the mix of funding, participation, components and characteristics[25] likely to produce the hoped for outcomes?** Where possible, we consider the expected impacts as well. We seek to ascertain whether they have attained (or are they on the way to advancing) the goals of the initiative, the city and Europe as a whole.

## 2.2. Smart City definitions

### 2.2.1. Problems of definitions

Examples of Smart Cities come in many variants, sizes and types. This is because the idea of the Smart City is relatively new and evolving, and the concept is very broad. Every city is unique, with its own historical development path, current characteristics and future dynamic. The cities which call themselves 'Smart', or are labelled as such by others, vary enormously.

The evolution of the Smart City concept is shaped by a complex mix of technologies, social and economic factors, governance arrangements, and policy and business drivers. The implementation of the Smart City concept, therefore, follows very varied paths depending on each city's specific policies, objectives, funding and scope.

[24] Detailed further in the European Commission's Impact assessment guidelines: http://ec.europa.eu/governance/impact/commissionguidelines/docs/ iag2009en.pdf

[25] Further explained in Chapter 5.

Any useful working definition of a Smart City needs to incorporate these highly diverse circumstances while still enabling improved understanding of good practice, the potential for scaling and the development of relevant policy frameworks.

**There is also considerable overlap of the Smart City concept with related city concepts**[26] such as:

- 'Intelligent City'
- 'Knowledge City'
- 'Sustainable City'
- 'Talented City'
- 'Wired City',
- 'Digital City'
- 'Eco-City'.

However, the Smart City concept has become predominant among these variants, especially at city policy level, globally as well as in Europe, so here we concentrate on the specific definitions and characteristics of the Smart City.

### 2.2.2. Existing definitions

Many definitions of the Smart City focus almost exclusively on the fundamental role of ICT in linking city-wide services. For example, one suggestion is that a city is smart when:

> 'the use of ICT [makes] the critical infrastructure components and services of a city – which include city administration, education, healthcare, public safety, real estate, transportation, and utilities – more intelligent, interconnected, and efficient'.[27] Similarly, another approach states, 'We take the particular perspective that cities are systems of systems, and that there are emerging opportunities to introduce digital nervous systems, intelligent responsiveness, and optimization at every level of system integration.'[28]

Other definitions, while retaining ICT's important role, provide a broader perspective, such as the following wide working definition:

> 'a city may be called 'Smart' 'when investments in human and social capital and traditional and modern communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance'.[29]

Such definitions tend to balance different economic and social factors with an urban development dynamic. They also serve to open the definition potentially to encompass smaller and less developed cities which are not necessarily able to invest in the latest technology. This latter point is also emphasised by a number of sources: 'While megacities [defined as over 5 million inhabitants] have captured much public attention, most of the new growth will occur in smaller towns and cities, which have fewer resources to respond to the magnitude of the change.'[30]

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[26] As for example described by Nam and Pardo (2011).
[27] Washburn and Sindhu (2009).
[28] MIT (2013).
[29] Schaffers et al. (2011).
[30] Such as Gorski and Yantovsky (2010).

The broader approach suggested above also emphasises sustainability, quality of life and urban welfare creation through social participation, for example by addressing societal challenges like energy efficiency, environment and health.[31]

### 2.2.3. Towards a working definition

We have seen that what makes a city a Smart City is the use of ICTs, which are used to optimise the efficiency and effectiveness of useful and necessary city processes, activities and services. This optimisation is typically achieved by joining up diverse elements and actors into a more or less seamlessly interactive intelligent system. In this sense, the concept of a Smart City can be viewed as recognising the growing and indeed critical importance of technologies (especially ICT) for improving a city's competitiveness, as well as ensuring a more sustainable future, across networks of people, businesses, technologies, infrastructures, consumption, energy and spaces.

In a Smart City, these networks are linked together, supporting and positively feeding off each other. **The technology and data gathering used in Smart Cities, should be able**:

- constantly to gather, analyse and distribute data about the city to optimise efficiency and effectiveness in the pursuit of competitiveness and sustainability
- to communicate and share such data and information around the city using common definitions and standards so it can be easily re-used
- to act multi-functionally, providing solutions to multiple problems from a holistic city perspective.[32]

Finally an important, but often overlooked, additional dimension of the Smart City concept is city networking supported by ICT. Such networking is beyond immediate city governance control, but allows for crucial communications within the same region, within the same country and as part of European and global city networks.

**Overall, ICT enables a Smart City to**:

- make data, information, people and organisations smart
- redesign the relationships between government, private sector, non-profits, communities and citizens
- ensure there are synergies and interoperability within and across-city policy domains and systems (e.g. transportation, energy, education, health and care, utilities, etc.)
- drive innovation, for example through so-called open data, 'hackers marathons', living labs and tech hubs.[33]

While ICT is a definitive component, Smart Cities cannot simply be created by deploying sensors, networks and analytics in an attempt to improve efficiency. Indeed, at worst, this can lead to a one-size fits all, top-down approach to sustainability and economic development.

[31] Schaffers et al. (2011).
[32] http://www.cphcleantech.com/
[33] See for example EurActiv (2013).

In Japan, cooperation between government and industry, involving large Japanese conglomerations (such as Sumitomo and Mitsubishi Electric) has been leveraged to support smart city initiatives focusing on increasing the quality of life of citizens through green ICTs and smart grids.[34]

In short, such a strategy focuses on the city as a single entity, rather than the people and citizens that bring it to life. Any adequate model for the Smart City must therefore also focus on the Smartness of its citizens and communities and on their well-being and quality of life. In so doing, it can encourage the processes that make cities important to people and which might well sustain very different – sometimes conflicting – activities. Thus, the 'Smartness' of Smart Cities will not only be driven by orders coming from unseen and remote central government computers which try to predict and guide the population's actions from afar. Smart Cities will be smart because their citizens have found new ways to craft, interlink and make sense of their own data and information, changing the behaviour of people and organisations. For example, many cities monitor air quality down to neighbourhood scale and make this data available. But how can citizens use this information?

Most people are unable to move house just because their neighbourhood has polluted air. Rather, a citizen-led air quality monitoring system which complements the official statistics would see measurements taken in places they choose, such as at the height of a child's push-chair, in playgrounds or different parts of a park.

In this example, people could choose their walking or cycling routes, measure the impact of their car, and experiment with community inspired initiatives to improve air quality, such as planting trees or setting up car-free zones.[35] Without the engagement of stakeholders, a city can never be Smart, no matter how much ICT shapes its data.

**To sum up, this study defines 'Smart City' initiatives as multi-stakeholder municipally based partnerships aimed at addressing problems of common interest with the aid of ICTs, which underpin 'Smart' classification**. 'Smart City' initiatives address problems of common interest with the aid of ICTs. To be classified as a Smart City, a city must contain at least one initiative that addresses one or more of the following characteristics: Smart Governance, Smart People, Smart Living, Smart Mobility, Smart Economy and Smart Environment. ICT initiatives based on these characteristics aim to connect existing and improved infrastructure to enhance the services available to stakeholders (citizens, businesses, communities) within a city.

**Box 2: Working definition of a Smart City**

**Working definition:** As a result, this study's working definition of a Smart City is 'a city seeking to address public issues via ICT-based solutions on the basis of a multi-stakeholder, municipally based partnership'.

Table 3 provides a summary overview of the main Smart City definitions as well as the working definition adopted in this study.

[34] http://www.europarl.europa.eu/RegData/etudes/etudes/join/2013/507481/IPOL-IMCO_ET(2013)507481_EN.pdf
[35] Haque (2012).

**Table 3 : Overview of the key Smart City definitions in the literature and this study's working definition**

| Type | Definition | Source |
|---|---|---|
| **Technology focused definitions** | The use of ICT [makes] the critical infrastructure components and services of a city – which include city administration, education, healthcare, public safety, real estate, transportation, and utilities – more intelligent, interconnected, and efficient. | Washburn and Sindhu (2009) |
| | Cities [should be seen as] systems of systems, and that there are emerging opportunities to introduce digital nervous systems, intelligent responsiveness, and optimization at every level of system integration. | MIT (2013) |
| | In a Smart City, networks are linked together, supporting and positively feeding off each other, so that the technology and data gathering should: be able to constantly gather, analyse and distribute data about the city to optimise efficiency and effectiveness in the pursuit of competitiveness and sustainability; be able to communicate and share such data and information around the city using common definitions and standards so it can be easily re-used; be able to act multi-functionally, which means they should provide solutions to multiple problems from a holistic city perspective. | Copenhagen Cleantech Cluster (2012)[36] |
| **Broad definitions** | A city is smart when investments in human and social capital and traditional and modern communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance. | Caragliu, Del Bo and Nijkamp (2009) |
| | A [smart] city is where the ICT strengthens freedom of speech and the accessibility to public information and services. | Anthopoulos and Fitsilis (2010) |
| | [Smart Cities are about] leveraging interoperability within and across policy domains of the city (e.g. transportation, public safety, energy, education, healthcare, and development). Smart City strategies require innovative ways of interacting with stakeholders, managing resources, and providing services. | Nam and Pardo (2011) |
| | Smart Cities combine diverse technologies to reduce their environmental impact and offer citizens better lives. This is not, however, simply a technical challenge. Organisational change in governments – and indeed society at large – is just as essential. Making a city smart is therefore a very multi-disciplinary challenge, bringing together city officials, innovative suppliers, national and EU policymakers, academics and civil society. | Smart Cities and Communities (2013) |
| | [a city may be called 'smart'] when investments in human and social capital and traditional and modern communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance. | Schaffers et al. (2011) |
| | Any adequate model for the Smart City must therefore also focus on the Smartness of its citizens and communities and on their well-being and quality of life, as well as encourage the processes that make cities important to people and which might well sustain very different – sometimes conflicting – activities. | Haque (2012) |
| **This study's working definition** | A Smart City is a city seeking to address public issues via ICT-based solutions on the basis of a multi-stakeholder, municipally based partnership. | |

[36] http://www.cphcleantech.com/

## 2.3. Smart City characteristics

As we have described, the wealth of initiatives in the dynamic socio-economic, technical and policy environment in the EU potentially gives rise to a wide variety of Smart City characteristics. These can be associated with different objectives (general, specific and operational, for example) and with different patterns of actor roles and relations, policy instruments and implementation methods. Each of these qualities may, in turn, be mapped against different locations, city sizes, funding arrangements and framework conditions and outcomes.

In order to capture as many of these circumstances as possible, we propose a framework of characteristics. This will enable us to identify relevant projects and initiatives which, when implemented, contribute to the formation of a Smart City. We will then use these projects and initiatives identified in this study to populate a structured evidence base. We can thereby analyse possible correlations among characteristics, attempt to draw causal inferences and on this basis develop recommendations concerning good practices and strategies.

Taking our working definition of a Smart City, supplemented by the additional evidence presented above, we can summarise the Smart City concept as firmly anchored in the enabling power of ICT, which interconnect systems and stimulate innovation to facilitate a series of policy goals. Given the needs of cities to compete, such policy goals include economic growth, which is in turn underpinned by well-developed human capital.

There is also a need to make economic development sustainable in environmental terms. This could involve ICT-based 'Smart Networks' to reduce energy transmission costs and improve the resilience of utility networks by matching demand and supply dynamically. Such networks would have the additional advantage of allowing local cogeneration to meet local power demand. They could also provide individual utility users with accurate and timely information to enable them to take costs and environmental impact into account when choosing and using appliances.

Another class of examples is provided by city mobility systems that use sensors, processors and ICT-driven traffic controls to provide Smart and efficient arteries. As we have made clear, however, other aspects (social, welfare, cultural, quality of life) are also critical for balanced Smart City development. Underpinning each of these features is the need for new modes of bottom-up and top-down holistic governance, which also enable and encourage broad participation and engagement by all stakeholders in all aspects of a city's life.

Building on the work of the European Smart City Project,[37] as well as numerous other sources,[38] we propose six **Smart City characteristics:**

- Smart Governance
- Smart Economy
- Smart Mobility
- Smart Environment
- Smart People
- Smart Living

[37] http://www.smart-cities.eu/

[38] Including Giffinger and Pichler-Milanovic (2007), Giffinger and Gudrun (2010), Schuurman et al. (2012) and Batty et al. (2012).

These same six characteristics are deployed by a number of studies to develop indicators and Smart City development strategies.[39]

This type of characterisation framework is well justified and documented, and already used in practice by an increasing number of cities and policy makers.

The framework aims to capture the key dimensions of European Smart Cities described above while retaining simplicity through specifying a relatively small number of characteristics which define these initiatives and cover the range of existing projects. When defining a Smart City in the present study, at least one of the six characteristics must be present in a given Smart City project or initiative. This is a baseline, however, and we must also keep in mind the Smart City definitions and summary outlined above. These point to the deployment of multi-dimensional strategies, which consist of many components and projects designed to be synergistic and mutually supportive. Indeed, the most successful Smart City strategies might be expected to adopt a multi-dimensional approach to maximise such synergy and minimise negative spill-over effects, as might happen, for example, if a Smart Economy strategy were prioritised which was detrimental to the environment. For this reason, we might expect to see more than one characteristic present in the most successful Smart Cities. The six characteristics of Smart Cities are described in more detail in Table 4.

[39] See, for example, Cohen (2012b).

**Table 4 : Overview of the six Smart City characteristics**

| Characteristic | Description |
|---|---|
| Smart Governance | By Smart Governance we mean joined up within-city and across-city governance, including services and interactions which link and, where relevant, integrate public, private, civil and European Community organisations so the city can function efficiently and effectively as one organism. The main enabling tool to achieve this is ICT (infrastructures, hardware and software), enabled by smart processes and interoperability and fuelled by data. International, national and hinterland links are also important (beyond the city), given that a Smart City could be described as quintessentially a globally networked hub. This entails public, private and civil partnerships and collaboration with different stakeholders working together in pursuing smart objectives at city level. Smart objectives include transparency and open data by using ICT and e-government in participatory decision-making and co-created e-services, for example apps. Smart Governance, as a transversal factor, can also orchestrate and integrate some or all of the other smart characteristics. |
| Smart Economy | By Smart Economy we mean e-business and e-commerce, increased productivity, ICT-enabled and advanced manufacturing and delivery of services, ICT-enabled innovation, as well as new products, new services and business models. It also establishes smart clusters and eco-systems (e.g. digital business and entrepreneurship). Smart Economy also entails local and global inter-connectedness and international embeddedness with physical and virtual flows of goods, services and knowledge. |
| Smart Mobility | By Smart Mobility we mean ICT supported and integrated transport and logistics systems. For example, sustainable, safe and interconnected transportation systems can encompass trams, buses, trains, metros, cars, cycles and pedestrians in situations using one or more modes of transport. Smart Mobility prioritises clean and often non-motorised options. Relevant and real-time information can be accessed by the public in order to save time and improve commuting efficiency, save costs and reduce $CO_2$ emissions, as well as to network transport managers to improve services and provide feedback to citizens. Mobility system users might also provide their own real-time data or contribute to long-term planning. |
| Smart Environment | By smart environment we include smart energy including renewables, ICT-enabled energy grids, metering, pollution control and monitoring, renovation of buildings and amenities, green buildings, green urban planning, as well as resource use efficiency, re-use and resource substitution which serves the above goals. Urban services such as street lighting, waste management, drainage systems, and water resource systems that are monitored to evaluate the system, reduce pollution and improve water quality are also good examples. |
| Smart People | By Smart People we mean e-skills, working in ICT-enabled working, having access to education and training, human resources and capacity management, within an inclusive society that improves creativity and fosters innovation. As a characteristic, it can also enable people and communities to themselves input, use, manipulate and personalise data, for example through appropriate data analytic tools and dashboards, to make decisions and create products and services. |
| Smart Living | By Smart Living we mean ICT-enabled life styles, behaviour and consumption. Smart Living is also healthy and safe living in a culturally vibrant city with diverse cultural facilities, and incorporates good quality housing and accommodation. Smart Living is also linked to high levels of social cohesion and social capital. |

## 2.4. The relationship between characteristics and components

The characteristics used to classify Smart Cities include the areas addressed by Smart City initiatives, and illustrate the variety of projects and Smart Cities across the EU Member States. They are, put simply, the ends to which stakeholders participate in an initiative. We call the means by which those ends are achieved components. If, for example, the characteristic of an initiative is Smart Environment, the components may be various environmental technologies.

The term 'components' covers a wide range of activities, resources and methods; some are pre-existing, while others are assembled or even created for specific projects. In order to interpret the design and potential contributions of Smart Cities and the portfolio of initiatives they host, it is useful to analyse how the characteristics and components of their initiatives align to Europe 2020 targets.

This section discusses the relationship between characteristics and components. In practice, components and characteristics are often difficult to distinguish; components, in particular, are not systematically identified. The central thesis of this section is that they cannot easily be separated and that they should therefore be analysed together.

**Components can be conceptualised as the building blocks of Smart City initiatives.** They comprise the inputs, technologies and processes of specific initiatives, as well as the norms or standards deployed. In discussing the relationship between Smart City components and characteristics, some scholars argue that the components can be loosely stratified by the six characteristics, which in turn are used to identify whether a city is 'Smart'.[40] Cohen treats Smart City components as key drivers of specific characteristics, based on the specific challenges and needs a city faces with respect to that characteristic.[41] However, we observe in our sample (see Annex 10) that while some components pertain to a specific characteristic (e.g. 'green buildings' and 'energy sensors', which are specific to the Smart Environment characteristic), others are of a horizontal or enabling nature (such as 'open data' and monitoring technologies[42]) and cover several characteristics.

Because Smart City initiatives go beyond the development and application of technology –in attracting participants and delivering impacts – we must take into account human or social factors, such as education and social capital, or institutional factors surrounding the role of stakeholders and funders. Only in this way may we arrive at a workable conceptualisation of the relationship between components and characteristics. Nam and Pardo adopt a holistic approach, categorising Smart City components within three core factors, as shown in Table 5.[43]

**Table 5 : The three core factors of Smart City components[44]**

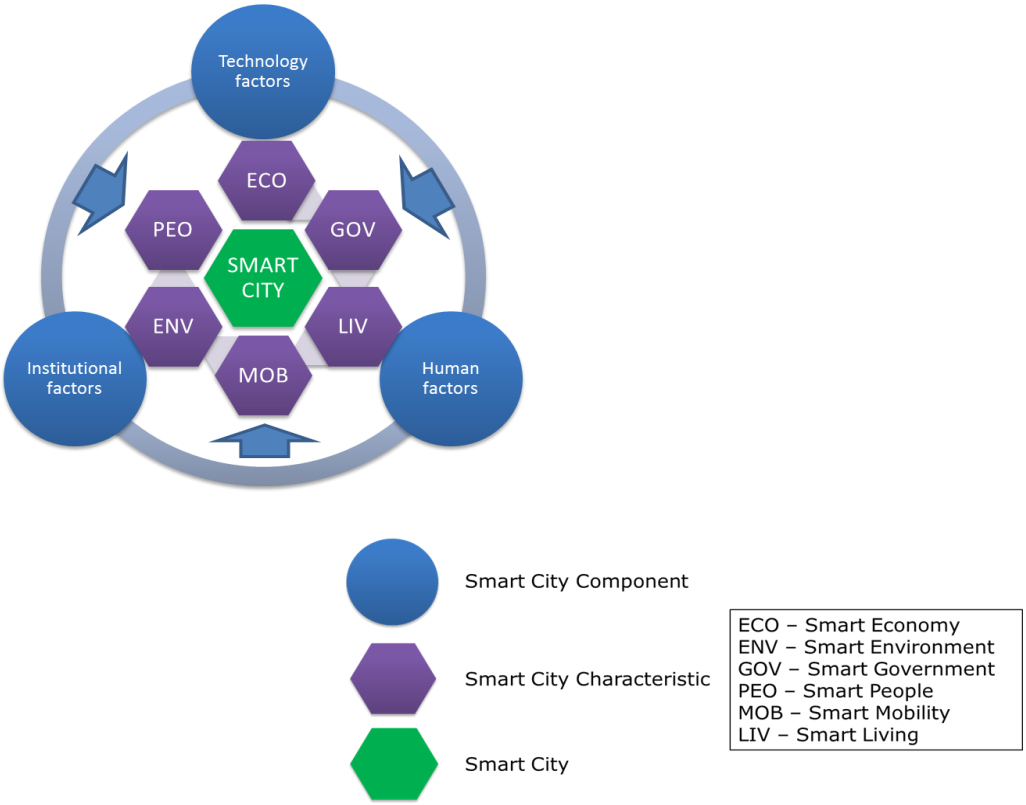
| Technology factors | Human factors | Institutional factors |
|---|---|---|
| Physical infrastructure | Human infrastructure | Governance |
| Smart technologies | Social capital | Policy |
| Mobile technologies | | Regulations and directives |
| Virtual technologies | | |
| Digital networks | | |

The relationship between characteristics and components is summarised in Figure 3. The outer ring shows the components, and the inner ring the characteristics. Rather than each

[40] Cohen (2012a) and Giffinger and Pichler-Milanovic (2007).
[41] Cohen (2012a).
[42] Further examples of components can be found in the dashboards in Annex 10.
[43] Nam and Pardo (2011).

component mapping onto a specific characteristic, a range of technological, human and institutional factors underpins all characteristics.

**Figure 3 : The relationship between components and characteristics of Smart Cities**




This allows us to understand the relationships between components and characteristics as both direct and indirect. In some cases, the characteristic fully describes the initiative by displaying what the initiative is about and the priorities of its participants and direct beneficiaries.

In other cases, the characteristics are a vehicle for the components; the initiative is primarily a way to bring people together and create new ways of collaborating. This is the case when the primary contribution is to the Smartness of the city itself.

In some cases, the linkage from objectives to characteristics to components is direct; an objective is furthered by a specific initiative with an associated characteristic that necessitates and justifies the use of a particular component. Take, for example, the objective of improving energy efficiency within the city. This objective may be associated with an environmental initiative (characteristic), which makes use of Smart buildings (component) to permit energy network managers to adjust load in order to make efficient use of existing supply capacity. The linkage may also be indirect, if a specific component contributes to more than one characteristic, altering the way those characteristics are pursued across other initiatives and their associated components and objectives. We can see this type of linkage in the above example. Here, the use of Smart meters can help individual energy users to optimise their demand patterns (contributing to the environmental characteristic).

[44] As discussed in the conceptualisation by Nam and Pardo (2011).

Furthermore, this information will raise their awareness of the price implications of their behaviour, leading them to factor energy considerations into their appliance purchase (economy) and residential and job location (mobility) decisions.

It is important to recognise the dual role of components in this conception. First, **the availability of existing components can make it easier to mobilise and complete Smart City initiatives.**

Second, they can also be regarded as desired (or even essential) by-products of such initiatives, to the extent that they are developed or improved during the course of initiatives. The relationship between components and characteristics is inherently complex.

Moreover, given the absence of information on the outputs or outcomes of Smart City initiatives, it is difficult to allocate components to individual initiatives and to attribute success or failure to the presence or absence of specific components.

Pre-existing components are generally not mentioned in the description of the initiatives, but are taken for granted, even if they are central or essential to the initiative's success.

Therefore, characteristics associated with shortlisted initiatives will be aggregated and used in our analysis as a proxy for the profile of a given city. While it is important to note that the presence of specific characteristics is not enough to determine success of the outputs of an initiative or a Smart City, they do reflect the thematic objectives of an initiative. These can be aggregated for a given Smart City to characterise its portfolio of initiatives. This profile can then be then used to assess alignment with wider objectives, such as Europe 2020 targets.

# 3. MAPPING SMART CITIES OF EUROPE

**KEY FINDINGS**

- In 2011, 240 of the 468 EU-28 cities with at least 100,000 inhabitants (51% of the total) had at least one Smart City characteristic and can therefore be classed as Smart Cities.
- There are more small Smart Cities than large ones, but there are Smart Cities in all size categories and in most EU-28 countries.
- **The highest absolute number of Smart Cities are found in the UK, Spain and Italy; the countries with the highest proportion of Smart Cities are Italy, Austria, Denmark, Norway, Sweden, Estonia and Slovenia.**
- **Most Smart City initiatives are still in the early phases of development**, but the larger cities tend to be the most mature (with at least one fully launched or implemented initiative).
- **The most common of the six characteristics** defined in Chapter 2 are those associated with pan-European public goods problems – **Smart Environment and Smart Mobility, present in 33% and 21% of initiatives respectively. Each of the other four characteristics (governance, economy, people and living) is addressed in approximately 10% of the Smart Cities**, reflecting specific local strengths or weaknesses.
- City size is clearly positively correlated with the number of characteristics sought through Smart City initiatives; Smart Cities with only one characteristic tend to have between 100,000 and 200,000 inhabitants.
- Smart Living initiatives are found throughout the EU-28; initiatives focusing on other characteristics are less evenly distributed.
- Smart Governance projects are seen mainly in Northern Europe (e.g. France, Spain, Germany, Sweden and the UK) and Italy.
- Smart Mobility initiatives are relatively well represented in non-Nordic Northern Europe, Spain, Hungary, Romania and Italy, but underrepresented in Nordic Member States.
- Some characteristics are likely to be found in combination with others, such as Smart People and Smart Living.

## 3.1. How were Smart Cities identified for the study?

The comprehensive mapping of European Smart Cities was based on a database of all 468 cities with a population of at least 100,000 within the 28 Member States of the EU.[45] This entailed three steps:

[45] City population data are derived from United Nations Statistics Division (2011), pp. 350–364.

1. Data and other information on all 468 cities was drawn from the following sources:
   - general sources including websites[46] and references cited in the bibliography.
   - specific city sources, including their websites where available, together with other city-specific sources were used to identify Smart City characteristics in (for example) articles describing strategies, visions, plans, initiatives, city projects.
   - Smart City project websites, including those funded or otherwise supported at EU level by the Competitiveness and Innovation Programme (CIP),[47] Future Internet Public Private Partnership (FI-PPP),[48] Eurocities[49] and other networks of European cities.[50]

2. These sources were then analysed in depth to determine whether each city in the sample could be defined as a Smart City based on the definition and characteristics developed in Chapter 2. Specifically, this involves the presence of at least one of the Smart City characteristics (Smart Governance, Smart Economy, Smart Mobility, Smart Environment, Smart People and Smart Living). In looking for such evidence, we examined elements such as city strategies, projects, initiatives, programmes, networks, platforms, components and solutions. These elements could be either planned or in the process of being implemented. Initially, the search focused on cities using the exact words 'Smart City' or 'Smart'. Other types of city designation (including Intelligent City, Knowledge City, Sustainable City, Talented City, Wired City, Digital City and Eco-City), as well as general city development policies, strategies and plans, were also examined to determine whether the city might be a candidate for Smart City designation. A Smart City also needs to have its characteristics at least partially enabled or supported by ICT.[51] Using these criteria, 240 Smart Cities were identified.

3. The 'maturity level' of the identified Smart Cities was then examined using the following categorisation:
   - maturity level 1: a Smart City strategy or policy only
   - maturity level 2: in addition to level 1, a project plan or project vision, but no piloting or implementation
   - maturity level 3: in addition to level 2, pilot testing Smart City initiatives
   - maturity level 4: a Smart City with at least one fully launched or implemented Smart City initiative.

Cities that do not attain maturity level 1 did not qualify as 'Smart': clearly there would also be no evidence of them having any of the six characteristics.

Where projects or initiatives in a Smart City have different maturity levels, the city as a whole was designated at the highest maturity level.

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[46] Such as http://www.planetinspired.info;http://cityprotocol.org/;http://smartcitylab.eu/;http://www.smart-cities.eu/;http://www.smartcities.info/;http://www.icityproject.com/; http://setis.ec.europa.eu/implementation/technology-roadmap/european-initiative-on-smart-cities;http://eu-smartcities.eu/

[47] http://ec.europa.eu/cip/

[48] http://www.fi-ppp.eu/

[49] http://www.eurocities.eu/

[50] See http://ec.europa.eu/eip/smartcities/links/index_en.htm

[51] In order to distinguish them from, e.g. sustainable cities, which might not use ICT as an integral part of their plans or initiatives.

In summary, the research team compiled a database which includes all 468 EU-28 cities with at least 100,000 inhabitants. This database indicates each city's country location and population totals, and classifies 240 of them as Smart Cities.

For each Smart City, the database also records which of the six Smart City characteristics are present, as well as the overall maturity level. Finally, links to specific city website URLs with information on their Smart City activities are provided where available.

## 3.2. What does the sample tell us?

Overall, slightly over half (51%) of the 468 cities in the main sample meet our Smart City criteria, indicating how prevalent the Smart City movement has become in Europe in the last few years. Some significant Smart City trends observed in the database are analysed in this section.

First, all but six of the 52 cities in the EU-28 with more than 500,000 inhabitants have some form of Smart City (see Figure 4); this is very clearly a large city phenomenon. **The incidence of Smart Cities decreases with city size.** This does not mean, however, that smaller cities are not engaging in Smart City development. As Figure 4 shows, 43% of cities with between 100,000 and 200,000 inhabitants are involved.

**Figure 4 : The ratio of Smart Cities to Smart City initiatives across the EU**

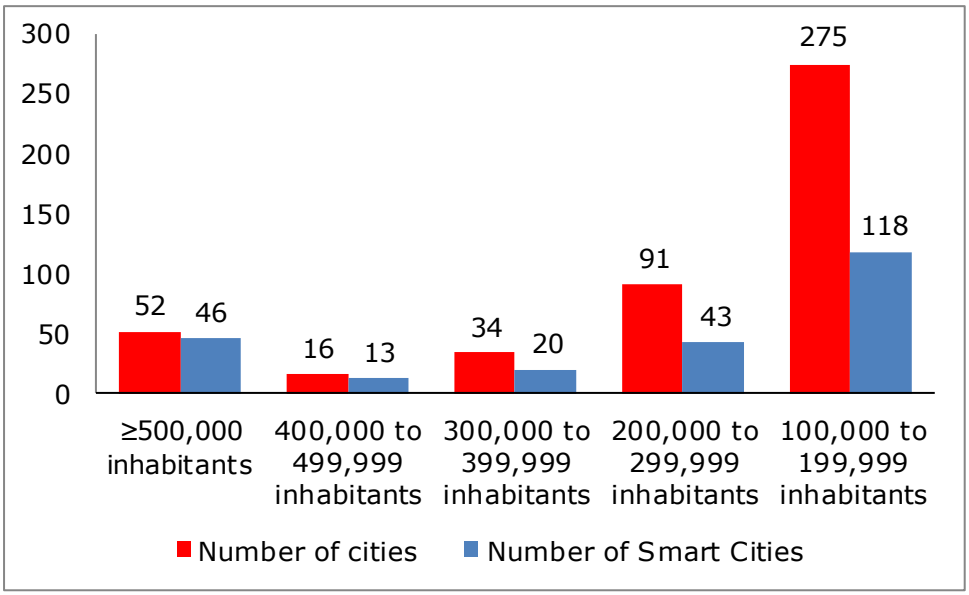



Figure 5 shows the distribution of maturity levels, which is relatively even; just over 50% have not yet started pilots or implementation. It may be unsurprising that many cities are using the relatively new Smart Cities concept as a tool for self-promotion or are at an early stage of development. However, by the same token, almost 50% of cities that we consider Smart are already engaged in some form of active implementation.

**Figure 5 : Maturity levels across Smart Cities in the EU**

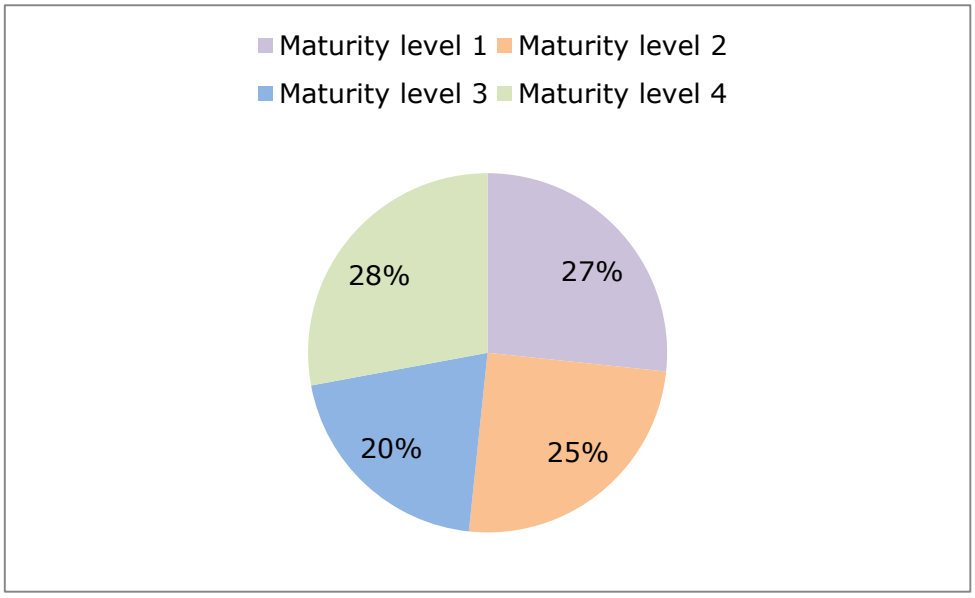



Figure 6 shows the number of the Smart Cities studied containing each of the six Smart City characteristics. **Smart Environment has significantly greater representation than the other characteristics, followed by Smart Mobility.** The remaining characteristics are more or less evenly distributed (around 10% coverage by all cities). This resonates with the overall impression that issues of congestion and the need to improve the overall city environment are among the foremost drivers of European Smart City policy.[52] These two characteristics – environment and mobility – may also be more easily identifiable than the others, and therefore attract political attention (there may be some quick political gains despite the potential need for a more long-term approach to all characteristics).

The decision to pursue specific Smart City initiatives is broad and complex, and reflects the priorities, capabilities and concerns of interested actors and stakeholders. The prevalence of environmentally orientated initiatives may reflect the common nature of the associated issues. All cities experience environmental problems to some degree, and these issues rank high on the agendas of civil society groups and businesses (whether in relation to corporate social responsibility or as a result of soaring energy prices and the related consequences of environmental degradation). This prevalence is also likely to reflect an emphasis coming from the community level, and other national and international sources.[53] The transnational nature of all environmental issues also suggests that it is a key area in which European institutions can add value. **The emphasis on Smart Environment across the majority of cities may, therefore, reflect the significant role of large, multi-city initiatives focusing on this characteristic.[54]**

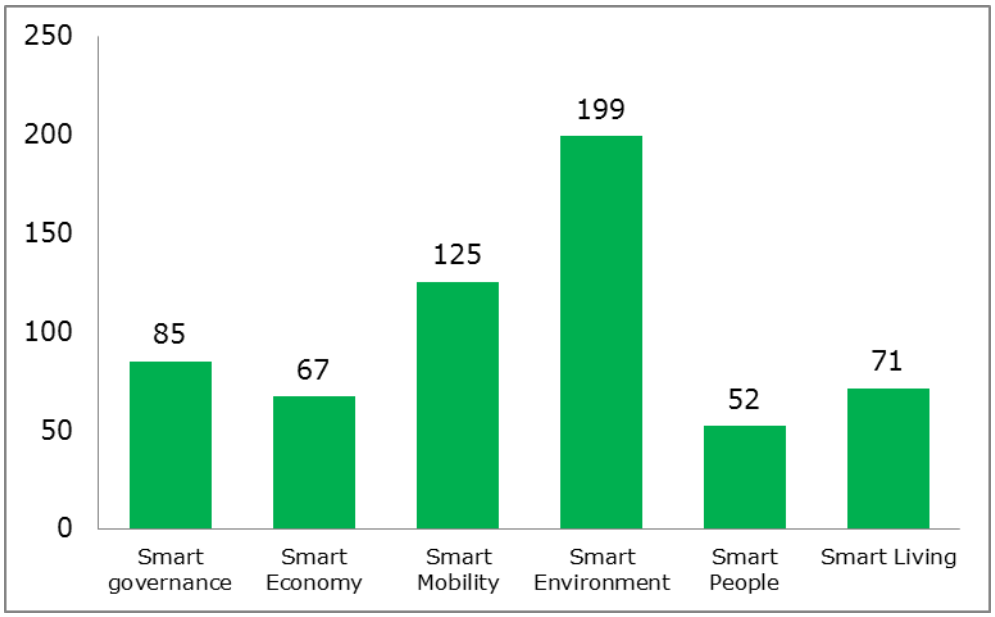
Environment initiatives are relatively straightforward to identify, but some kinds of Smart initiative are more difficult to localise at the city level. The asymmetry of characteristic coverage may reflect this difficulty.

[52] Smart Cities and Communities (2013).
[53] For example the environment is the focus of the technology roadmap for the European initiative on Smart Cities, and energy-related objectives account for three of the eight national and EU-level targets in Europe 2020.
[54] Such as the Network Intelligent Cities for Energy Efficiency (NiCE) in which 15 of the 20 sampled cities participate.

Cities involve fundamental networks, infrastructures and environments related to their key functions: city services, citizens, business, transport, communication, water and energy.[55]

While systems related to transportation, communication, water and energy are underpinned by hard (and physically localised) infrastructure, issues affecting public services, business and social networks may be less tangible and harder to link to an individual city. In this instance, **Smart Governance and Smart Economy projects may be more likely to be pursued at a national level**; the associated issues may be harder to frame as 'municipal problems'. Examples of Smart City initiatives at national level include Italy's project 'Burocrazia! Diamoci un taglio!' (Let's cut the red tape!),[56] a national initiative aimed at encouraging citizens to use digital tools. Similarly, Portugal's national version of the project 'Fix my street'[57] allows citizens to report problems in public spaces to a central government portal.[58] Therefore, the relative lack of coverage of Smart Governance and Smart Economy characteristics in the sample of cities may, to a degree, reflect the lack of initiatives framed at a city level rather than a lack of problems or awareness of the associated issues.

**Figure 6 : The number of Smart Cities in the EU presenting the six Smart City characteristics**




**Note:** totals are higher than the number of Smart Cities as each Smart City can have more than one Smart City characteristic.

The data show that 82 (34% of) Smart Cities have only one characteristic.

Figure 7 demonstrates that **there is a clear correlation between city size and the number of Smart City characteristics a Smart City has**. This supports the notion that larger cities tend to have the greatest resources and more ambitious Smart City policies.

[55] http://www-31.ibm.com/solutions/cn/government/downloads/GBE03227USEN.PDF.
[56] http://www.magellanopa.it.
[57] http://www.portaldocidadao.pt/PORTAL/entidades/PCM/AMA/pt/SER_a+minha+rua+_+comunicacao+de+ocorrencias.htm?flist=s.
[58] European Commission (2011a).

**Figure 7: The average number of Smart City characteristics**

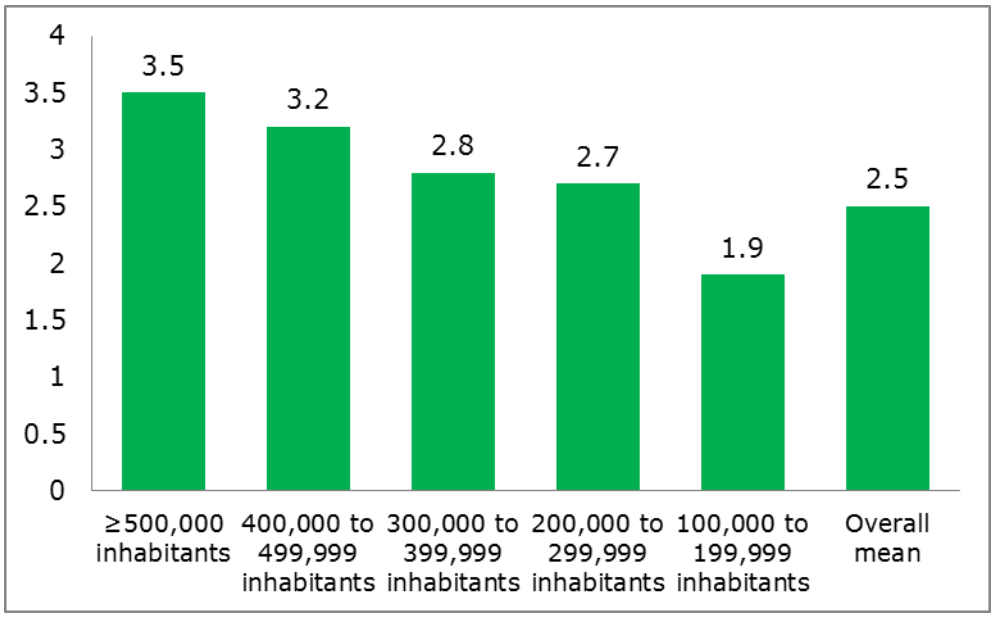
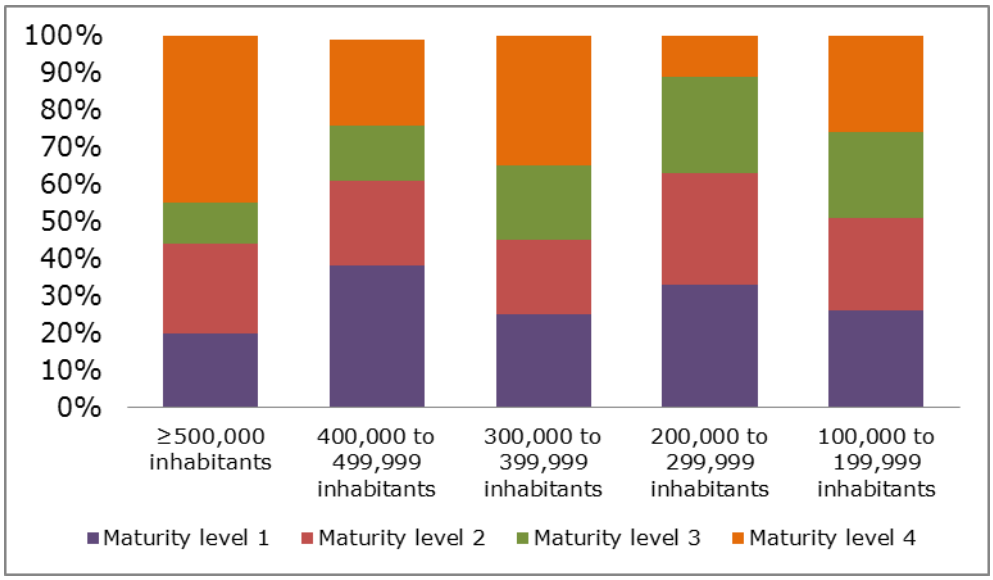



Figure 8 compares Smart City size with maturity. It demonstrates a very strong tendency for cities of over 500,000 inhabitants to have the most mature Smart City initiatives (implementation beyond the planning and any pilot stages). Clearly, such cities tend to have the greatest resources and political clout. However, the data do not show any other clear relationship between city size and maturity level.

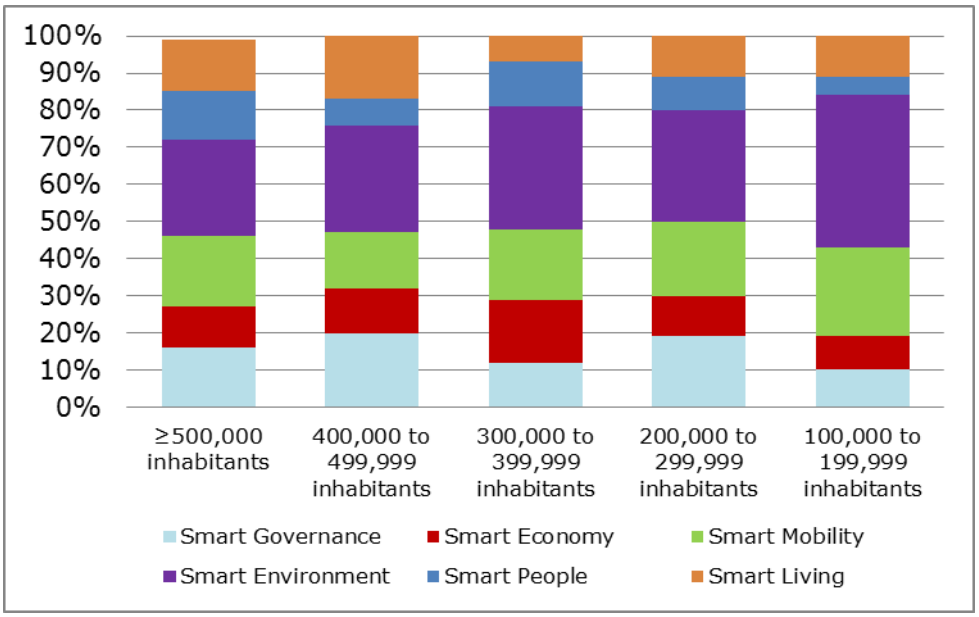
**Figure 8 : The relationship between the maturity level of a Smart City and its population**




As we see in Figure 9, comparing Smart City size with Smart City characteristics does not show any highly significant trends. The largest cities tend to have a more even distribution of characteristics than the average, while the smallest cities tend to focus on the two most common characteristics: environment and mobility.

**Perhaps this again supports the notion that the largest cities are more ambitious given their resources and political influence, while the smallest are more likely to focus more exclusively on the most common characteristics.**

**Figure 9 : The relationship between Smart City characteristics and population**




## 3.3. Mapping Smart Cities

This section presents detailed maps of the location of Smart Cities within the EU Member States, depicting all European cities of at least 100,000 inhabitants and those which we identify as Smart Cities (Figure 10, Figure 11 and Figure 12). These are followed by Figure 13 which illustrates the distribution of Smart Cities according to each of the six Smart City characteristics.

In Figure 13 cities in blue are the designated Smart Cities and those in red are cities with a population of over 100,000 for which we did not find sufficient information online to categorise as a Smart City. It shows that Smart Cities are widely spread across Europe and exist in almost every country within EU-28. As Cyprus, Luxemburg and Malta do not have any cities with a population over 100,000 they are outside the scope defined in this study.[59] **It is important to note that virtually all Nordic Member State cities can be characterised as Smart Cities, as can the majority of cities in Italy, Austria and the Netherlands, and approximately half of British, Spanish and French cities. Germany and Poland have relatively few Smart Cities. Eastern European countries generally have a lower incidence of Smart Cities than the rest of EU-28.**

[59] However, in the interest of presenting a full picture of the Member States, the location of one Smart City in Cyprus, Luxemburg and Malta have been listed in Figure 10 – they do not meet the size criterion but otherwise qualify as Smart Cities

**Figure 10: The location of cities with a population of more than 100,000 that are not Smart Cities and Smart Cities in Europe**

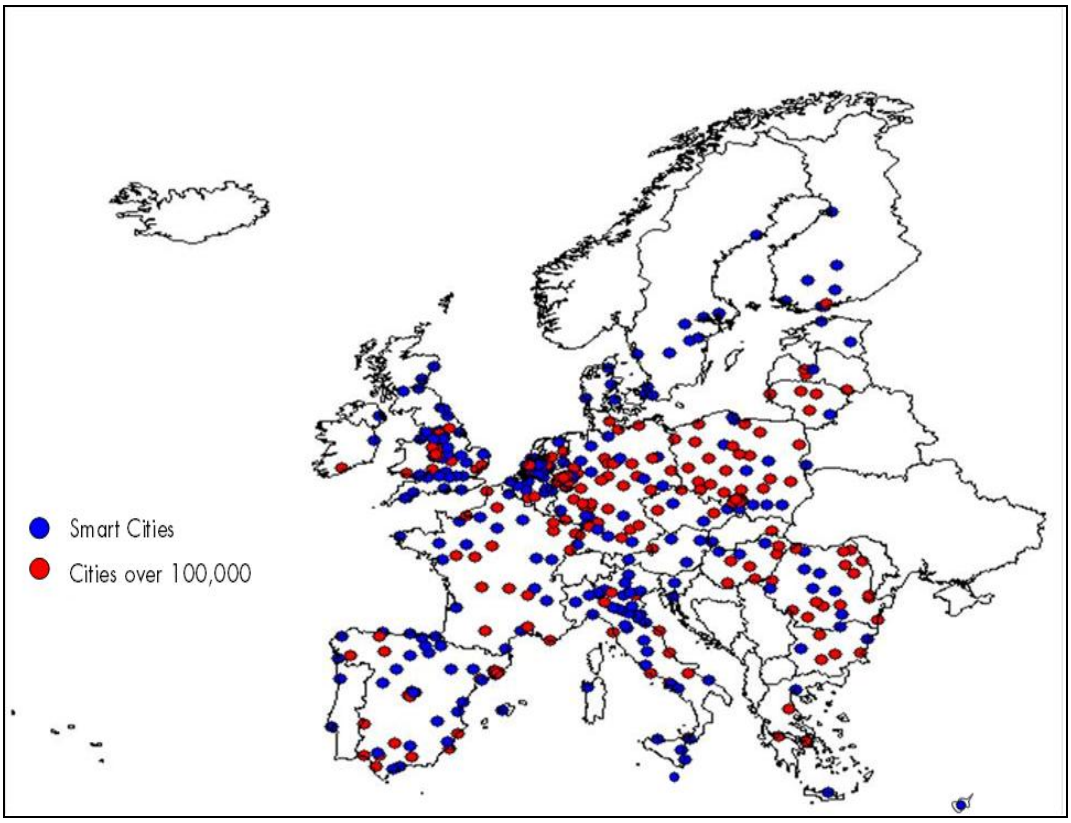
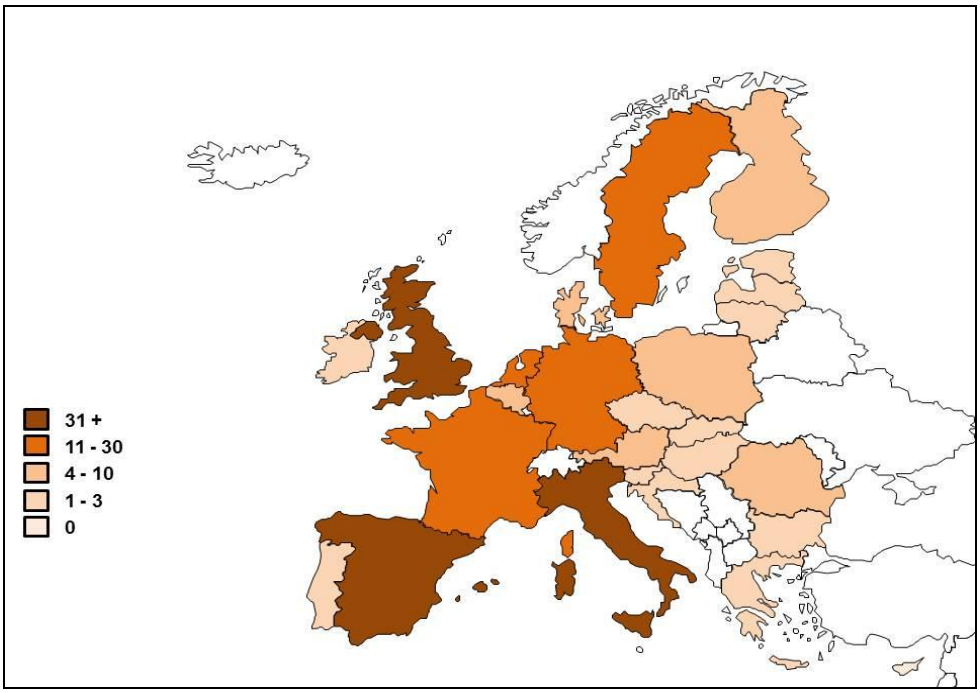



Figure 11 shows the total number of Smart Cities in the EU-28. It is clear that the larger countries, especially the UK, Spain and Italy, have the largest number of Smart Cities – more than 30 each. However, this is not universally true; large countries such as Germany and France have fewer Smart Cities overall. As would be expected, the smaller countries have absolute lower numbers of Smart Cities.

**Figure 11 : The number of Smart Cities per country in Europe**



The trends shown in Figure 10 and Figure 11 are confirmed by Figure 12, which shows the proportion of cities (of over 100,000 inhabitants) in each country meeting the **Smart City criteria. The leaders are Italy, Austria, the Nordic Member States, Estonia and Slovenia**; they are followed by the UK, Spain, Portugal, the Netherlands and Belgium. Lower percentages of Smart Cities to overall number of cities are seen in Ireland, France and Germany, most Eastern European countries and Greece.

**Figure 12: The percentage of Smart Cities to cities by country in Europe**

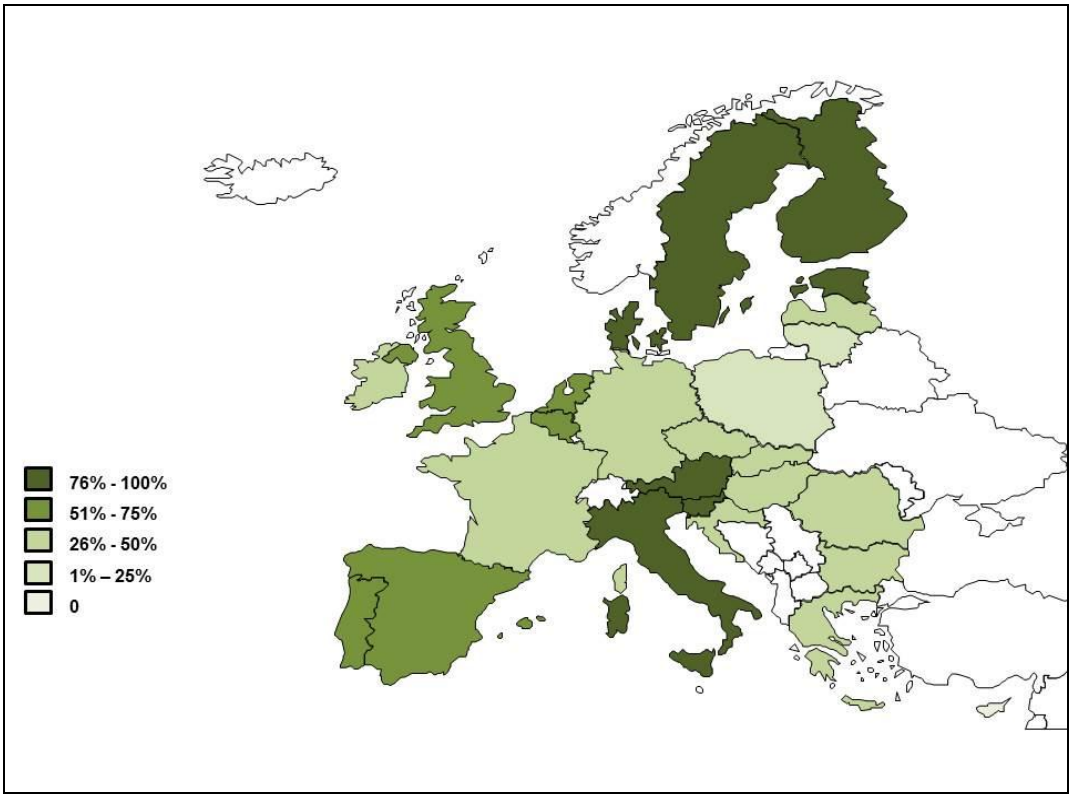
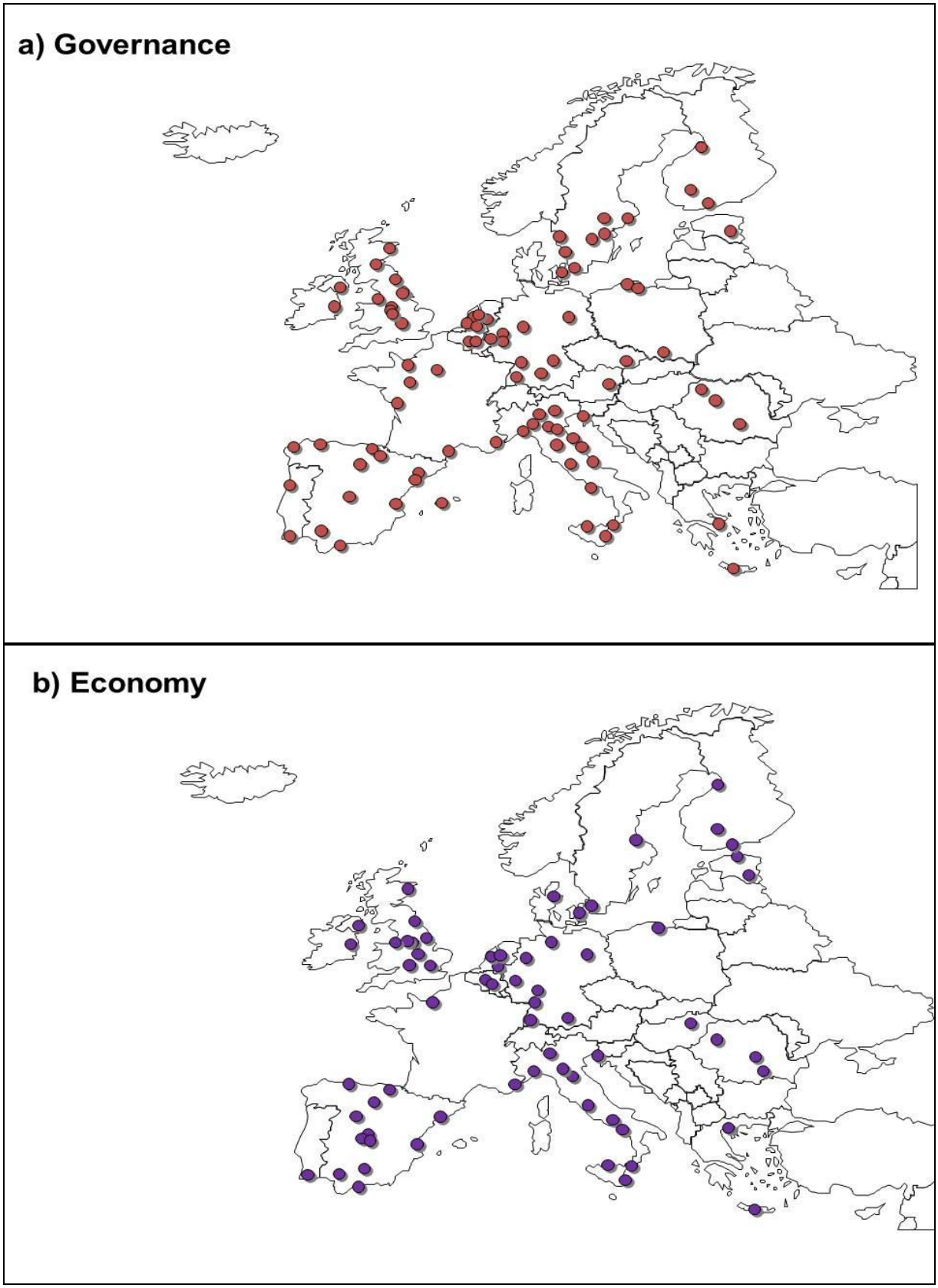
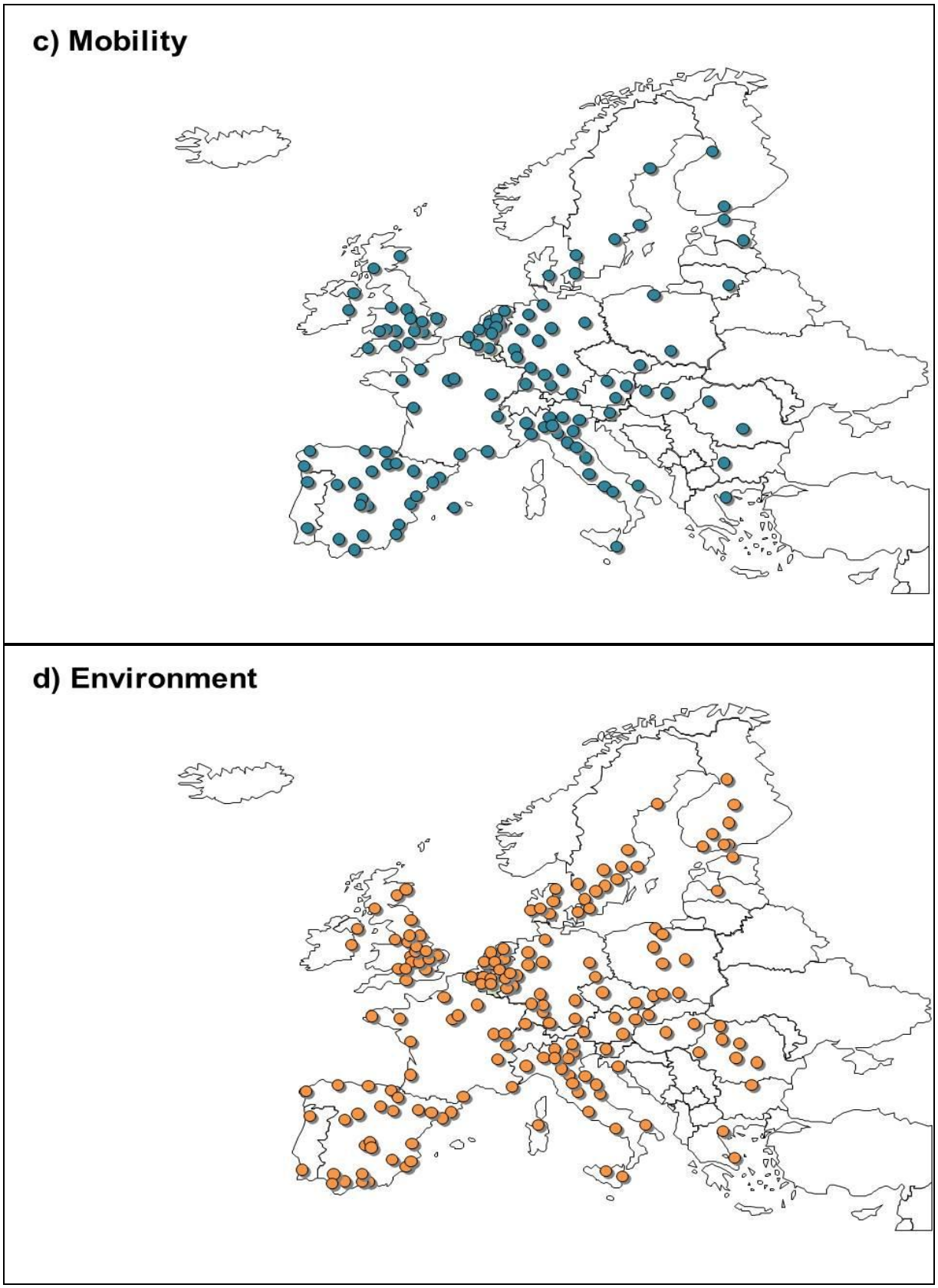


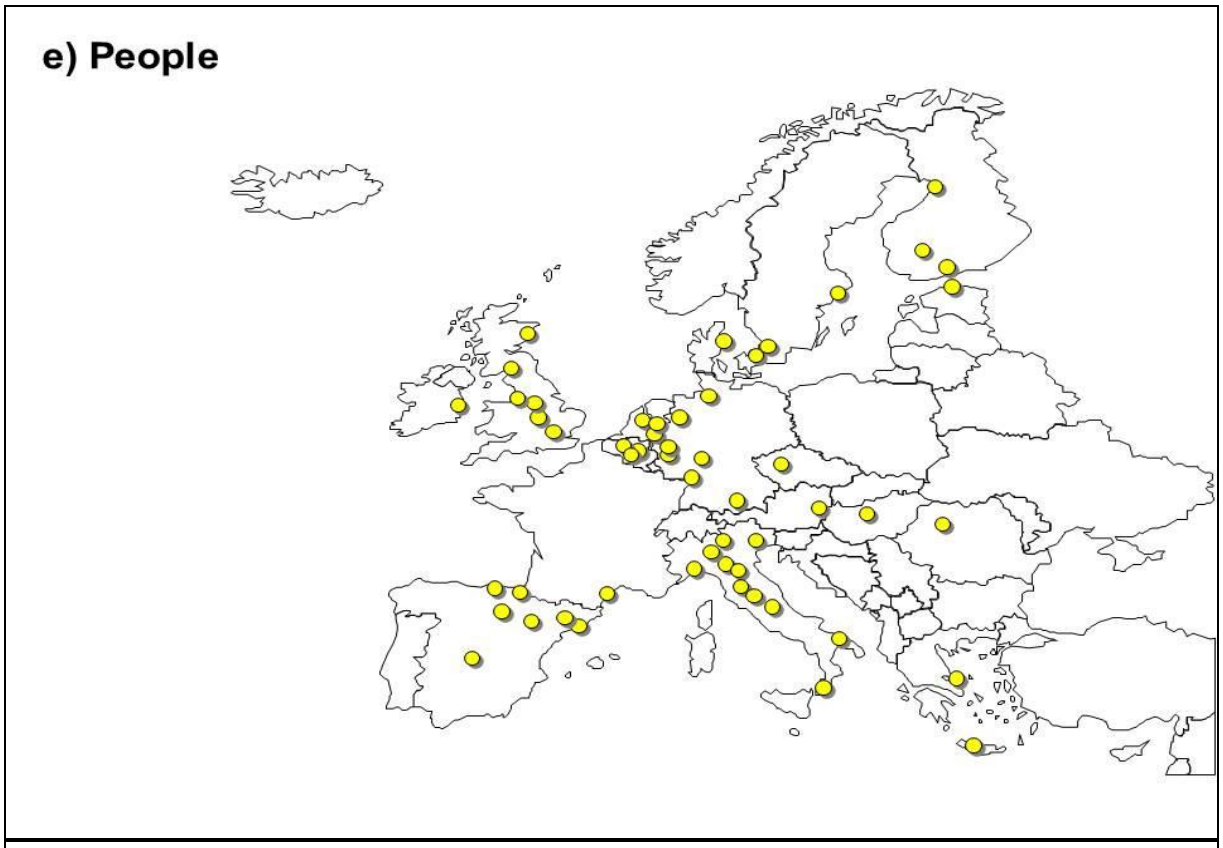

Figure 13 shows the incidence and geographic distribution of Smart Cities according to each of the six characteristics. As described above, (Figure 7) two-thirds of the Smart Cities focus on more than one characteristic with an overall average of 2.5 characteristics per Smart City. There is a clear correlation between city size and the number of Smart City characteristics; Smart Cities with only one characteristic are, to a great extent, smaller cities with between 100,000 and 200,000 inhabitants. In most of these cities, that single characteristic is Smart Environment or Smart Mobility.[60] These two characteristics are also the most common overall; where a Smart City has two or more characteristics they are often found in combination, typically as traffic management solutions. Furthermore, in the two-thirds of Smart Cities with two or more characteristics, the most common combinations are Smart Environment and/or Smart Mobility, with one or more other characteristics. Other trends are described in Table 6.

[60] Smart Cities with just one characteristic: Smart Governance: 5 Smart Cities, Smart Economy: 1 Smart City, Smart Mobility: 19 Smart Cities, Smart Environment: 56 Smart Cities, Smart People: 1 Smart City, Smart Living: 0 Smart Cities.

**Figure 13: The location of Smart Cities in Europe by the Smart City characteristics**




c) Mobility
d) Environment


e) People

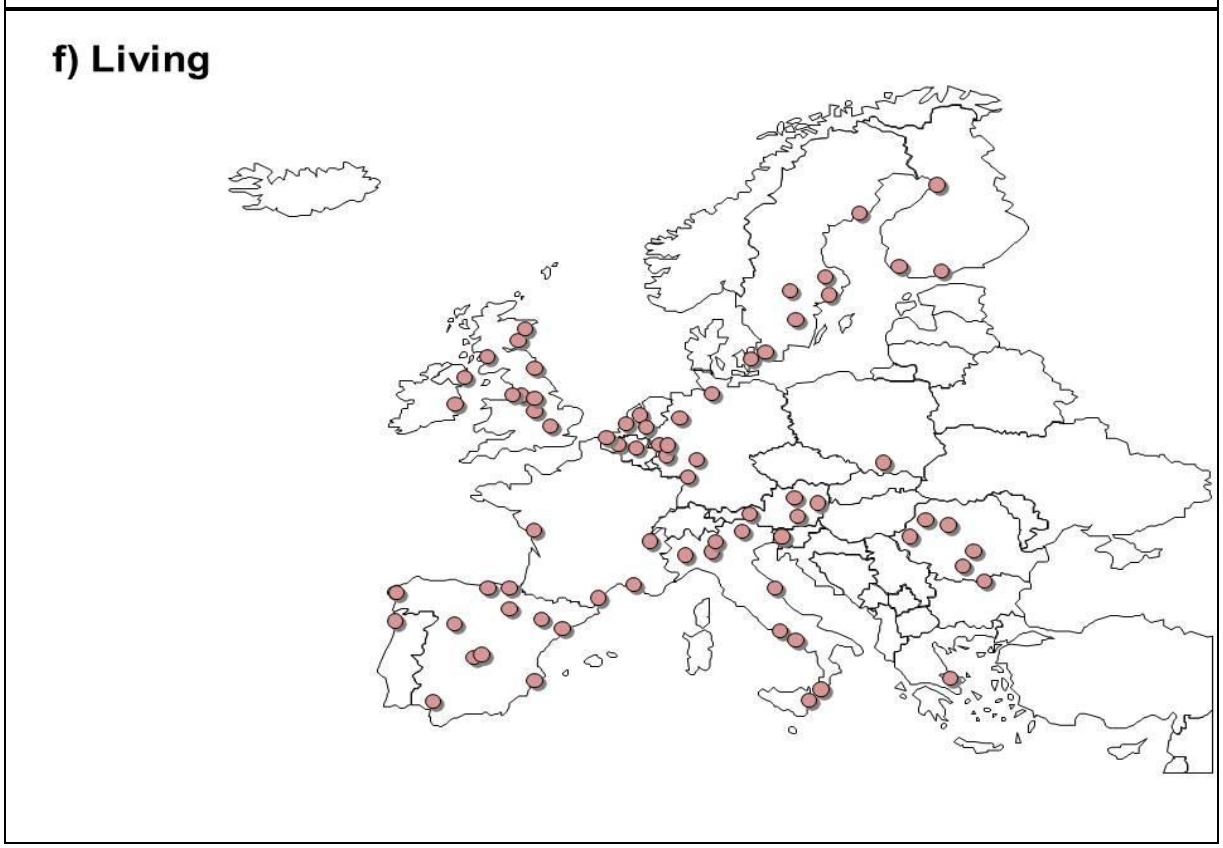

f) Living

**Table 6 : The geographical distribution of Smart Cities in Europe by Smart City characteristic**

| | Number of charac-teristics | % of charac-teristics | Geographical distribution |
|---|---|---|---|
| Smart Governance | 85 | 14% | Figure 16a shows that in particular the French, Spanish, Dutch, British, German, Italian and Swedish Smart Cities are often characterised by Smart Governance. A few cities in Greece, Romania, Hungary, Poland, Estonia and Denmark have Smart Governance initiatives or projects. Smart Governance cities are found in all city sizes. |
| Smart Economy | 67 | 11% | On the Smart Economy map (Figure 16b) German, Spanish, Italian and British cities predominate. On the other hand, Sweden, the Netherlands, Belgium and France have very few Smart Economy cities in absolute and relative (to the number of Smart Cities) terms. Overall, most Smart Cities with Smart Economy characteristics have more than 300,000 inhabitants. |
| Smart Mobility | 125 | 21% | Smart Mobility projects or initiatives (Figure 16c) are relatively well represented in British, German, Dutch, Spanish, Austrian, Hungarian, Romanian and Italian Smart Cities. Compared to the number of Smart Cities in Nordic Member States, there are only a few which have Smart Mobility initiatives or projects. Smart Cities with a Smart Mobility focus tend to be spread across all city sizes. |
| Smart Environment | 199 | 33% | Smart Environment is the most popular characteristic among EU Smart Cities (Figure 16d). In particular, Spanish, British, Italian, Dutch, Belgian and Nordic Member State cities can be characterised by a Smart Environment focus, but such initiatives and projects are spread throughout Europe. The characteristic of Smart Environment is well distributed across different sizes of cities but with a small tendency to be more common in cities of between 100,000 and 200,000 inhabitants. |
| Smart People | 52 | 9% | Smart Cities focusing on Smart People are generally small in number, and this characteristic has the lowest overall incidence. The Smart People characteristic is especially present in north Spanish and north Italian cities, as well as in German and British cities (Figure 16e). French, Swedish and Benelux cities also focus to some extent on Smart People. In general, cities that target Smart People are medium or large sized cities, typically having more than 500,000 inhabitants. In almost every case, the Smart People characteristic is used in combination with other characteristics. |
| Smart Living | 71 | 12% | Smart Living cities are quite evenly distributed across Europe, but especially in Spain, Italy and the UK (Figure 16f). Some Nordic Member States, Austrian and Romanian cities have also adopted the Smart Living characteristic. Cities in western Germany and the Benelux area are also quite well represented. Smart Living cities are found in all city sizes and are typically present in combination with other characteristics. |
| | **Total 599** | **Total 100%** | |

# 4. WHAT DOES A SUCCESSFUL SMART CITY LOOK LIKE?

**KEY FINDINGS**

- **At present, more than two-thirds of sampled Smart City projects are still in the planning or pilot testing phases.**
- A sample of 50 Smart City projects across 37 Smart Cities was identified on the basis of maturity, availability of information, size and geographic location.
- The projects in this sample were clustered into five characteristic types: neighbourhood units, testbed micro infrastructures, intelligent traffic systems, resource management systems and participation platforms.
- Project success is defined in relation to meeting project-specific and/or city-specific objectives and contributing to the Europe 2020 goals; successful projects in this sense have clear objectives, goals, targets and baseline measurement systems in place from the outset.
- Other correlates of success include key strategic and funding roles for a strong local government partner and the placement of the project within a comprehensive city vision. Many successful projects involve an active partnership between public and private participants: shared governance and direction, and specific private–partner contributions of developer expertise and financial and technological capabilities.
- **All successful projects in the sample used public and private finance; the highest proportion of public funding is found in intelligent traffic system and smart neighbourhood projects.** The mix is more balanced for resource management systems and testbed micro infrastructure projects, which normally entail substantial financial and in-kind support from business. Participant platforms typically have only modest funding needs; the primary 'costs' associated with such projects are the time and other resources invested by platform users.
- The overall impacts of projects and specifically their contribution to the Europe 2020 goals are strongest when they can be scaled, replicated or otherwise extended to other locations or pan-European level. Therefore, we considered the 'scaling potential' of the various project types. All five project types have some scope for EU-level scaling or replication; replication is most likely for participation platforms, while testbed micro infrastructures and intelligent traffic systems were designed to be scaled. The scaling or replication of Smart City neighbourhood units and resource management systems is limited by their high degree of local specificity. **Unsurprisingly, initiatives involving the participation of international commercial technology providers were better able to benefit from scaling, though causality remains an open question.**

As discussed in Chapter 1, measuring the success of a Smart City is a complicated process. The relative immaturity of most Smart City initiatives, and the difficulty of linking initiatives to particular socio-economic issues or systems within a city are factors which contribute to this complexity. Any balanced assessment (e.g. for the purposes of interim or ex-post evaluation) should also take into account the multiple levels at which Smart City initiatives and Smart Cities themselves may succeed. These levels involve meeting the objectives, or addressing the problems, of:

- individual participants in the initiatives (e.g. solution providers)
- indirect beneficiaries within the city (e.g. small and medium-sized enterprises (SMEs) or demographic groups that benefit from Smart services without participating directly in the initiative)
- the city as a whole, which could be helped to meet its strategic development objectives or by energising a collective willingness to collaborate in Smart ways to tackle other issues
- other cities and potential Smart City participants or indirect beneficiaries
- the country in which the city is located
- the EU as a whole (by direct contribution or by example).

To detect emerging benefits to these stakeholders, it is usual[61] to follow the life cycle or intervention logic of the policy. This covers:

- the relevance of design
- the adequacy, quality and other attributes of inputs
- the efficiency of activities and the delivery of outputs
- the effectiveness of wider impacts
- the sustainability of progress towards strategic objectives.

Most Smart City initiatives are relatively new, and their contributions to concrete wider objectives can be indirect. **In order to compare and learn from Smart Cities in Europe, therefore, we must develop indicators of success linked to the most visible elements: the objectives, inputs, processes and intended impacts associated with current initiatives**.

In outlining the profile and vision of a city on the basis of these elements, 'successful cities' will be identified as cities which exhibit a wide range of initiatives whose objectives align with the city's particular challenges and the Europe 2020 targets.

## 4.1. Initiative objectives vs. outcomes

We have mapped and characterised all identifiable Smart Cities in the EU-28 with a population of at least 100,000 inhabitants. In this section, we analyse a sample of 50 such projects chosen to achieve a good representation across a range of characteristics, as explained below. They are analysed for common features, levels of success (as defined in Box 1) and prospects for scaling to EU level.

### 4.1.1. Project selection criteria and sampling strategy

In order to take a representative sample of the 50 most successful Smart City projects, the following four step process was used.

1. **Exclude immature projects**. Smart Cities at maturity level 1 were excluded since their projects by definition only have a strategy or policy.
2. **Access relevant evidence**. Cities for which we have not been able to identify good information on project descriptions, objectives, stakeholder, funding and impacts were

[61] Detailed further in the European Commission's Impact assessment guidelines: http://ec.europa.eu/governance/impact/commissionguidelines/docs/ iag2009en.pdf

excluded. This ensured that we had good, if not necessarily always complete, information on key features of each project. Although this is an unavoidable step, the impact of possible bias needs to be considered, but there is every reason to believe that the lack of information will be distributed randomly across projects and will not unduly bias the sample taken, with two possible exceptions. There is probably an over-representation of information dearth in the very recent and immature projects, an issue addressed in the previous step, and in smaller cities, which have fewer resources than larger cities. We attempt to address this potential bias in the next step.

3. **Take a representative sample of projects**. The analysis in Chapter 3 shows a strong tendency for a high proportion of Smart Cities to be larger cities, which have a greater number of Smart City characteristics than smaller cities do, as well as being located in northern and Western Europe. In order to remove this bias, the population sizes and geographic location of the Smart Cities were examined in order to obtain a more balanced sample across size and location:

   - Population. Cities were stratified by population into three groups: small cities with between 100,000 and 500,000 inhabitants; medium cities with between 500,000 and 1,000,000 inhabitants; and large cities with over 1,000,000 inhabitants.[62]
   - Location. The EU was divided into five geographical areas to ensure a fair geographic spread: North Eastern Europe (Estonia, Latvia, Lithuania, Poland, Czech Republic, Slovakia and Hungary); South Eastern Europe (Bulgaria, Romania, Croatia, Slovenia); North Western Europe (France, Belgium, Luxembourg, Netherlands, Germany, Austria, UK and Ireland); Mediterranean Europe (Portugal, Spain, Italy, Greece); and the Nordic Member States (Denmark, Sweden, Finland).

4. **Identify what constitutes Smart City project success**. The final sampling step focused on project success. This was assessed by project size, scope and type of impacts and achievements compared with the stated objectives within each characteristic. Evidence for such impacts was sought in the project documentation and validated from other sources where possible, as well as by examining any indirect evidence from reports, opinions and other indicators.[63] Given the shortlist of projects resulting from steps 1, 2 and 3, only just over 20 projects could be assessed in this way as having actual impacts and achievements. Thus, in order to make up the sample of 50 projects, we also included projects that could be judged to have a realistic chance of achieving impacts by examining, as above, the project's own reporting and other sources where available. Overall, this result reflects the fact that many European Smart City projects have not yet achieved actual and significant impacts, given that most have only started quite recently.

   More projects could have been selected that have already achieved real impacts, but this would bias the sample towards larger cities, Northern and Western Europe, older projects and/or projects seeking the most immediate impacts. As it is clearly difficult to untangle evidence and reasons for success, we have also taken into account (where available evidence permits) issues such as:

   - time horizon (e.g. how far along the project is, indicating what can reasonably be expected to count as 'success' in relation to stated objectives)
   - the fact that 'success' can mean different things to different stakeholders (e.g. what is good for some stakeholders may not be good for others)

[62] Other size categories were tested in relation to the final list of 50 projects to see which provided the most balanced final sample.

- the incidence of 'unintended' outcomes, beneficial and detrimental and differentiated by stakeholder
- any results from the projects' own measurement frameworks.

Using this sampling strategy, we identified 50 Smart City projects and initiatives deriving from 37 Smart Cities (summarised in Annex 2). Relevant information about objectives, stakeholders and governance, funding and benefits, impacts and achievements for each of the 50 cases is detailed in Annex 2-5,[64] where used later on in the study, and Annex 2.

### 4.1.2. Approach to project analysis

With this sample of 50 Smart City projects, we undertook analysis in order to identify clusters or types of projects whose impacts could then be compared. Four factors of each project were considered: project-specific objectives; stakeholders and governance; funding; and benefits, impacts and achievements. For the purposes of this analysis we ignored the factors considered in Chapter 3 (city size, location and Smart City characteristics). As a result of the analysis we grouped the projects into five types, in a manner that maximised in-group similarity across the factors, while creating a manageable number of groups with a fair number of projects in each:

- neighbourhood units
- testbed micro infrastructures
- intelligent traffic systems
- resource management systems
- participation platforms.

Table 7 shows the distribution of Smart City projects across these five project types. **Smart neighbourhoods and resource management systems are the most common project types.**

**Table 7: The distribution of Smart City projects across the five project types**[65]

| | Smart Neighbourhoods | Testbed micro infrastructures | Intelligent traffic systems | Resource management systems | Participation platforms |
|---|---|---|---|---|---|
| | **10** | **7** | **11** | **14** | **8** |
| **Smart Environment** | +++ | +++ | ++ | +++ | * |
| **Smart Mobility** | ++ | ++ | +++ | | * |
| **Smart Governance** | | | | ++ | +++ |
| **Smart Economy** | ++ | ++ | | ++ | ++ |
| **Smart Living** | ++ | | | + | * |
| **Smart People** | ++ | | | + | ++ |

[63] Such as external referencing or copying, growth in participation, and so on.
[64] Information about the dashboards containing these and other data is provided in Annex 10
[65] +++ indicates approximate priority; indicates that although this is not a stated priority they are often a tool that is used to support that type of project. Further information is given in Annex 5.

### 4.1.3. Description of project types

#### Smart Neighbourhoods

Smart Neighbourhoods are neighbourhood-sized complete infrastructures. They are ICT-enabled carbon-neutral and sustainable, and are designed to support Smart Environment, Smart Mobility, Smart Economy and Smart Living. Examples include the London suburb of Hackbridge (UK),[66] Hafencity in Hamburg (Germany),[67] Nordhavn in Copenhagen (Denmark),[68] Stockholm Royal Seaport (Sweden),[69] Oulu Arctic City (Finland),[70] Lyon Smart Community (France)[71] and Aspern in Vienna (Austria).[72] These neighbourhood-scale Smart Cities, typically built for 10,000 to 40,000 inhabitants, are implemented either on green field (i.e. completely new) sites or as retrofitted development projects. They are usually used to expand city capacity and boost economic development by showcasing the city as a tech and sustainability frontrunner. The projects are holistic, representing complete visions of a future Smart City on a smaller scale. They are, therefore, intended for scaling up to city level at least.

The environmental objectives include the reduction of energy consumption and the provision of a complete, reliable and integrated energy infrastructure (including smart meters and grids, alternative and renewable energy, and water and waste management). All the sampled projects emphasise Smart Living (enhancing residents' quality of life) and Smart traffic infrastructures (Smart Mobility) for public transportation and cycling.

#### Testbed micro infrastructures

Testbed micro infrastructures are small city demonstration and testing pilots for Smart City technology. They emphasise Smart Environment, Smart Mobility and Smart Economy. The infrastructures are created by connecting as many things as possible (in the sense of the 'Internet of Things' – systems, sensors and physical objects). Operational overlay systems are then implemented, to manage communication among these interconnected things with minimal direct human involvement. In most cases the scope of these infrastructures is limited to a so-called Smart Street or climate street;[73] such smart streets can be found in the Barcelona suburb of Sant Cugat (Spain),[74] Milan (Italy),[75] Amsterdam (the Netherlands)[76] and Cologne (Germany).[77] Other examples operate on a larger scale such as the Greenwich Peninsula Operating System (OS) in London (UK)[78] or the Glasgow intelligent street light system (UK).[79]

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[66] http://www.sutton.gov.uk/CHttpHandler.ashx?id=4366&p=0.
[67] http://www.hafencity.com/en/home.html.
[68] http://www.nordhavnen.dk/.
[69] http://www.stockholmroyalseaport.com/en/.
[70] http://www.ouka.fi/c/document_library/get_file?uuid=a04f2f94-5c69-450e-8b8d-c9731f4984fd&groupId=139863
[71] http://www.economie.grandlyon.com/fileadmin/user_upload/fichiers/site_eco/20121121_gl_lyon_smart_community_dp_en.pdf.
[72] https://smartcity.wien.at/site/en/projekte/bauen-wohnen/aspern-seestadt/.
[73] An entire street embedded with testbed micro infrastructures.
[74] http://smartcity.santcugat.cat/?lang=en.
[75] http://www.milanexpotours.com/milan-expo-project-2015/numbers/milan%E2%80%99s-first-%E2%80%9Csmart-street%E2%80%9D.html.
[76] http://amsterdamsmartcity.com/projects/detail/label/Climate%20Street.
[77] http://www.smartcity-cologne.de/klimastrasse/.
[78] http://www.bbc.co.uk/news/technology-17940797.
[79] http://sustainablefutures.info/2013/05/02/smart-cities-glasgow-barcelona/. An example is provided by self-organising traffic lights; this experiment replaced centralised control of traffic light timing with local communication among lights at adjacent intersections. Because timings could respond to local variations in traffic flow and vice versa, this system produced more even flow and reduced journey times and levels of congestion than centralised management approaches. See e.g. Prothmann et al. (2012).

The technology involves sensor monitoring systems for a range of city functions, most typically in combination, including intelligent energy management, parking, mobility, garbage, environmental (temperature, humidity and pollution) conditions, street lights, use of free Wi-Fi and demand for electric vehicle charging stations.

These are real-life laboratories for companies to demonstrate technology, understand the complex behaviour (resilience and fragilities) of such systems and learn how to integrate, manage and monitor their behaviour. The Sant Cugat Project (Spain), for example, aims to achieve efficiency and avoid traffic jams. To this end, sensor network monitoring systems are deployed in parking areas and outdoor areas of commercial buildings and mobility sensor systems are in operation for vehicles. Solar energy allows automatic garbage compaction to reduce the volume of waste to a fifth, and volume sensors allow efficient garbage collection. Environmental sensors (temperature, humidity and pollution) provide additional information on waste collection and the management of the irrigation system for intelligent urban green areas. Meanwhile, the presence of sensors controls lighting intensity in pedestrian areas.[80]

All the testbed micro infrastructure cases sampled here have a multiplicity of objectives (e.g. to reduce $CO_2$ emissions, save money, foster economic development and strengthen the technological base of local businesses and increase exports).

Most importantly the cases seek to find ways to expand and scale these micro infrastructures to a city level.

### Intelligent traffic systems

Traffic management Smart City projects focus on Smart Mobility and Smart Environment. They are ICT-enabled systems, typically based on road sensors or active GPS[81] (i.e. while users have them 'on').

The objective is to monitor real-time traffic information in order to manage city traffic in the most efficient and environmentally friendly way possible. Examples include the Zaragoza traffic monitoring system (Spain),[82] Dublin Road Congestion System (Ireland),[83] Eindhoven Traffic Flow System (the Netherlands),[84] Enschede Vehicle Inductive Profile (the Netherlands),[85] and the Thessaloniki Mobility Project (Greece).[86]

This objective is to be achieved by speeding up the resolution of road network issues, reducing congestion and improving traffic flow. Although the general and specific objectives are very similar across projects, the technological solutions employed are very different. For example, Zaragoza employs a sensor-based solution to obtain real-time city traffic information. The system supports efficient traffic management decisions and provides citizens with relevant information so that they can make their own choices. With 150 'urban' sensors over the urban grid of Zaragoza, 90% of all urban routes are monitored, and 30% of all traffic is audited daily. Travel time information goes directly to the Traffic Management Centre of Zaragoza City Council[87] and is displayed on a web interface specially intended for management purposes.

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[80] http://smartcity.santcugat.cat/?lang=en.
[81] http://www.guardian.co.uk/local-government-network/2013/jun/05/dublin-city-smart-approach-data
[82] http://www.bitcarrier.com/zaragoza.
[83] http://www.theguardian.com/local-government-network/2013/jun/05/dublin-city-smart-approach-data.
[84] http://mwrf.com/semiconductors/eindhoven-proving-ground-improving-traffic-flow.
[85] http://imtech.com/EN/traffic-infra/Traffic-Infra-Newsroom/Divisie-Imtech-Traffic-Infra-Homepage-Newsroom-Highlights/City-of-Enschede-treats-road-users-as-VIPs.html.
[86] http://www.mobithess.gr/.
[87] http://www.bitcarrier.com/zaragoza.

In Eindhoven, on the other hand, participating pilot cars are equipped with a device containing a telematics chip 'ATOP',[88] which gathers data from the central communication system of the car (CAN-bus). Sensor data (e.g. indicators of potholes or icy roads) is collected in-vehicle and transmitted to the cloud-enabled traffic centre. The Enschede system collects actual travel times of vehicles by means of Smart detection loops of traffic lights. The test installation covers three main roads in Enschede. Travel time savings are stored in a database, processed and shown on four dynamic route information panels on Highway 35. The city of Enschede aims to use this technology to optimise the use of the available infrastructure.

In Thessaloniki (Greece) two different systems have been put into place. First, a new traffic control centre manages incidents with real-time information, dynamically estimates traffic for the rest of the day, assesses and confirms estimated travel times, and dynamically manages traffic lights. The second system is a mobility planner that provides citizens with real-time traffic condition data, enabling them to choose between the shortest, most economical and most environmentally friendly route.[89]

### Resource management systems

Many Smart City projects within the EU-28 – and therefore a substantial proportion of our sample – address ICT-enabled resource management systems such as Smart grids, Smart meters, Smart energy and solar, wind and water management systems.

Resource management initiatives primarily involve Smart Environment, but Smart Governance, Smart Economy and Smart Living are also important characteristics. Examples include Smart Power Hamburg (Germany),[90] Barcelona Smart grid and solar hot water ordinance (Spain),[91] the Copenhagen wind power and Smart grid system (Denmark),[92] the Copenhagen waste water management system (Denmark),[93]Cologne Smart metering (Germany),[94] Mannheim E Energy (Germany)[95] and the Gothenburg managed Celsius Project (Germany).[96]

### Participation platforms

These projects involve the participation of citizens through ICT-enabled platform. Examples in our sample include: open data strategies and platforms, crowdsourcing and co-creation platforms, and other forms of citizen participation and ideation. The open data projects include citizen or user competitions to develop apps and other digital services (often re-using public data) to improve the quality and level of participation of public services. The open data projects currently under deployment are regarded by participants and government officials as providing better Smart Governance and Smart Economy outcomes than conventional approaches. Because citizen and business participants set the agenda, the degree to which other characteristics are reflected depends on the project scope, as well as the preferences and capabilities of participants.

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88 http://www.nxp.com/news/press-releases/2013/02/dutch-city-region-of-eindhoven-works-with-ibm-and-nxp-to-improve-traffic-flow-and-road-safety.html
89 http://www.et-online.gr/default.asp?pid=11&la=1&arc=12&art=166&nwID=14
90 http://www.smartpowerhamburg.de/.
91 http://www.c40cities.org/c40cities/barcelona/city_case_studies/barcelonas-solar-hot-water-ordinance.
92 http://www.dac.dk/en/dac-cities/sustainable-cities-2/all-cases/energy/copenhagen-cities-can-run-on-wind-energy/?bbredirect=true.
93 http://www.ecoinnovation.dk/NR/rdonlyres/9FEEE910-27A4-4BE7-8A01-DD17BE0C072E/0/KBH_havn_baggrundsartikel_1.pdf.
94 http://www.smartcity-cologne.de/smartmeter/.
95 http://www.e-energy.de/en/95.php.
96 http://eu-smartcities.eu/content/celsius-smart-district-heating-and-cooling-solutions.

Cities developing ICT-enabled citizen participation platforms include Amsterdam (the Netherlands),[97] Helsinki (Finland)[98] and Florence (Italy)[99] among others, while EU backed projects include Periphea,[100] Citadel[101] and CitySDK.[102]

Overall, the strategic objective of these projects is to develop better public services. This is based on input from citizens obtained by providing ideation platforms to develop a better city (e.g. the Amsterdam Smart City Platform), or competitions to take advantage of open public data to develop apps, useful data mash-ups or new services. For example, the city of Helsinki, Finland, is looking for new ways to encourage developers to exploit open data in order to create digital services and useful applications for citizens. The underlying themes of the Helsinki project are transparency of city decision-making and enabling better feedback from citizens to civil servants. Smart City services are thereby tested in the Helsinki Metropolitan area as part of people's everyday life.

97 http://amsterdamsmartcity.com/projects/detail/id/36/slug/amsterdamopent.nl.
98 http://www.forumvirium.fi/en/project-areas/smart-city/open-helsinki-hack-at-home.
99 http://www.theflorentine.net/articles/article-view.asp?issuetocId=8342
100 http://www.peripheria.eu/.
101 http://www.citadelonthemove.eu/en-us/home.aspx.
102 http://www.citysdk.eu/.

### 4.1.4. Project attributes

Table 8 lists the attributes of Smart City projects by type.

**Table 8: The attributes of Smart City projects by type**

| | Description and objectives | Stakeholders | Funding | Success and benefits | Scaling potential at EU level |
|---|---|---|---|---|---|
| Smart Neighbourhoods | ICT-enabled infrastructure to create carbon neutral and sustainable residential areas, typically built for 10,000 to 40,000 inhabitants. | A mix of public and private stakeholders – citizens also play a critical role in maintaining and developing neighbourhood units. | Government and private investment.<br>Often part of the overall vision for a city and therefore financed in part by the municipality. | The projects in our sample of this type are all currently in the stages of planning or development and most will not be in service before the late 2020s.<br>In general the projects emphasise potential positive externalities, happier citizens, improved real estate markets, attracting tax payers or public savings. | The size and scope of the project could provide opportunities to identify 'good practice' and thus impact on the transferability and scalability of this type of project. |
| Testbed micro infrastructures | ICT-enabled infrastructure for piloting a network of technologies that interact in a given area of a city. Typically this involves sensors and devices creating data and therefore by-passing human involvement. | Involvement from public and private institutions in which local government collaborates with industry to test new technologies. | Public–private partnership between municipalities and private investment. In-kind contributions from industrial partners. | The majority of the projects in this category have been implemented. Results include reducing the costs of management for a service and helping reduce $CO_2$ emissions, and helping to promote the economic competitiveness of the city. | Test these small entities in order to ensure successful scaling to the whole city level. Almost by definition, the companies involved would be interested in expanding their expertise and experience to other cities based on the testbed approach. |
| Intelligent traffic systems | ICT-enabled systems based on road sensors or GPS to monitor real-time traffic information and manage city traffic in an efficient and sustainable manner. | These are primarily driven by the public sector as these systems are often the responsibility of local government or councils. | Primarily financed directly by the public sector (municipalities and EU funding). Private companies are more likely to | The range of projects examined differ in maturity and time frame although they seem so far to lack evidence of proven effects. We predict there will be a number of indirect effects and positive | There are a number of indirect effects and positive externalities once these projects are scaled up to city level. Traffic management and parking |

| | Description and objectives | Stakeholders | Funding | Success and benefits | Scaling potential at EU level |
|---|---|---|---|---|---|
| | | Private sector actors are involved in providing technological support. Citizens are often involved as end-users but often do not have a stake in the project. | provide technology and other in-kind support. | externalities including time savings for citizens, positive environmental effects, increased road safety, and a beneficial impact on insurance companies and their customers. | systems should be able to save time for citizens, and should further provide environmental and personal finance improvements. |
| Resource management systems | ICT-enabled infrastructure to improve the management of utilities for a city such as energy, water or electricity, e.g. smart power systems with intelligent management of energy mixes, smart grids, smart metering, heat storage, solar energy management systems, and surveillance management systems for resources such as clean tap water or wastewater or heating efficiency systems. | These are primarily driven by the private sector such as energy companies. Other actors include local administration, universities and citizens as 'prosumers'. | In most cases, private partners finance parts of the projects, but some – typically non-energy-related – projects are purely publicly financed. Some projects have used a cooperative approach enabling user funding. | Slightly less than half of the projects analysed have been fully implemented. The resource management system projects have produced a number of positive externalities. This has resulted in unintended benefits in other areas of the city, including increased real estate values, quality of life and tourism, and the revitalisation of local business life. | These may be difficult to replicate or scale up to the European level as they tend to be more participant dependent, because of the large number of stakeholders involved. |
| Participation platforms | ICT-enabled citizen participation open data strategies, crowdsourcing and co-creation platforms. | Most projects driven by the local municipality, with inputs from citizens and technological expertise from the private sector. | Reuse of widely availability ICT equipment. Therefore the primary cost is time: citizen inputs and municipality administration. | Most projects using this resource are either in an early or pilot testing stage. The goal is to develop citizen participation platforms as one of the leading testing environments for digital services and thereby to improve the service development process. | The transferability of citizen participation platforms is high because cities already have access to the data and the infrastructure involved is relatively low cost in comparison with other components. |

## Stakeholders

**All the projects have a mixture of participants drawn from (local) government, commercial industry and civil society, but the degree and nature of participation varies, as do the roles of the participants.**

As the name implies, the Smart Neighbourhoods rely on citizens (local residents) to guide the development of the projects and to maintain the facilities. In other words, the projects rely on local residents 'taking ownership'. The city government acts as a guarantor or supporter, providing co-finance, strategic guidance (in conjunction with overarching city development plans) and administrative support. Municipal governments and the local neighbourhoods generally need additional development expertise, technical access and support and (often) funding. These projects therefore typically involve close partnerships with external stakeholders from the business and research communities (financial institutions, software and application developers, technology providers and universities). Effectively, the private entities provide services to the citizens, with local government acting as an intermediary.

The testbed micro infrastructure initiatives, while similar in scale and geographic scope, are much more technologically orientated, capital-intensive and commercially relevant. As a result, business entities play a much more prominent role. These are often configured in a hub-and-spoke manner, with local government providing the testbed area to a large number of technology-heavy companies interested in testing their technologies in real-life settings. Generally, because of the commercial payoff and risks involved, private co-financers have an important role in the partnership agreements. In principle, at least, this is not wholly a commercial relationship. Businesses obtain valuable real-world test experience, while local municipalities obtain cutting-edge services for their citizens and valuable learning relating to public service provision (depending on the project). Local residents are involved, of course, as users and informal evaluators of the technologies and services deployed on the testbed, but they generally do not influence the project or its implementation.

Intelligent traffic system projects are primarily driven and owned by city governments, in conjunction with their public service obligations regarding traffic and mobility. Private sector participants provide technological and service support. End-users include residents and local businesses that rely on roads and other traffic systems to run their businesses, but these users have a largely passive role as far as the design, implementation and operation of the projects are concerned. For such projects, the private sector may be regarded as providing services to the municipality, which acts on behalf of the citizens' generalised interest.

Resource management systems can be subdivided. 'Smart meter' or 'Smart grid' projects aim to improve the efficiency of (typically electric) power distribution. Other projects use similar technologies and approaches to encourage the deployment and uptake of alternative energy sources (generally renewables). A final subgroup includes projects applying the same techniques to other networked utilities (e.g. gas, water). The power distribution projects are driven and owned by the private sector – in particular by large (often multi-city or multi-national) generation, transmission and (especially) distribution companies.[103] These projects depend crucially on the infrastructures provided by these firms, whose interests are generally commercial,[104] but not confined to the local area.

[103] All three aspects of the electric power value chain are mentioned because there are national differences in the degree to which they are vertically integrated and in the way management authority is divided.

[104] This is not exclusively the case; many power companies have corporate social responsibility strategies and an interest in sustainable development.

In other project types, the key industrial parties may range from large power companies or poly-utilities[105] to local suppliers of alternative technologies. Local businesses also participate in other ways, especially businesses with cogeneration facilities, which act both as users and power generators, and can take an active role in demand management and load-shifting. Similarly, citizens can take active roles, for instance by managing power use and negotiating supply contracts collectively for the neighbourhood. Local administrations play secondary roles by providing administrative, planning and regulatory support. Universities provide analytical assistance to validate impacts and to measure, assess and draw lessons from project performance.

The participant platforms are generally the lowest-cost and most open-ended projects. They tend to be driven by local municipalities on behalf of platform users. These reflect the full range of city actors: individuals, civil society groups, small businesses in the retail service, and manufacturing sectors and larger businesses established in the city. The projects primarily reuse existing technologies and platforms, so there is little reliance on commercial entities as critical suppliers of essential functionalities. By the same token, the commercial return to businesses supplying such facilities and services is likely to be modest (except to the extent that such projects serve as test beds for new forms of social networking or Enterprise 2.0 processes and business models).

### Funding

**All project types use a mix of public and private finance. The differences occur in the purposes for which such finance is provided, the modality and scale, and the way in which risks are managed and economic returns captured. The highest level of public (municipalities and EU) finance is provided to intelligent traffic system projects.** This reflects the fact that municipal organisations, by and large, have sole responsibility for traffic, as well as the high level of pan-European interest in transport infrastructures and the environmental impacts of transport.

**Major (but primarily local) public finance is provided for Smart Neighbourhoods to the extent that it is provided for in municipal development strategies. Local public funding is also provided in the form of capital expenditure incurred to create future benefit (CAPEX) to the testbed micro infrastructure projects.** This funding acts as a counterpart to the in-kind support generally provided by the business users of the testbed facilities and (in some cases) co-financing by private citizens.

The mix is more varied for resource management systems. **The 'smart grid' type of project tends primarily to rely on CAPEX from large energy supplier participants. For the alternative energy and non-power projects, there is often a higher level of public and citizen support.** For alternative energy sources, there is a range of existing public support instruments tied to environmental objectives. However, public subsidy is generally seen as a transitional measure: it tends not to be associated with major fixed capital formation and ownership, but rather underwrites investments by other actors. **It is also noticeable that a range of innovative forms of cooperative finance have been used experimentally with this type of project, ranging from crowd-funding to buy-and-lease-back financing of household solar panels.**[106]

[105] Increasingly, networked utilities are provided in a horizontally diversified fashion; the same company supplies bundled electricity, gas, water and even telecommunications.

[106] Details and further examples are given in Annex 5.

As noted above, the participant platforms tend to have only modest capital costs,[107] most of which are already sunk.[108] The primary cost associated with such projects is the opportunity cost[109] of time, which is provided by the participants.

The pattern of funding provides a useful complement to power, responsibility and influence, discussed in the previous section. **When the important decisions are made by the main provider of financial support, there is a strong likelihood that that dominant player's preferences will guide the project.** For instance, the power-related resource management systems are likely to prioritise the commercial returns to innovative solutions. In other cases the provider of funding acts as a principal, delegating decisions to agents who have better information or are closer to the realities of the project and its impacts. This is the case where public authorities act as third-party payers on behalf of citizens, as in the Smart Neighbourhoods.

The pattern of funding also serves as an indirect indicator of the success of the project and the potential to extend it to other settings. **Where funding is provided by a party with little choice or flexibility (such as consumers paying road-tolls on roads they have to use), there is no guarantee that their interests will be furthered by the project, or that the costs are justified by the benefits.** However, in projects with greater flexibility (e.g. the participant platforms) costs and benefits are compared by each party who decides whether or not to participate. In this case, participation is itself an indicator of success.

### Success and benefits

The project types differ in the extent to which their success and benefits can be assessed. Some (especially the two management system types) have concrete measures of performance. In such cases, we have precise indicators of the degree to which systemic (traffic and resource) management performance has been improved. For other types, evaluation is complicated by the absence of objectives stated in concrete and measurable terms, and by the lack of identified and agreed baselines for comparison. Even where partial indicators are identified (or can be inferred), **the data necessary to assess performance are not always collected, made available, or provided at the necessary levels of quality and coverage.** This can be seen in the importance attached to the participation of university researchers in the more open-ended and user-defined project types.

**Assessment and benchmarking are also limited by maturity.** As we have noted, more than two-thirds of Smart City projects remain in the planning or pilot testing phases. Neither soundly tested business cases nor comprehensive hard evidence of impacts of these projects is widely available. This hinders the development of – and learning from – successful projects. This particularly affects the Smart Neighbourhoods and participation platforms; most of those in our sample are still in the planning or development stage.

However, some types of projects have produced concrete results consistent with their initial objectives. Most of the testbed micro infrastructures have been implemented and have already begun to reduce service management costs and $CO_2$ emissions, and are regarded as contributing positively to their cities' economic competitiveness.

Similarly, nearly half of the sampled resource management system initiatives have been implemented and are producing (in addition to the expected efficiency improvements) spill-over benefits such as increased real estate values, quality of life and tourism, and the revitalisation of local business life.

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[107] One-time setup cost of a plant or project, after which there will only be recurring operational or running costs.
[108] Money already spent and permanently lost.
[109] A benefit, profit, or value of something that must be given up to acquire or achieve something else.

## Scaling and dissemination potential

Four broad findings regarding the potential for and obstacles to wider dissemination of Smart City initiatives emerge from the sample of initiatives studied here, as presented in Table 9.

**Table 9: The scaling and dissemination potential of Smart City initiatives**

| Finding | Scaling/Dissemination potential |
|---|---|
| Framework conditions | There are several 'framework conditions' that affect the potential for expanding the scale of initiatives (in the sense of adding participants or areas to existing projects) or creating duplicate projects in other areas. These conditions reinforce the general need for strong governance, sustained sponsorship and the right stakeholder mix. They include:<br>• financial uncertainties, especially when they limit the ability of local authorities to provide finance or the willingness of the private sector to invest<br>• the often substantial risks associated with specialised fixed capital investment in infrastructure-based projects (especially Smart Neighbourhoods and resource management systems – the infrastructure used in testbed micro infrastructure projects and intelligent traffic systems is owned by the municipality)<br>• the fact that benefits to major investors in Smart Neighbourhoods, testbed micro infrastructure projects and (some) resource management systems are joint, long term and shared with other stakeholders with much smaller sunk investments<br>• the difficulty of monetising returns (especially for societally orientated Smart Neighbourhoods and participation platforms initiatives). |
| Citizens as stakeholders | Citizens are important stakeholders in Smart Neighbourhoods and participation platforms initiatives. It is important to give them strategic roles in development and execution phases, or as co-financers of cooperative activities in the development and operation of city services. In this way, citizens, consumers and users can serve as useful conduits and advocates for the dissemination of Smart City projects. Moreover, by ensuring that the interests of civil society are incorporated into the design and business model of the initiative and by building in 'consultation by design', such initiatives are likely to prove more acceptable to citizens in other cities under a replication, Smart City services or ecosystem seeding model. |
| Participation of the private sector | The participation of a private company (ideally a national or pan-European company) as a key player alongside the city authorities and local firms can provide an institutional base for scaling. This is particularly important in project types where the business is a central stakeholder or investor. However, this brings risks of its own because of the potential for such businesses to accumulate significant market power in a way that (by virtue of the wide replication of the initiative) bypasses local or even national regulation. |
| Cooperation among cities | Cooperation among cities to create common Smart City platforms for large-scale development and testing of smart solutions is likely to make dissemination easier and more convincing for new stakeholders in collaborating cities, especially if such cooperation is conducted on open terms. |

Conversely, some types of initiative (especially Smart Neighbourhoods and resource management systems) depend heavily on the extent and quality of local networks and capabilities, and may be difficult to extend under any of the models described above. By the same token, initiatives that lack evidence of success and/or sound business cases will be difficult to scale or extend.

# 5. SMART CITIES AND EUROPE 2020

**KEY FINDINGS**

- **The objectives of the Smart City initiatives are generally aligned with those of city innovation and development strategies and the overarching Europe 2020 targets.** This is not surprising; the problems are widely recognised and agenda-setting at both city and European level consciously strives for openness and wide participation.
- **The characteristics of Smart City initiatives also reflect the actual situation of the city or country.** This alignment can take three forms, corresponding to three different motives for pursuing Smart City strategies.
- **Inclusion of characteristics recognised as Smart City hallmarks (e.g. environment and innovative use of ICTs) may be motivated by a desire to attract businesses to the city or to participate in European-funded Smart City projects.**
- Inclusion of characteristics associated with areas where the city or country is particularly weak is appropriate where critical mass, economies of scale and scope, and the Smart City political halo effect can be used to tackle collectively issues that have (as shown by weak performance) resisted solution through 'normal' channels.
- Inclusion of characteristics that correspond to areas of particular local strength (e.g. environmental characteristics among Smart Cities in Nordic Member States) provides a fruitful platform for Smart City coalition-building. The 'cost of failure' is modest and the risk of failure reduced by starting from solid and effective technologies and working arrangements. Such initiatives stimulate knowledge-sharing with other domains – a city with strengths in one area might develop them as a 'Smart City solution' to exchange with another city whose strengths match the problems faced by the first city.
- **The match among different objective levels (Europe 2020, Smart City strategies and specific Smart City initiatives) is only approximate, indicating that Europe 2020 serves to stimulate and harmonise local action, but that other factors give each Smart City a unique flavour.** These include the severity of different local problems; the strategic drive behind the inclusion of different characteristics discussed above; variations in city and project size; the specific strengths, weaknesses and motivations of local stakeholders; and cultural norms favouring or inhibiting effective partnerships among government, business and civil society stakeholders.
- There appears to be a clear difference among cities that: pursue a mix of characteristics through many holistic initiatives; use a differentiated portfolio of specialised initiatives; support only a few holistic (multi-objective) initiatives; and implement a small number of initiatives tightly focused on the most salient characteristics.
- This suggests that Smart City initiatives are viewed both as instrumental means of tackling specific problems and as a way to build a community of interest or overarching awareness of the potential of such joint initiatives to provide a platform for continued progress that adapts to changing circumstances.
- **Most initiatives aim to contribute towards smart, sustainable and inclusive growth. Environmental issues and green solutions appear to be the principal concern; nearly 50% of sampled initiatives address environmental problems**

**through improved energy efficiency in buildings or smarter city transportation options.**

In this section we come to the quantitative analysis of our sample of 20 cities; the structure of the analysis of this chapter is shown in Figure 14. We begin with an assessment of the prevalence of Smart City characteristics in a given initiative and a given city. This is used to highlight which cities have a greater level of activity in the areas targeted by their Smart City initiatives and the ambitiousness of a city's initiatives. This information is then used to rank the cities according to two scores based on:

- how far the portfolio of initiatives in the city is from an ideal set covering all characteristics
- whether every one of the characteristics is represented in at least one of the selected initiatives.

The scores are then reassessed according to the relevance of a particular characteristic for a given city to the Europe 2020 targets (Table 10). In order to calculate the relevance of a characteristic, we developed a performance-weighted score based on the difference between the country-specific Europe 2020 targets and the country's actual performance. The significance of a characteristic for a given city can therefore be reassessed based on the city's relative position in relation to achieving its Europe 2020 targets. The cities are then ranked according to this performance-weighted score and the rankings for all three scores are compared. Finally, the characteristics are correlated against each of the scorings to assess whether there are general trends in whether characteristics are used effectively.

**Figure 14: The structure of the analysis in Chapter 5**

## 5.1. Europe 2020

Europe 2020 is the EU's strategy for boosting growth and jobs across the region in order to create a smart, sustainable and inclusive economy.[110] To further these aims, key targets within five areas have been set on at national and EU-wide levels to be achieved by the 2020, including employment, R&D, climate change and energy, education, and poverty and social exclusion. The European level targets are listed in Table 10.

**Table 10: Europe 2020 targets for the EU as a whole[111]**

| Focus area | Targets |
|---|---|
| Employment | 75% of 20–64 year olds to be employed |
| R&D and innovation | 3% of the EU's GDP (public and private combined) to be invested in R&D or innovation |
| Climate change and energy | Greenhouse gas emissions to be 20% (or even 30%, if the conditions are right) lower than 1990<br>20% of energy from renewables<br>20% increase in energy efficiency |
| Education | Reduce school drop-out rates below 10%<br>At least 40% of 30–34 year olds have completed third level education |
| Poverty and social exclusion | At least 20 million less people in or at risk of poverty and social exclusion |

**Smart City initiatives can be considered a useful vehicle for cities to achieve their Europe 2020 targets.** Cities are conurbations that house a significant number of people, often in densely populated areas. Therefore, cities as Smart entities may be particularly well suited to initiatives addressing local public goods problems, such as energy and climate change. Moreover, the impacts may be highly visible, especially compared with less densely populated areas. The density and diversity of inhabitants (population and business alike) facilitates mutual recognition of problems, mobilisation of critical mass, and efficient reallocation and monitoring of roles and responsibilities. **These are some potential uses and characteristics of Smart City initiatives:**

- The Europe 2020 energy target could be addressed through initiatives that focus on Smart Environment or Smart Mobility.
- Smart Economy and Smart People initiatives are oriented towards employment and education targets, which include e-skills development.[112] Moreover, improving citizens' skills should make them more employable which in turn supports the Europe 2020 employment targets.
- Smart Governance and Smart Living initiatives address poverty and social exclusion through measures including improvements to the quality of life, a focus on citizen connectivity (including e-government services) and the use of open data to create citizen services.

[110] http://ec.europa.eu/europe2020/index_en.htm.
[111] European Commission (2013).
[112] This equips citizens with the skills needed to utilise available technologies and therefore to make the most of services delivered by means of those technologies; in turn, governments can concentrate on the use of the best available channels without depriving citizens of the services that they need and to which they are entitled.

- The majority of Smart City initiatives have the potential to support innovative growth and R&D. They are funded by a variety of sources, including government and private companies, which share a common interest in progress in this area. To contribute to the innovation and R&D target by further stimulating private sector R&D investment, it is essential that projects are evaluated and lessons learnt from them to enable further development.

In reality, a Smart City initiative aims to make improvements in relation to a number of the Europe 2020 targets. For instance, a project that enhances mobility may make it easier for individuals to travel to the most appropriate school or job (thus contributing to the employment and education targets). This, in turn, can help alleviate location-based problems of poverty and social exclusion, although the impacts are likely to be less than the primary contribution to the energy and environment targets. Table 11 provides a more nuanced view of the strength of contributions of Smart City characteristics (defined in Section 2.3) to the objectives of Europe 2020.

**Table 11: The alignment of Smart City characteristics with Europe 2020 targets**

| Characte-ristics or targets | Employ-ment | R&D or GDP | $CO_2$ | Renew-ables | Energy consumption | Early leaving | Terti-aryed. | Poverty risk |
|---|---|---|---|---|---|---|---|---|
| **ECO** | 20.8% | 20.8% | 8.3% | 4.2% | 8.3% | 8.3% | 12.5% | 16.7% |
| **ENV** | 4.8% | 4.8% | 23.8% | 23.8% | 23.8% | 4.8% | 4.8% | 9.5% |
| **GOV** | 17.6% | 11.8% | 5.9% | 5.9% | 5.9% | 17.6% | 17.6% | 17.6% |
| **LIV** | 16.7% | 5.6% | 5.6% | 5.6% | 5.6% | 16.7% | 16.7% | 27.8% |
| **PEO** | 16.7% | 5.6% | 5.6% | 5.6% | 5.6% | 16.7% | 16.7% | 27.8% |
| **MOB** | 10.0% | 10.0% | 20.0% | 20.0% | 20.0% | 5.0% | 5.0% | 10.0% |

The values used reflect the stated objectives and details of the initiatives and the recognition that Smart City initiatives, and the Smart Cities with which they are associated, contribute to the Europe 2020 targets in different ways:

- directly, by improving the target-specific performance of that city, and thus its country
- indirectly, by demonstration and knowledge transfer to other cities and areas in that country, and to other cities and areas in other EU countries
- collectively, by creating a 'Smart City' critical mass or community of interest capable of further development, exploiting initiatives in broad deployment and realigning business, government and civil society along 'Smart' lines.

The calibration of initiatives and cities to the severity of the challenges they face is critical. The underlying assumption is that the importance of a characteristic comes from the salience of the Europe 2020 performance areas to which it is linked.

### 5.1.1. What is the EU's role in Smart Cities?

As illustrated in Chapter 4, many Smart City initiatives, especially those that span multiple countries, are funded by the EU. This funding occurs predominantly through the *CIP* and PPPs.

The European Commission (EC) defines its approach to Smart Cities as 'coordinated';[113] various parts of the EC are collectively and independently involved in supporting Smart Cities at international and national levels. For example, the Directorate-General for Communications Networks, Content and Technology (DG CONNECT)[114] has funded Smart City projects through *7th Framework Programme (FP7)* projects and the *ICT-Policy Support Programme (PSP)*[115] which is part of CIP; it has also worked together with the Directorate-General for Research & Innovation (DG RTD)[116] and the Directorate-General for Energy (DG ENER)[117] on cross-cutting PPPs including the *European Green Cars Initiative*[118] and the *Energy-Efficient Buildings Programme*.[119] The EC has provided policy support through particular policies of the Directorate-General for Mobility and Transport (DG MOVE)[120] and via several communications that specifically refer to the role of Smart Cities.[121]

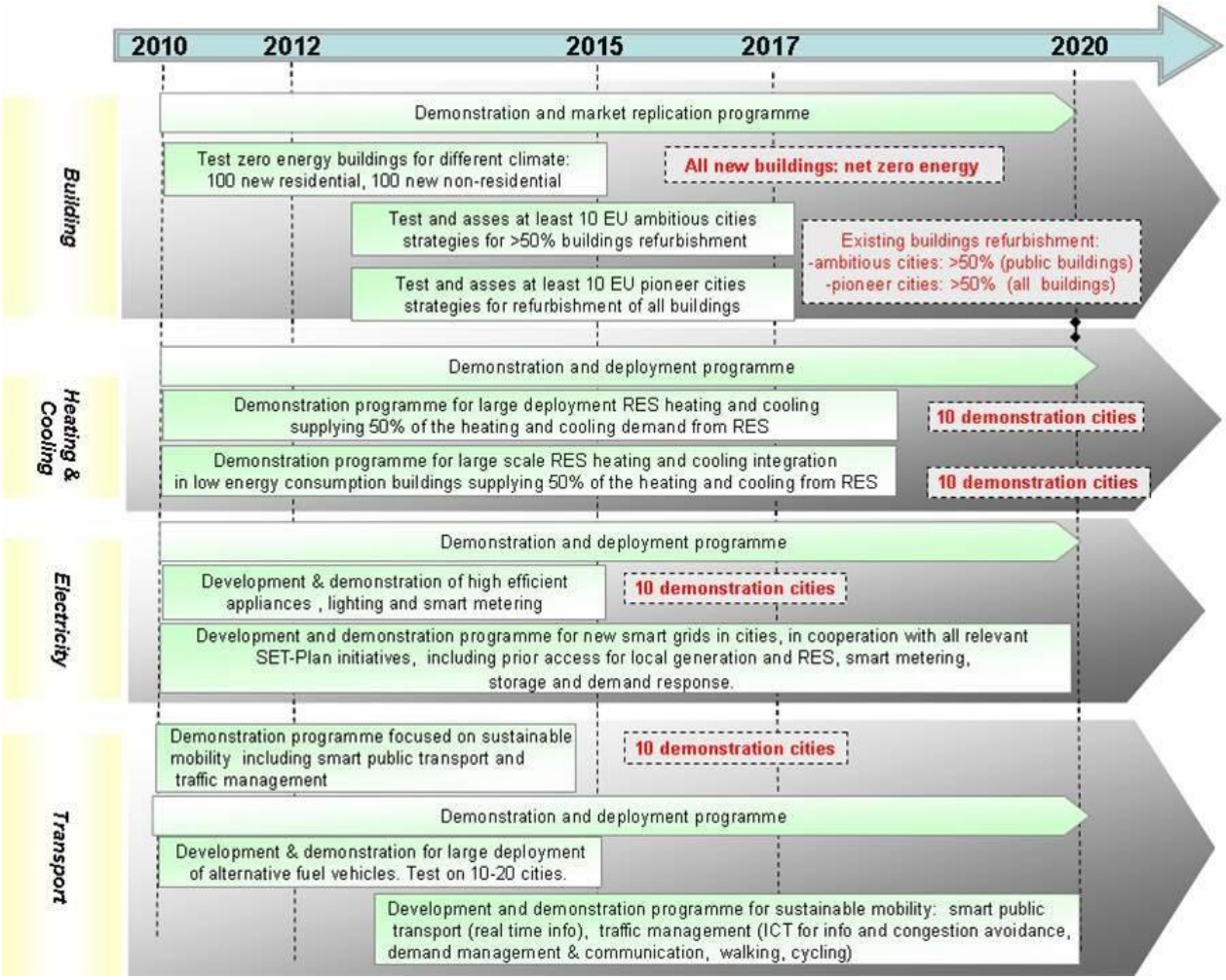
This indicates the connected nature of these initiatives not just in improving conditions within their own area, but also in showcasing best practice which others could learn from and improve upon.

Figure 15 shows **the 'technology roadmap', drawn up by the EC for the European Initiatives on Smart Cities[122]. The focus of this roadmap is on buildings, heating and cooling, electricity and transport. In general, it concerns technologies that aim to improve the environment and therefore does not include all aspects of the Europe 2020 targets.** However it usefully illustrates the potential for Smart City initiatives to contribute toward some of the objectives of Europe 2020.

The focus on the environment can be linked to the roadmap's status as a global public 'bad'[123] that affects all citizens and countries and to its prominence on national and international policy agendas. It must therefore be addressed simultaneously at all levels; it cannot be resolved unless local actors have support and reinforcement from national and European levels. It also lies squarely within European Community competence. It is, therefore, not surprising that environmental issues play a prominent role in Community support for Smart City initiatives.

113 http://ec.europa.eu/dgs/connect/en/content/smart-cities
114 http://ec.europa.eu/dgs/connect/en/content/smart-cities
115 http://ec.europa.eu/information_society/activities/ict_psp/index_en.htm
116 http://ec.europa.eu/research/index.cfm?pg=dg
117 http://ec.europa.eu/dgs/energy/index_en.htm
118 http://www.green-cars-initiative.eu/public/.
119 European Commission (2012a).
120 http://ec.europa.eu/transport/index_en.htm
121 For example, the October 2009 Science, Engineering and Technology Plan financing communication discussing low carbon vehicles stated that the overarching EC Smart City initiative has:"the objective to create the conditions to trigger the mass market take-up of energy efficiency technologies […]. By 2020, the Smart Cities initiative should put 25 to 30 European cities at the forefront of the transition to a low carbon future. These cities will be the nuclei from which smart networks, a new generation of buildings and low carbon transport solutions will develop into European wide realities that will transform our energy system."
122 It is important to note that the Smart Cities and Communities European Innovation Partnership is not a single initiative but part of a broader effort by the EC to foster a new approach to EU research and innovation. To date five European Innovation Partnerships have been launched. The other four are: Active & Healthy Ageing, Agricultural Sustainability & Productivity, and Water and Raw materials
123 See e.g. Kaul, Grunberg and Stern (1999).

**Figure 15: European initiative on the Smart Cities technology roadmap[124]**




## 5.1.2. Analysis of initiatives vis-à-vis Europe 2020 targets

As we have seen, the characteristics used to classify initiatives align with Europe 2020. In addition, some initiatives explicitly reference Europe 2020 targets or aims in setting their objectives. This allows us to identify three broad classes of initiative:

- those that reference the terminology of Europe 2020 targets, such as the 'IREEN'[125] initiative in Manchester (UK), which aims to increase the uptake of ICT for energy efficiency
- those that do not use the terminology of Europe 2020 but have objectives which, if met, will contribute to meeting the Europe 2020 targets; for example, the 'PEOPLE'[126] initiative in Bremen (Germany) aims to improve students' quality of life by facilitating digitally promoted social interactions and group activities, which contributes to the Europe 2020 target on tertiary education
- those that do not aim to or even indirectly address the targets of Europe 2020 , such as the 'Tallinn Smart card initiative'[127] (Estonia).

[124] Source:http://setis.ec.europa.eu/implementation/technology-roadmap/european-initiative-on-smart-cities
[125] ICT Roadmap of Energy Efficient Neighbourhoods - http://www.ireenproject.eu/
[126] http://www.people-project.eu/portal/index.php?option=com_content&view=article&id=79&Itemid=30
[127] http://www.kaardiekspert.ee/se/uudised/45-tallinn-public-transportation-rfid-card-e-system

The high prevalence of the Smart Environment characteristic across cities is mirrored at the initiative level. Over 50% (46) of the initiatives in our sample included the Smart Environment characteristic, spanning all the cities with the exception of Athens (Greece) and Tirgu Mures (Romania). However, this probably overstates the prevalence of this characteristic among *unique* initiatives. This is due to double-counting caused by the multi-city Networking Intelligent Cities for Energy Efficiency (NiCE)'[128] initiative that aims to decrease the direct carbon footprint of ICT by 30% per city, contributing to the Europe 2020 energy efficiency and $CO_2$ targets. Three-quarters (75% or 15) of the cities in our sample are part of the NiCE initiative. If we count NiCE as a single initiative, the prevalence of the Smart Environment characteristic drops to 43% (32 out of 74 unique initiatives). Moreover, some cities (e.g. Helsinki in Finland and Eindhoven in the Netherlands) only address environmental improvement via their local NiCE projects.

Table 12 shows the number of projects that, from the information available to us, directly or indirectly contribute to Europe 2020 targets.

**Table 12: The number of cities with initiatives directly or indirectly aligned with Europe 2020 targets**

| Europe 2020 targets | Number of cities |
|---|---|
| Employment | 4 |
| R&D | 2 |
| Energy and environment | 18 |
| Education | 1 |
| Poverty | 7 |

As noted above, the prevalence of environmental initiatives partially reflects the influence of the European initiative on Smart Cities technology roadmap (Figure 15). The detailed alignment of the initiatives with the technologies identified in the roadmap is shown in Table 13. Transport is the most prevalent area of technological focus.

**Table 13: The number of initiatives focusing on technologies identified in the Smart Cities technology roadmap**

| Initiative focus | Number of initiatives in our sample |
|---|---|
| Buildings | 5 |
| Heating and cooling | 4 |
| Electricity | 8 |
| Transport | 19 |

One-fifth of cities have initiatives that address employment and over one-third have initiatives that support the attainment of poverty reduction targets. While only two of the initiatives directly seek to advance R&D, if implemented correctly all Smart City initiatives have the capacity to encourage private sector R&D investment. Some cities have project portfolios that aim to contribute to the attainment of multiple Europe 2020 targets.

[128] http://www.greendigitalcharter.eu/

For example, in Malmo, Sweden, the NiCE Project aims to decrease the carbon footprint of cities (contributing to the energy and environmental targets); the 'Citadel Project'[129] provides public data access to stimulate reuse and app creation (contributing to the innovation and R&D targets, and possibly others addressed by the apps and data mash-ups); and the 'Peripheria Project'[130] gives citizens a voice through online apps (reducing social exclusion). Other cities give more uniform coverage to specific characteristics. For example, all of Copenhagen's initiatives (Denmark) that are detailed in the dashboard have a focus on energy. Some cities, such as Oulu (Finland) have Smart City initiatives which link to sustainability, but there is little alignment between their objectives and the wider objectives of Europe 2020. Indirectly, however, these contribute to meeting the Europe 2020 targets.[131] The proportion of coverage of the characteristics by the 20 Smart Cities covered in this report is shown in Annex 7.

### 5.1.3. The prevalence of Smart City characteristics and their contribution to success

As discussed in previous chapters, there is no single measure of the 'success' of a Smart City, nor a consistent basis to develop such a measure from concrete, measurable and comparable outcomes or impacts. Therefore, it is appropriate to analyse a city's success by the portfolio of initiatives it supports, the alignment of their characteristics with the Europe 2020 targets, and the appropriateness of those characteristics in light of the city's position vis-à-vis those targets. In this section, we consider the extent to which cities cover the Europe 2020 targets.

In addition, it is important to consider the individual initiatives within a city. These indicate whether those initiatives match the Europe 2020 targets, the number of initiatives the city pursues and the degree to which the city covers the characteristics by means of specialised or broadly based initiatives.

This leads us to identify two 'ideal' configurations:

- The 'characteristic score' measures how far the portfolio of initiatives is from an ideal set covering all characteristics. This does not distinguish one characteristic from another.
- The 'coverage score' measures whether every one of the characteristics is represented in least one of the selected initiatives.

These ideals should not be taken out of context. There is no implication that a city or initiative that deviates from the ideal will be unsuccessful or even that the ideal is appropriate in view of the specific mix of problems facing the city (this subject is addressed in Section 5.1.4). The ideals are therefore used in this instance to convey an optimum portfolio of initiatives in a given city.

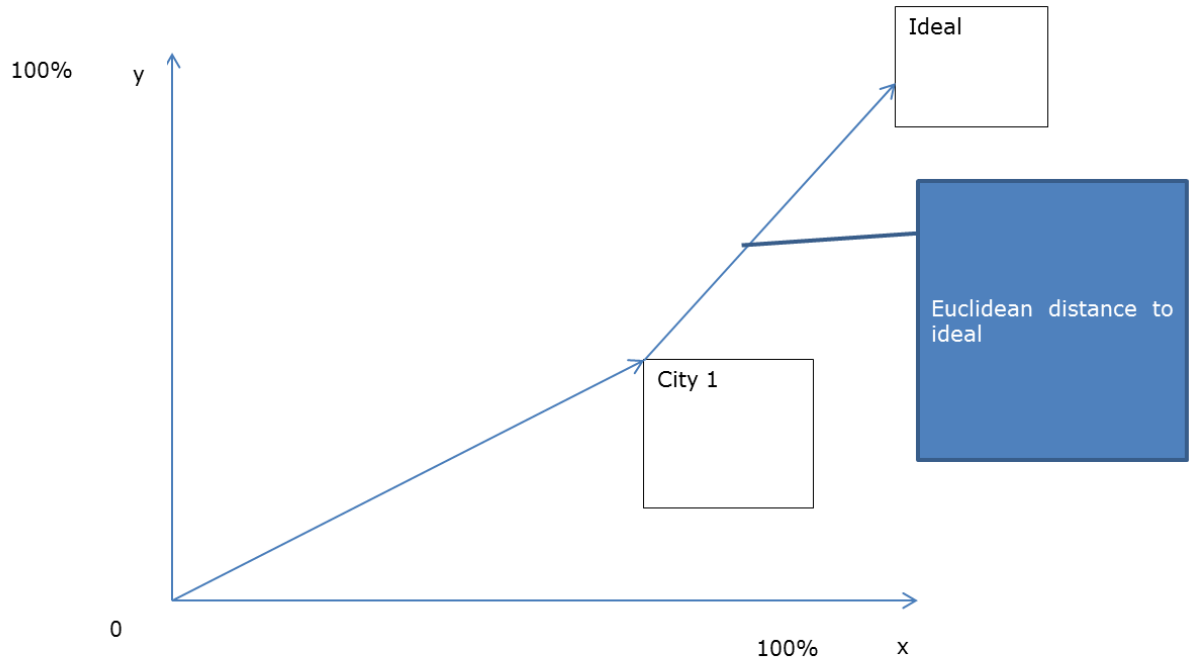
Table 6 lists the geographical distribution of Smart Cities in Europe by their characteristics. For the sample of cities examined in this chapter, the characteristic coverage score for each city, along with specific indicators of the 'depth' of coverage (the proportion of initiatives displaying each characteristic) are calculated in Annex 7 and summarised later in this chapter (Table 15). The characteristics are not weighted in the aggregate score.

[129] http://www.citadelonthemove.eu/
[130] http://peripheria.eu/
[131] For example, SMARTiP, OULLabs and Smart Urban Spaces initiatives focus on up-skilling the workforce, which as previously discussed could have an impact on employment rates.

A city displaying all characteristics of a Smart City is assigned a score of 100%. The portfolio of characteristics displayed in an initiative for a given city allows us to view the city as a vector of characteristics.

An appropriate way to assess the distance of such a vector from an ideal is the Euclidean distance used in regression and cluster analysis,[132] which is illustrated graphically in Figure 16.

**Figure 16: The Euclidean distance to ideal**




Formally, if $x_i$ is the actual depth of coverage of characteristic *i* and $y_i$ is the corresponding ideal or target value, the distance score is:

$$s\,(x, y) = 1 - \sum_i (x_i - y_i)^2$$

Annex 8 shows each characteristic's Euclidean distance from the ideal of full (100%) coverage, and the score based on the corresponding distance of the city as a whole from the ideal configuration (a score of 0 – i.e. 0 equals no distance from Ideal). These scores are then summarised in Table 15. This calculation allows us to see how far each city is from addressing each of the Smart City characteristics. For example for the Smart Environment characteristic, Copenhagen (Denmark) receives a score of 0 as every Smart City initiative in the city addresses Smart Environment, therefore it matches the ideal. Tirgu Mures (Romania) receives a score of 100 as none of their initiatives cover Smart Environment and therefore it is the greatest distance possible from the ideal. Figure 17 compares the number of initiatives in each city to the 'breadth' of the initiatives (the average number of characteristics addressed per initiative). It suggests a clustering of cities into four separate groups (Table 14)[133].

[132] StatSoft (n.d.).
[133] Our sample of 20 cities saying: chosen to be representative of the sampling criteria used in earlier chapters whilst reducing the sample size for analysis purposes. More information is provided in Section 1.2

**Figure 17: Cluster analysis of Smart City initiatives and the number of characteristics per initiative**

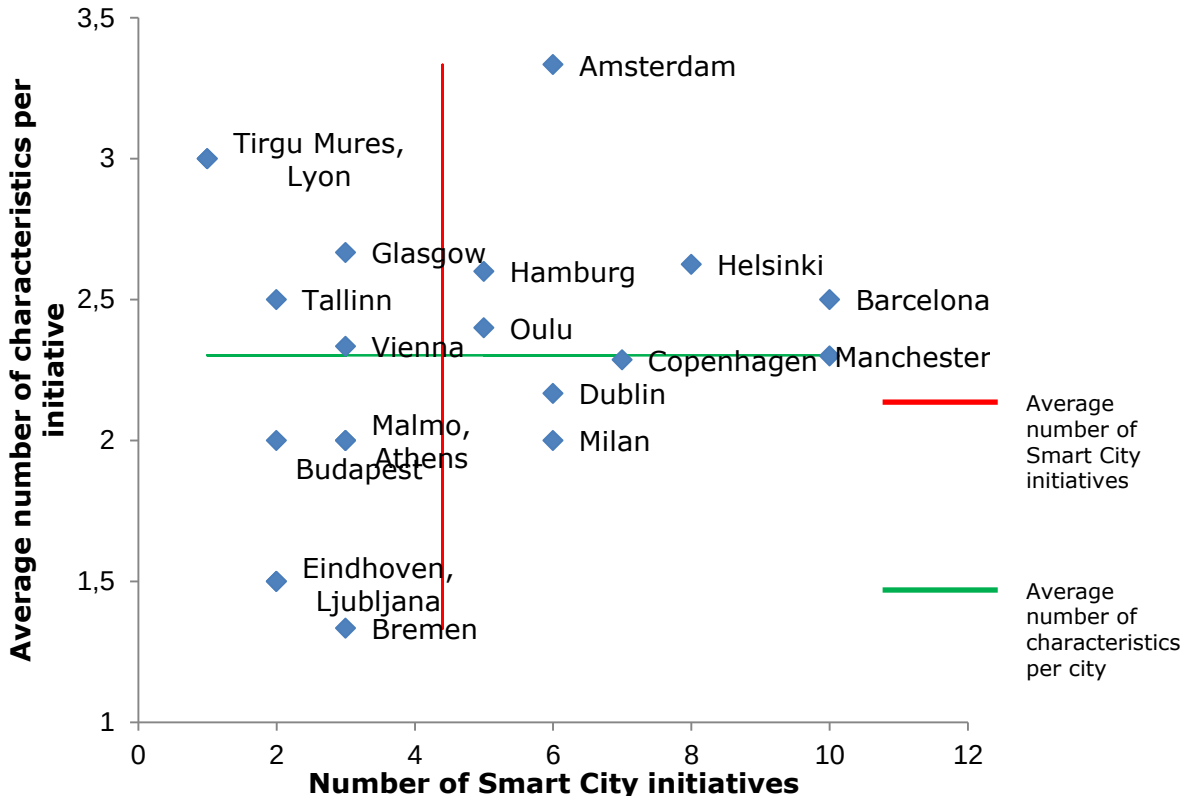



**Table 14: Clusters of Smart Cities defined by the number of initiatives and variety of characteristics displayed**

| Group | Number of initiatives | Variety of characteristics | Cities |
|---|---|---|---|
| 1 | High | Great | Amsterdam, Helsinki, Barcelona, Hamburg, Oulu |
| 2 | High | Few | Copenhagen, Manchester, Dublin, Milan |
| 3 | Low | Great | Glasgow, Vienna, Tallinn, Tirgu Mures, Lyon |
| 4 | Low | Few | Malmo, Athens, Budapest, Eindhoven, Ljubljana, Bremen |

In this sample of cities, there is roughly equal representation across each of the four groups. Cities in three groups can contribute to our understanding of the variety of Smart Cities in Europe and may offer potential implementation solutions. (The exception is Group 4, comprising cities with low levels of initiatives and a limited breadth of initiatives).

Although cities that pursue many broad-based initiatives stand out as the most developed or established Smart Cities, lessons can be learnt from cities with more targeted initiatives (Group 2), especially in cities that face particular problems. Cities with a small number of broadly based Smart City initiatives (Group 3) may provide interesting lessons in the use of Smart City initiatives to create a broadly based community of interest. Moreover, the smaller or more focused cities may provide examples of Smart City strategies in municipalities with limited resources. Chapter 6 analyses cities from each of these three groups for instances of good practice across a range of routes towards Smart City status.

### 5.1.4. Weighted characteristics

Figure 17 is based on the assumption that each characteristic – and by implication each Europe 2020 target – has the same significance for each city. This is obviously unrealistic, so it is appropriate to repeat the above analysis using a weighting scheme to indicate the likely importance or salience of given targets to different cities.

To obtain a weighted distance metric, there are two parts of the computation: first we obtained characteristic-based scores, then we linked them to the Europe 2020 targets and to the associated dimensions of performance for the city.[134]

The initiatives considered in this study form a subset of those in the cities, and the cities themselves are a subset of the full population of Smart Cities, selected on the basis of a specific definition of success.

The alignment (connection) between the main Europe 2020 targets and the characteristics is shown in Table 11.

For the purpose of the analysis, it is assumed that the performance of the city is related to the performance of the country in which it is located. This is because the Europe 2020 national targets are defined at country level; data showing actual performance are typically only available at country level and it is assumed that the spill-over and demonstration effects of a smart initiative are strongest in the country where the city is located:

- If a city is located in a country that is far away from a given target, the inclusion of characteristics that contribute to performance against that target is more important (at least to the country's direct contribution to the Europe 2020 targets) than inclusion of characteristics that are not strongly linked to that target.
- If a city is located in a country that is already close to attaining its version of a given target, including characteristics tied to that target has less direct importance, and receives lower weight.

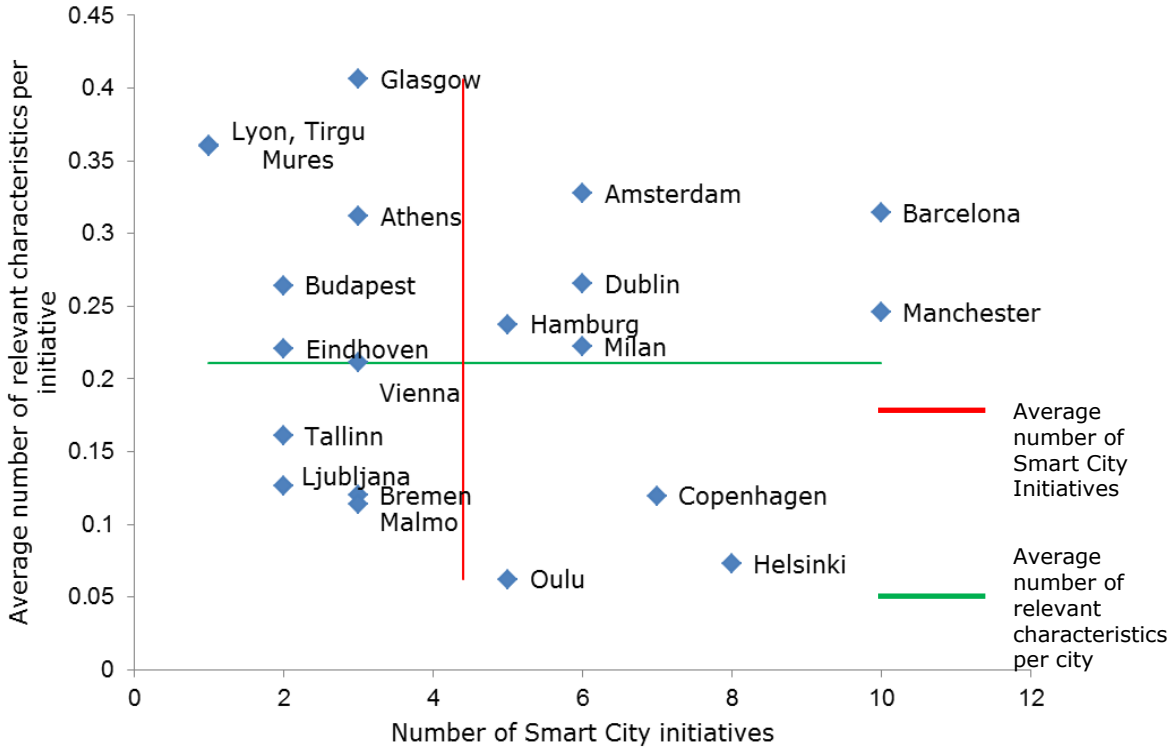
The procedure in outline is as follows:

- Data are collected on the country's performance (and EU-28 averages135) and on the associated Europe 2020 targets at national and EU level and converted to comparable and appropriate units (as described in Annex 1).
- The distance of the country from a relevant comparator is computed (in this report, we use the percentage difference between actual performance and the corresponding national target where available and relevant).
- The alignments given in Table 11 are used to compute performance-weighted multipliers for each of the characteristics.
- The performance-weighted score is computed using these multipliers to weight coverage of each characteristic.

These weights are used to compute the 'performance-weighted' scores and ranks (Figure 18).

[134] A detailed mathematical description of the computation is given in Annex 1.
[135] The data used are from the dashboards, which used multiple sources (see Annex 10).

**Figure 18: Weighted average cluster analysis of Smart City initiatives and the number of characteristics per initiative**




When performance is weighted in this way, only eight cities move groups from their unweighted positions. Cities such as Athens, Dublin, Budapest and Milan move up as they are in countries which are further from achieving their Europe 2020 targets. Their uses of initiatives that address these issues, therefore, compares favourably to those of countries that are closer to meeting their targets. Conversely, the Nordic Member State cities of Helsinki, Oulu and Copenhagen are the only ones to drop relative to their unweighted positions. This perhaps reflects the **Nordic Member States' relatively strong position in respect to Europe 2020 targets, and the possible perceived importance of a demonstration effect based on the availability of good practice or the importance of building a community of interest based on low-hanging fruit**. Unfortunately, available data do not allow us to distinguish these alternative explanations. The performance-weighted characteristic scores[136] can also be used to rank the cities.

Table 15 summarises the scores and ranks for the three methods of comparing cities.

[136] Annex 1 describes a range of alternative specifications. In the current analysis the performance-weighted score is based on the percentage difference between country actual performance and country specific Europe 2020 targets. Environmental and energy data were analysed per capita, and over-performance (cities in countries that had already passed their Europe 2020 targets) was not analysed (this option is included in the formal model).

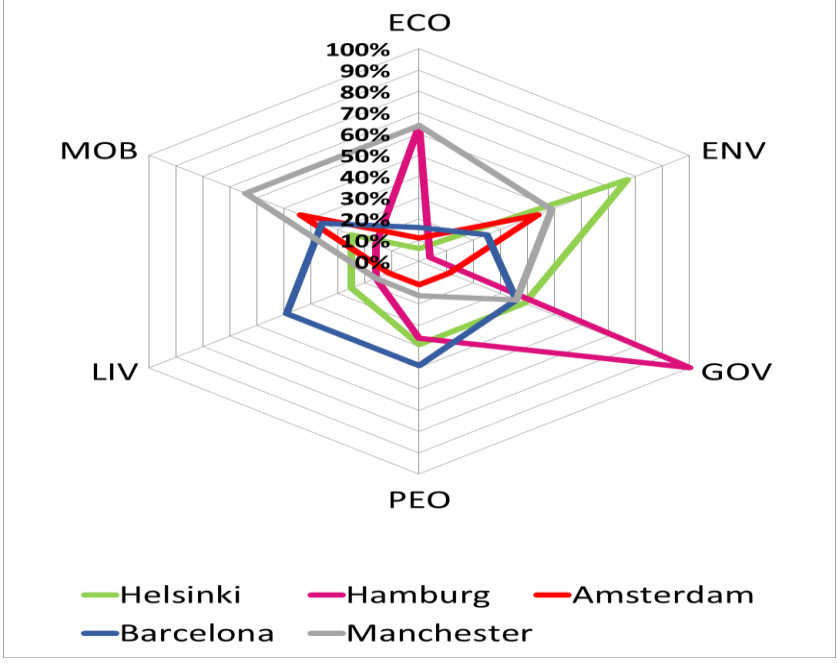
**Table 15: Scores and rankings for coverage, unweighted characteristics and performance-weighted characteristics of Smart Cities**

| City | Europe 2020 characteristic score | Europe 2020 coverage score | Performance-weighted score | Europe 2020 characteristic rank | Europe 2020 coverage rank | Performance-weighted rank |
|---|---|---|---|---|---|---|
| Helsinki | 71% | 100% | 36% | 5 | 1 | 7 |
| Oulu | 68% | 88% | 34% | 7 | 7 | 9 |
| Copenhagen | 64% | 100% | 41% | 9 | 1 | 4 |
| Lyon | 63% | 88% | 33% | 10 | 7 | 10 |
| Hamburg | 71% | 88% | 41% | 4 | 7 | 2 |
| Malmo | 57% | 75% | 20% | 13 | 11 | 16 |
| Amsterdam | 83% | 100% | 51% | 1 | 1 | 1 |
| Barcelona | 74% | 100% | 41% | 2 | 1 | 3 |
| Tallinn | 56% | 63% | 21% | 14 | 14 | 15 |
| Dublin | 73% | 100% | 40% | 3 | 1 | 5 |
| Glasgow | 67% | 75% | 37% | 8 | 11 | 6 |
| Bremen | 53% | 75% | 23% | 18 | 11 | 14 |
| Milan | 62% | 88% | 30% | 12 | 7 | 11 |
| Eindhoven | 53% | 63% | 24% | 16 | 14 | 13 |
| Manchester | 69% | 100% | 34% | 6 | 1 | 8 |
| Tirgu Mures | 63% | 63% | 30% | 10 | 14 | 12 |
| Vienna | 52% | 63% | 20% | 19 | 14 | 19 |
| Budapest | 50% | 63% | 20% | 20 | 14 | 18 |
| Athens | 56% | 63% | N/A[137] | 15 | 14 | 20 |
| Ljubljana | 53% | 25% | 20% | 17 | 20 | 17 |

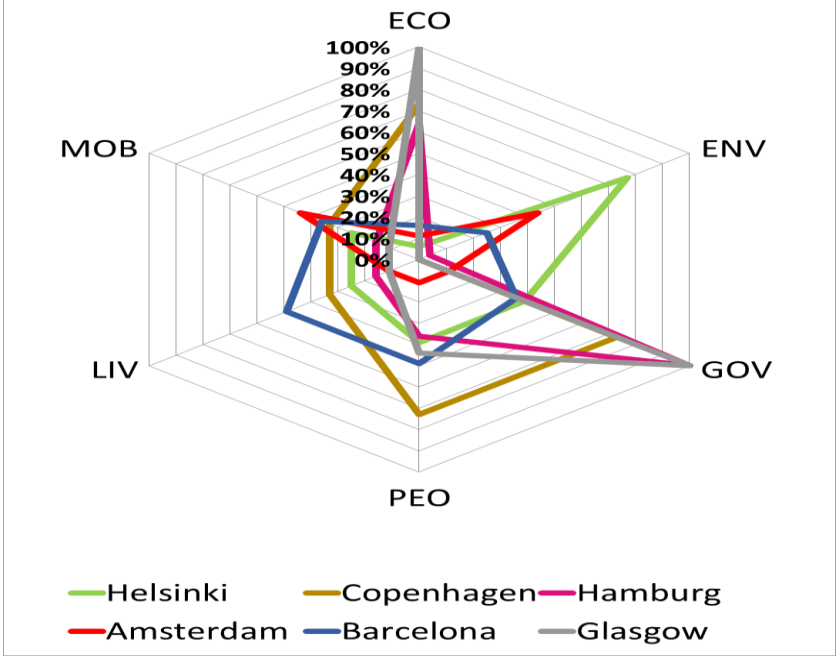
The ranking by each of the measures (coverage, characteristic and performance-weighted rank) given in Table 15shows that while Copenhagen (Denmark), Manchester (UK), Barcelona (Spain), Amsterdam (the Netherlands) and Dublin (Ireland) all cover each of the characteristics, the balance is very uneven. For example, Copenhagen strongly emphasises environmental characteristics, but has much less depth in economic, governance and people characteristics. Amsterdam ranks highest in all three scorings as not only are the range of characteristics in each of the initiatives high; they are also relevant to the city's Europe 2020 targets. The variation of the top-ranked cities is sensitive to the way the ranking is carried out: the radar plots in Figure 19 shows the scores for the six Smart City characteristics for each of the cities that are top-ranked by characteristics and by performance-weighted scores.

[137] Because of lack of data on R&D – ignoring the fact that the R&D target gives a performance-weighted score of 23% and raises the performance-weighted ranking from 20th to 16th place.

**Figure 19: The differential emphasis on Smart City characteristics among the top five ranking cities**




Top-ranked by characteristics

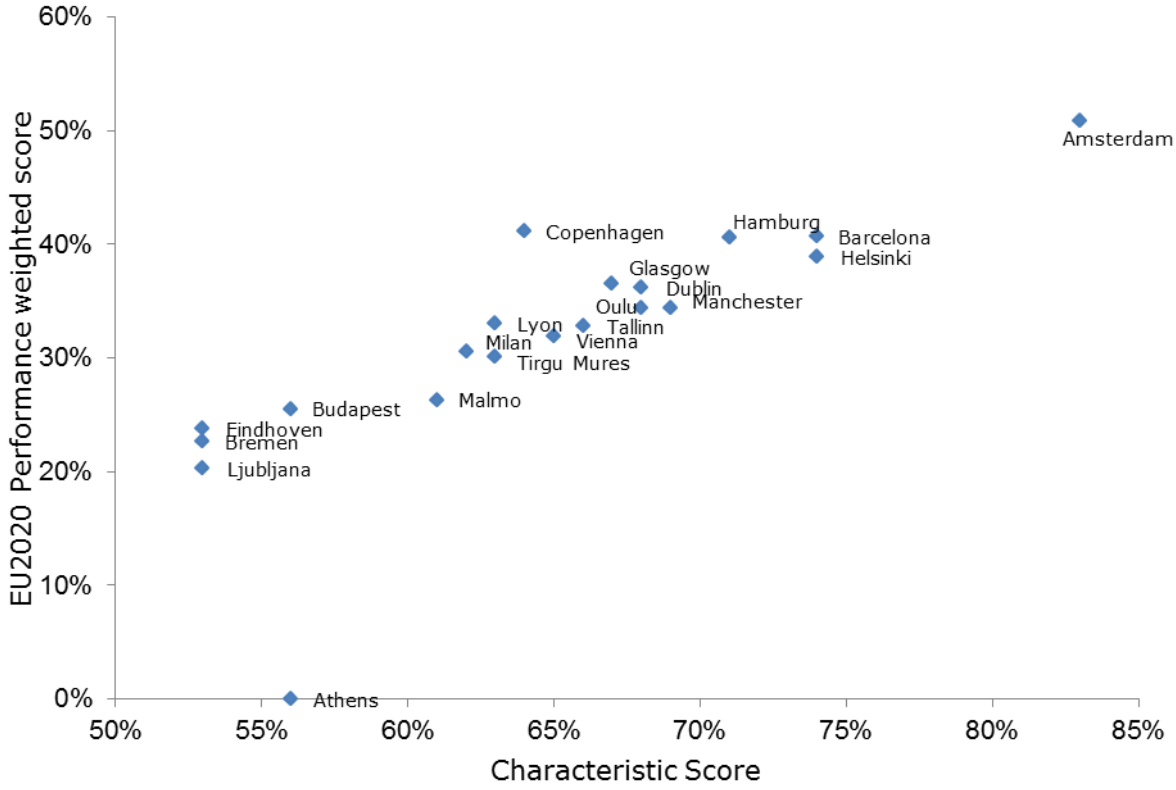



Top-ranked by performance

The top-ranked cities by characteristic score tend to be more tightly clustered around the origin than the top coverage cities (not shown). This is, in particular, a result of the inclusion of Hamburg (Germany) – with its heavy emphasis on governance and people to the relative exclusion of other characteristics – and the exclusion of Copenhagen (Denmark), where the same emphasis is typically accompanied by the economic characteristic. The performance-related ranking tends to elevate cities that include a narrow set of characteristics in the majority of their initiatives, especially economy, people and governance.

Figure 20 shows the relationship between performance-weighted and characteristic scores for the Smart Cities in our study. It illustrates the close alignment between the two ways of measuring performance, indicating that cities at the upper end of the characteristic score (having a broad-based and relatively even approach) nonetheless tended to emphasise characteristics closely related to areas where they see the most need for improvement, and where, in consequence, critical mass may be easier to achieve. Cities with lower scores in the characteristic measure are those tending to take a more selective approach. The relatively low performance-weighted scores may indicate that they are doing relatively well compared with their targets or that they tend to structure Smart City initiatives around low-hanging fruit, where substantial progress may already have been made.

**Figure 20: The correlation between performance-related and characteristic scores for the Smart Cities in this study**




Annex 9 considers the relationship between the characteristics and the three scoring methods, by calculating the correlations between the distance from ideal coverage of the characteristics and the correlations among the three scores.

# 6. SMART CITY SOLUTIONS AND GOOD PRACTICES

**KEY FINDINGS**

- **Crucial success factors for successful Smart Cities and the deployment of solutions are a clear vision, the involvement of citizens, representatives and local businesses as well as efficient processes.**
- The deployment **of certain ICT-powered Smart City solutions is generating significant if not massive impacts.**
- Not every solution which can be identified in the context of a Smart City programme contributes to the EU 2020 targets and not every solution contributing to EU 2020 targets is based on ICT. Therefore solutions meeting both criteria are rather rare.
- Many solutions are not yet deployed and are still in the phase of planning or piloting.
- For an economic assessment of Smart City solutions, it is important to take into account the local context. **Comprehensive cost-benefit analyses on the solution level are currently not available. Nevertheless the feasibility of the analysed solutions is possible in the short to middle term and the net value is positive.**
- There are eight generic solutions in the domains of transport and mobility, building technologies and smart governance. It is noticeable that most of the solutions belong to the domains of transport and mobility as well as smart governance.

## 6.1. Smart City solutions contribution to Europe 2020 targets

The main objective of this chapter is to identify Smart City solutions and good practices that are scalable and applicable in a wide range of city contexts, with real potential to make a significant combined contribution to the Europe 2020 targets. The approach involves case studies of a selected number of successful Smart City programmes. The cities were identified using a scorecard approach, which was applied to the cities and characteristics identified in the previous chapters.

## 6.2. Case study analysis

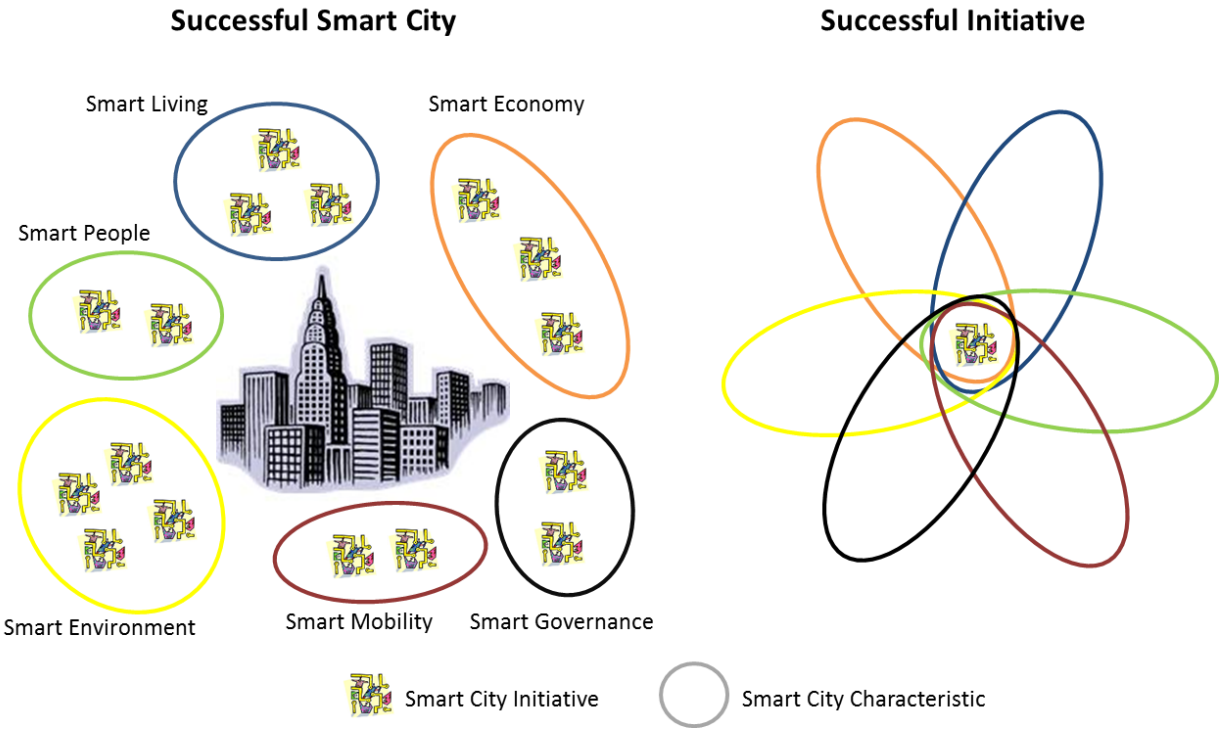
### 6.2.1. Identifying successful Smart Cities

In measuring the contribution of different characteristics to the success of Smart City initiatives, two criteria are considered:

- A successful Smart City has a range of initiatives that cover all of the characteristics (successful city).
- A successful Smart City initiative covers all of the characteristics (successful initiative).

Figure 21 shows diagrams of a successful Smart City and a successful initiative.

**Figure 21: Diagrams of a successful Smart City and a successful initiative**




We used our cluster analysis to divide the cities into four groups. Table 16 lists the groups and selected cities that fall into each of them. For the selection of case studies, we assume that cities that will yield the most innovative Smart City solutions are those in which the largest number of initiatives is present in combination with a high variety of Smart City characteristics. We therefore select three cities from Group 1. However, to ensure a good coverage and to learn from cities that are not yet that ambitious, we also select case studies from Group 2 (two cities) and from Group 3 (one city). Cities in Group 4 are not selected as the project deemed them not mature enough or too limited in scope and application.

**Table 16: Characteristics of the four groups of Smart City based on the cluster analysis, with examples of cities in each of them**

| Group | Selected cities |
|---|---|
| Group 1<br>Cities with a large number of initiatives, each covering a variety of characteristics | Amsterdam<br>Helsinki<br>Barcelona |
| Group 2<br>Cities with a large number of initiatives, each only focusing on a few characteristics | Copenhagen<br>Manchester |
| Group 3<br>Cities with a few number of initiatives, each covering a variety of characteristics | Vienna |
| Group 4<br>Cities with a few number of initiatives, each only focusing on a few characteristics | Not selected |

### 6.2.2. Approach

We used a case study approach, which involves defining specific success factors (vision, people, process as described in Section 6.2.3) to allow an objective and consistent evaluation of the success of Smart City programmes and projects. At the *city level* we considered the enabling environment and how it has been conducive to the realisation of innovative and productive Smart City solutions. At the *project or initiative level* we described and analysed city-specific solutions, by evaluating the factors that contributed to successful deployment. Finally, the costs and benefits of the specific solutions are expected impacts (benefits) and resources invested (costs), and these should be considered.

Prospective solutions must meet at least the following four criteria. They should:

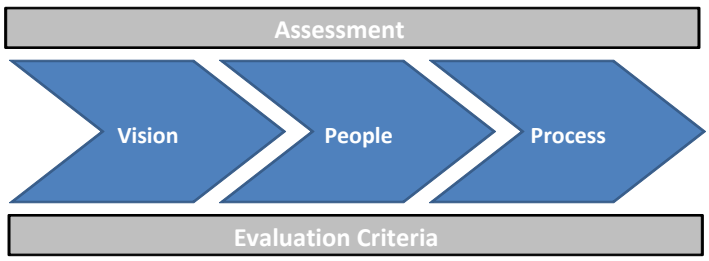
- be 'smart' (there should be a significant role for ICT enablers)
- contribute effectively to the achievement of the Europe 2020 targets
- be innovative
- offer sufficient information to assess its success.

Data availability on the city level and on the solutions level differ. In many cases the city level is documented more comprehensively than the individual projects. The collection of data is a result of desk research and the analysis of primary and secondary data.

### 6.2.3. Definition of success factors

A city becomes Smart by introducing new technologies and applications that improve the well-being of citizens and contribute to a cleaner environment. Therefore, a Smart City consists of projects and concrete actions that transform the city in this regard. **However, a Smart City is more than the sum of its projects. Rather, it needs a fertile environment guided by a clear vision, the participation of relevant actors (people), and the efficient and effective organisation of its processes**.[138] In the following section we consider why a Smart City is successful and what factors contribute to its success (Figure 22). Therefore we focus on projects and business models (solutions) that are carried out in a specific local Smart City context. In contrast, the assessment of the component or initiative level in Chapter 5 intends to identify success and to describe the Smart City as a whole.

**Figure 22: Success factors of Smart Cities**




[138] See van Beurden (2011); Achaerandio et al. (2012); The Climate Group (2013).

### Vision

**The need and desire to transform the city into a place with a better quality of life is common to all Smart City initiatives.** However, it is up to each city to define what that means in particular. What are the overall aims of the initiative and what is the grand idea to achieve specific targets? In many cases, the consideration of the initiation phase provides a deeper understanding of the vision of a Smart City.[139]

The vision establishes the connection between the Smart City components and its guiding principle. Setting high level principles at city and solution level is important for success because this ensures that measureable targets can be set.

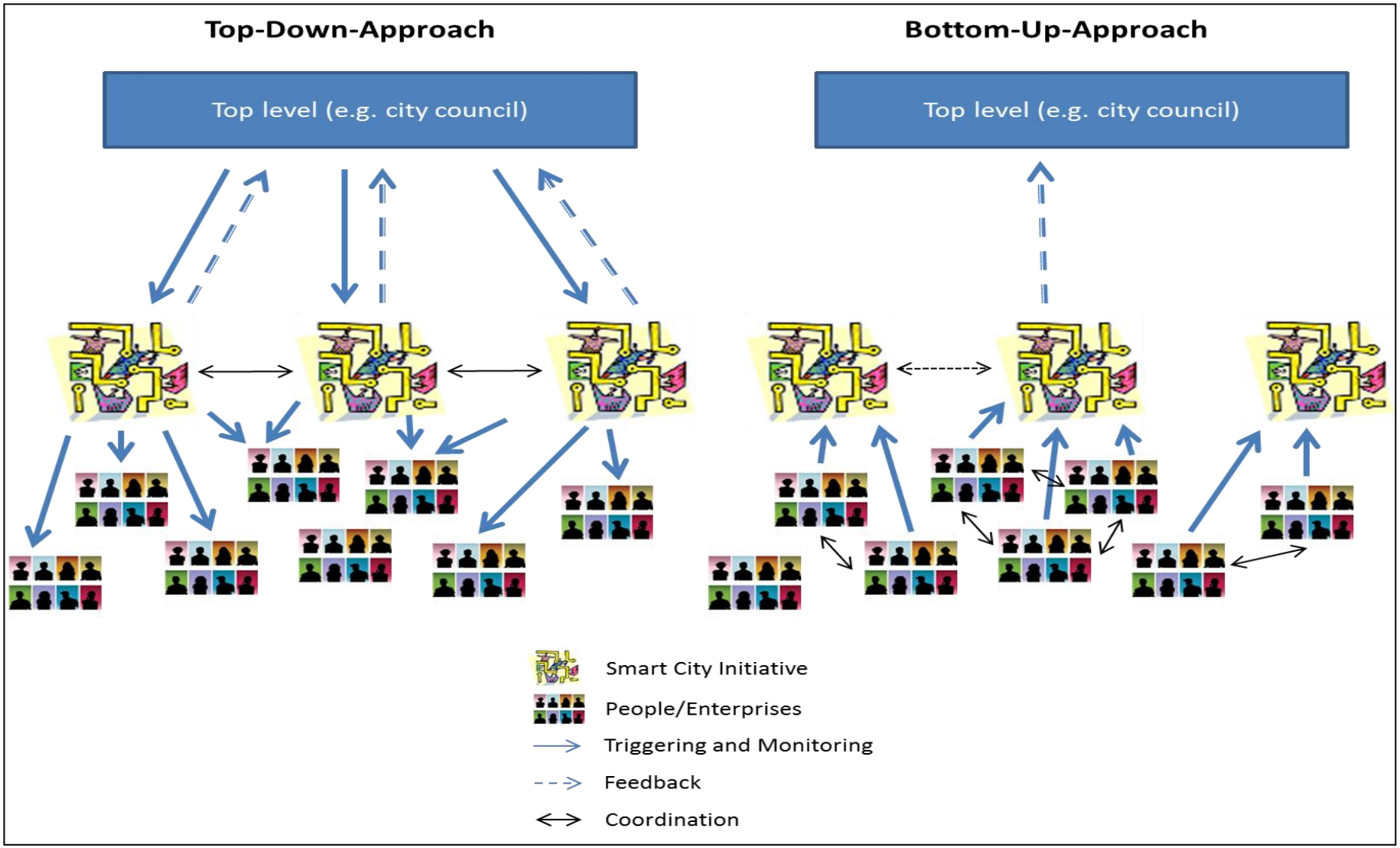
### People

**A Smart City consists of not only components but also people. Securing the participation of citizens and relevant stakeholders in the Smart City is therefore another success factor.** There is a difference if the participation follows a top-down or a bottom-up approach. A top-down approach promotes a high degree of coordination, whereas a bottom-up approach allows more opportunity for people to participate directly. The attempt to involve relevant stakeholders ensure that all people who are affected by or interested in a certain issue have the potential to influence processes and decisions on this issue, or at least have access to relevant information. This might be organised by access to a central data hub as well as by the construction of a knowledge management system which allows a cross-linking of knowledge of sectoral developments.

Identifying the right stakeholders is challenging because of the breadth of different constituencies that may be interested. These include individuals, communities and communities of interest, formal organisations such as businesses and public organisations, and hard to reach groups such as the marginalised in society.[140] The profile of an initiative is also a factor in drawing people in. **If the initiative for a Smart City is launched by the mayor of the city and leading representatives, as well as by CEOs from local enterprises, this increases the credibility of the initiative.**

[139] Van Beurden (2011).
[140] Ibid.

**Figure 23: Top-down and bottom-up approaches to encouraging the participation of citizens and stakeholders in Smart Cities**



### Process

**Successful process management requires effective project management with a one-stop-shop for the provision of information, guidance, practical support and assistance.** In turn, this approach can reduce administrative costs. This single point of contact is responsible for not only the communication with stakeholders but also public relations. The management would also be responsible for communication with the funding organisation or institution and budgetary control.

**Evaluation of programmes is another important aspect of a successful Smart City.** Normally sponsors are very interested in such an assessment. Assessing the past phases of a development is crucial to avoid or correct erroneous trends in a project or city. **There is a range of potential evaluation methods and the approach chosen should always fit within the context.** In general terms, the evaluation should assess whether objectives of projects have been accomplished and, if not, what difficulties were encountered and why. Evaluations may be continuous, or take place at discrete points in time. A precondition for any evaluation is that there are clear, measurable objectives and the evaluation is independent. Stakeholders in Smart Cities also demonstrate the ability to learn not just from their own experience but from the experience of other cities and other initiatives. It is in this way that stakeholders of a Smart City can be truly innovative and forward-thinking, basing its development and initiatives on concrete evidence and always building on the successes and accomplishments achieved elsewhere within and beyond the city.

**Another success factor is the structure of knowledge management. In this context, access to the relevant data, which is required to develop business models, is as important as the guarantee of data privacy and data protection.**[141] It takes time and effort to deal with this challenge and to ensure that data is shared in this way.[142] **In addition following open standards counts towards the success factors**.

In the next section, an analysis is carried out which assesses Smart City solutions in the context of the following cities: Copenhagen (Denmark), Barcelona (Spain), Vienna (Austria), Amsterdam (the Netherlands), Helsinki (Finland) and Manchester (UK) (see Annex 6). All of these are considered to be Smart Cities in our previous assessments (sections 3.2; 5.1.3) and are listed in international Smart City rankings.[143] Attention is drawn first to the city level and then to the solution level.

## 6.3. Smart City solutions

### 6.3.1. Solutions identified in the case studies

In our analysis of the case studies we identified 12 solutions (described and analysed in detail in Annex 6) with significant actual or potential impact on the Europe 2020 targets. An overview of solutions and contributing success factors is shown in table 17).

[141] See http://www.europarl.europa.eu/RegData/etudes/etudes/join/2011/464462/IPOL-ITRE_ET(2011)464462_EN.pdf and http://www.europarl.europa.eu/RegData/etudes/etudes/join/2012/492463/IPOL-ITRE_ET(2012)492463_EN.pdf
[142] Ibid.
[143] Cohen (2012a); Monocle magazine (2011) http://monocle.com/film/affairs/most-liveable-city-helsinki/

**Table 17: Overview of success factors for the solutions for six Smart Cities[144]**

| City and solution | Success factors | | |
|---|---|---|---|
| | Vision | People | Process |
| Copenhagen | + | + | + |
| Cycling | + | + | + |
| Integrated public transportation | + | + | o |
| Barcelona | o | + | + |
| Control of lighting zones | + | o | o |
| Smart parking | + | + | + |
| Media-tic Building | o | + | - |
| E-governance | o | + | + |
| Vienna | + | + | o |
| Mobility solution 'eMorail' | o | o | + |
| Integrated mobility concept 'SMILE' | o | + | + |
| Amsterdam | o | + | + |
| Climate Street | o | + | + |
| Ship-to-grid (green energy) | o | o | + |
| Smart building management systems (ITO Tower Project)[145] | o | + | + |
| Health lab | o | + | + |
| Helsinki | - | - | + |
| Open data platform (Helsinki Region Infoshare)[146] | o | + | + |
| Manchester | + | o | + |
| Digital inclusion | - | + | + |
| Digital Home Environment Energy Management System | - | + | + |

Although the picture drawn by the assessment is ambiguous, it shows that in almost every case the success factors are fulfilled and have strong emphases. The city-specific solutions represent eight generic solutions covering the domains of transport, building technologies and governance. These are listed in Section 6.3.4.

[144] Cities as a whole as well as the solutions have different emphases, shown in Table 23 as strong (+), average (o) and no emphases (-).
[145] http://amsterdamsmartcity.com/projects/detail/id/10/slug/ito
[146] http://www.hri.fi/en/

Apart from the selected six Smart Cities analysed, we found similar applied solutions in the city sample of Section 3.1. It is noticeable that most of the solutions belong to the domains of the transport and mobility as well as Smart Governance.

### 6.3.2. Discussion of the solutions found in case studies

Although the case studies demonstrated more solutions that effectively contribute to the Europe 2020 targets, these did not fit our definition of a Smart City solution.

**Overall the case studies demonstrated that it is still early days for truly Smart solutions (fully deployed initiatives with a strong ICT component contributing to Europe 2020 targets).**

**A relatively easy to implement, high impact solution is conversion to green energy contracts at city level** (see Amsterdam (the Netherlands) ship-to-grid (green energy) solution in Annex 6). Converting 'quick win' solutions is still a good strategy for any Smart City initiative. For that reason they are included in the discussion on good practices below (Section 6.4).

Another category of projects covered under good practices are projects that do not directly contribute to Europe 2020 targets, but help to build the foundation on which to deploy future Smart solutions. For example, the current crop of Smart grid projects helps to establish the infrastructure for future Smart Energy projects and solutions such as active demand, load balancing, power-matching and more. These will be vital in future mixed mode user or producer energy eco-systems. **In general, integrated infrastructure-type projects that cut across energy, transport and ICT sectors are still at the pilot stage. Their contribution to Europe 2020 targets remains a promise for now.**

### 6.3.3. Economic analysis of Smart City solutions

To assess the success of a Smart City solution and be able to give recommendations regarding its scalability, it is useful to compare the expected impacts with the resources invested.

Smart City projects and Smart City solutions tend to be planned and implemented at the city or government level even though private initiators and local enterprises participate. **The majority of Smart City solutions have a pilot character and are in an early stage of implementation, so there is limited data on costs and benefits, and detailed evaluations, cross-analysis and cost-benefit-analyses could not be carried out.**[147]

The generated output of a Smart City solution depends on the local context of the Smart City and its objectives, vision and challenges. This covers traffic congestion, security of supply of electricity, and the development and implementation of existing infrastructure such as ICT, telecommunication, transport and the energy grid. In the ICT context especially the question of the quality of ICT assets (like data centre capacity, connectivity and bandwidth) are elementary for the implementation of Smart City solutions.

When performing a cost-benefit analysis at the solution level, it is advised to assess the complete dimension rather than cover the single aspect of the Smart City solution. But even if cost-benefit analysis at the solution level were available, the information would only cover one single aspect of the whole dimension. As we have made clear at several points in our discussion and analysis, the value of a Smart City is more than the sum of its solutions.

[147] The Climate Group et al. (2011).

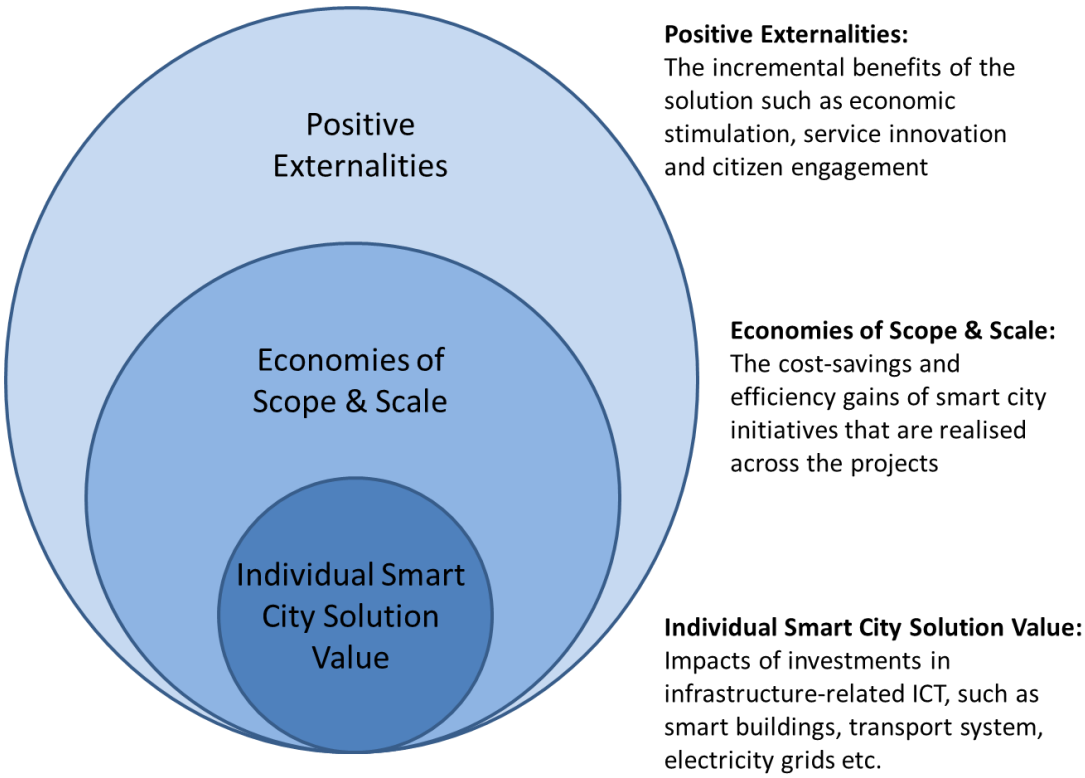
An integrated picture should take into account that benefits are also generated by the cross-linking of projects. The common use of infrastructure allows for the production of economies of scope and scale and therefore efficiency gains.

The economic case study analysis provides some general insights.[148] Table 18 shows that the identified Smart City solutions have various impacts; some relate directly to European 2020 targets but many have an indirect effect.

In some cases monetary benefits are obvious, but in other cases they are intangible and it is a challenge to assess them monetarily. Examples of such challenges are the image (reputation) improvement of a city and its strategic deliberations.

**The main benefits are assessable by measuring the monetary result from energy savings, time savings and the reduction of greenhouse gas emissions.** They are found in the transport and mobility sections as well as in the building technologies and the Smart Governance sections. Furthermore the increase of safety and health benefits play considerable roles. All in all citizens' quality of life improves by a higher effectiveness of the city's infrastructure and the access to its use. In addition, the output of a Smart City solution, like the generation of data, can provide a basis for further activities and business models, and thereby indirectly stimulate the economy.[149] These can generate a positive impact, also known as a positive externality. **The two main characteristics of positive externalities are that an uninvolved party benefits from the impact of an activity and the benefit is not transmitted through prices.** Figure 24 shows the different levels of benefit of a Smart City solution.

**Figure 24: The different levels of benefit of a Smart City solution[150]**




[148] In detail see Annex 6.
[149] For example, Dekkers et al. (2006) suggests that the public sector information market has a huge potential estimated for EU and Norway between EUR 10.3 billion and EUR 44.9 billion.
[150] Modelled after The Climate Group et al. (2011).

**Even though all these benefits should be taken into account, the benefits of an investment are not all paid out to the investor. This may be critical for market-driven business models and explains why the majority of the considered projects are currently centred on government service models.**[151]

**The cost assessment also depends on the local context. Again the existing infrastructure for ICT, telecommunication, transport and the energy grid influences the necessary investments for a Smart City solution.** The costs of a Smart City solution can be differentiated into asset investments and management and operational costs. The first category reaches from costs for ICT infrastructure like sensors up to construction costs for buildings and asset costs for digital information boards. The latter contains costs for updating software and applications as well as the maintenance of assets.

In conclusion, this brief analysis shows that an economic assessment of Smart City solutions depends on the local context. **In practice, cost-benefit analysis of the Smart City solution level is not available because the majority of projects are still publicly funded and in an early stage of implementation. The greatest challenge of carrying out such a cost-benefit analysis is to assess the benefits on the different levels. Nevertheless we arrive at the estimation that the feasibility of implementing the identified Smart City solutions is possible, and the net value is positive.**

### 6.3.4. Generic Smart City solutions

What remains are **eight generic smart solutions with true potential to contribute to Europe 2020 targets and other key EU targets such as those formulated under the Digital Agenda.** These are presented in Table 18. They can be applied in most city contexts and their cost-effectiveness allows for rapid scaling up to achieve the volume of impacts required to address targets at European level.

#### Transport and mobility solutions

The first set of generic solutions is concerned with urban transport and mobility innovation. They include three distinct solutions: **Smart cycling plans, integrated multi-modal travel and intelligent traffic routing.** They can be implemented city-wide, reduce $CO_2$ emission through reduced vehicle movements and better monitoring, and they build on existing infrastructure. Key technologies include geo-sensors, data-mining, smart cards or radio Frequency Identification (RFID), and tracking.

#### Building technology solutions

The second set of solutions is in the field of building technologies and management. They concern in particular **power and lighting management of existing and new buildings and developments including outdoor lighting.** They can be applied to most building developments and city contexts. Short-term electricity savings are the main impact. Key technologies include smart plugs, light sensors and power management automation software. One hurdle in many rental office markets is the inclusion of the cost of energy in square metre rental prices.

[151] This insight is also carried out by other studies. See Alcatel-Lucent (2012).

### Smart Governance solutions

The third set of solutions can be termed Smart Governance initiatives. They include **open service platforms where the government creates an interface to open government data and services for third parties including entrepreneurs and citizens to draw and build on.** In addition to their positive economic impacts on jobs and growth as a result of business innovation based on public sector information, reuse, new and enhanced services in environment and mobility, they can help contribute directly to $CO_2$ reduction.

In this category we also include so-called local sustainability initiatives such as the Klimaatstraat in Amsterdam (the Netherlands).[152] These are self-organising, bottom-up initiatives targeting a subset of sustainability targets through pragmatic, collaborative approaches that are specific to neighbourhoods or even streets. These initiatives are Smart in the way they use sensors and energy feedback monitors to track and share information on energy consumption with the aim to collectively improve the local situation. The focus on hyper-local issues and the participative nature facilitates ownership and buy-in from the start.

[152] http://amsterdamsmartcity.com/projects/detail/id/9/slug/climate-street

**Table 18: Overview of the characteristics and impacts of generic Smart City solutions**

| Solution category | Smart City solution | Where implemented | Keywords | Impacts | Cost recovery |
|---|---|---|---|---|---|
| Transport and Mobility | Smart cycling plans | Copenhagen, Paris, London | Cycle sharing, social sensors, electric bikes, smart cards | $CO_2$ emissions reduction, healthy living | Short to medium term |
| | Integrated multi-modal transport | Copenhagen, London, Helsinki, Glasgow, Hamburg, Tallinn, Milan, Dublin, Ljubljana | Smart tickets, multi-modal travel, travel information and routing, sharing | $CO_2$ emissions reduction through congestion reduction, increased public transport, enhanced transport and competitiveness | Short to medium term |
| | Smart Traffic flow system | Barcelona, Eindhoven | Smart vehicle routing, Smart Mobility, sensors, tracking | $CO_2$ reduction by reducing travel and transit times, enhanced traffic flow due to decreased travel times | Medium term |
| Building Technologies | Smart building technology and management | Amsterdam, Helsinki, Bremen | Smart and green building technology, demonstrators, Smart plugs, light emitting diode (LED), sensors, room climate | Reduced energy consumption, $CO_2$ reduction, awareness | Short to medium term |
| | Smart City lighting | Barcelona, Milan | Street lighting, sensors, central monitoring, LED | Reduced energy consumption, $C0_2$, safety | Short to medium term |
| Smart Governance | Smart open services platforms | Barcelona, Helsinki, Copenhagen, Malmo, Amsterdam, Dublin | Open services, open data, integrated transport solutions, Smart tickets, mobile apps | Reduced $CO_2$, private sector information reuse with knock-on effects on environment and energy, jobs and economic growth | Short to medium term |
| | Single access points for government services – | Barcelona, Manchester | eGov, single services window, online government portals | Reduced $CO_2$, reduced travel to municipal offices | Short to medium term |
| | Local integrated sustainability initiatives | Amsterdam, Barcelona, Cologne | Local, Smart Energy management, monitoring and user feedback, self organisation, local coordination | Reduced $CO_2$ through reduced energy consumption, democracy, inclusion | Short to medium term |

## 6.4. Good practice in designing and implementing Smart City Programmes

Based on the cross-analysis of case studies, a number of good practices in the design of Smart Cities have been identified. They are described below.

### 6.4.1. Vision

- Quick wins. Within Smart City programmes, technologically advanced projects are very attractive, but **in the initial stages the programme managers may want to target low-hanging fruit first to achieve quick results.** In Amsterdam (the Netherlands), for example, simply converting to green energy projects resulted in an instant reduction in CO2 emission (ship-to-grid solution in Annex 6).
- Inclusion. There are more sides to an attractive, competitive and sustainable city than those reflected in the Europe 2020 targets. One concern is the polarisation of the urban elite and low income, as has been observed in some of the most cited Smart City implementations on the 'creative class struggle'.[153] **Inclusion and participation thus remain important targets for successful Smart City programmes that touch all residents**, old and new.

### 6.4.2. People

- Create Smart empowered citizens through active involvement. Above all, a Smart City is a Smart community of people. **User-centric and bottom-up initiatives are therefore important.** For example the Bicycle Account (bi-annual evaluation of the bicycle system in Copenhagen (Denmark)) actively involves users in defining areas of improvement. This creates a broad support for the Smart cycling programs because investments in the cycling infrastructure are based on the needs of citizens, and that creates a sense of ownership. The Quiosc PuntBCN Project[154] in Barcelona (Spain) became a success through thorough pilot programs and rigorous public tendering. **Crowd-funding can also be successful when developing support and commitment within the local community**.
- **City champions. Inspiring leaders are at the centre of many successful initiatives.** This can be at the highest level, such as the mayor of Vienna (Austria), Michael Häupl, who actively pleads for Smart City Vienna.[155] It can also be found at street level, as evidenced by in the Amsterdam Climate Street Project driven by an inspired local business leader (see Annex 6).
- Holistic, participative approaches. An important element of any successful Smart City initiative is a fundamentally participative approach. **Collaboration, co-creation and co-development are key conditions for success.** This was one of the key factors of success in the Amsterdam Smart City platform (see Annex 6).[156] A clear vision of the future should, therefore, be accompanied by the development of a participative environment that facilitates and stimulates business, public sector and citizens to contribute.

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[153] See Hollands (2008); Peck (2005).
[154] Ajuntament de Barcelona, 'Smart City Barcelona, BCN Model', available at: http://de.slideshare.net/IFIF/20110328-model-smart-city-bcn-presentaci-rgb-angles1-8244403, 2011, last accessed on 18/07/2013.
[155] APA (2013).
[156] http://amsterdamsmartcity.com/about-asc

### 6.4.3. Process

- **Create a dedicated, high powered Smart City office**. Smart City developments in most cases involve cross-sectoral innovations. Innovative concepts require multi-stakeholder approaches. The creation of a central office that acts as the go-between for Smart City ideas and initiatives drawing in diverse stakeholders is of vital importance (see Amsterdam (the Netherlands) Smart City platform, Greater Manchester (UK) Low Carbon Hub,[157] Forum Virium in Helsinki (Finland)[158]). **This central office should communicate a clear vision but also broker fertile partnerships**. According to The Economist, the crucial quality of Amsterdam's success is not that it '[came] up with a master plan, but that it uses a combination of institutions and infrastructure that helps businesses and citizens develop and test green projects'.[159]
- Open up your data. Making public service information openly available contributes to effective Smart City developments. As studies indicate, the opening up of public service data can have enormous economic impact.[160]
- **Local coordination and alignment**. Project contexts differ from city to city, but within cities differences can also be important for the uptake of a Smart City solution. Close cooperation with end-users and local stakeholders is necessary to identify integrative solutions that tackle real problems effectively.
- **Learn and disseminate through networks and living labs.** Sharing of knowledge, successes and good practices between cities can give a budding Smart City initiative a headstart. Modern living labs support open innovation, co-creation and co-development and should aim at open dissemination through international networks to other cities.[161]

[157] http://www.agma.gov.uk/what_we_do/gmlowcarbonhub/index.html
[158] http://www.forumvirium.fi/en/
[159] The Economist (2012).
[160] Dekkers et al. (2006).
[161] An example of this is the European Network of Living Labs. An international federation of benchmarked living labs in Europe and worldwide now contains over 300 living labs (source: www.openlivinglabs.eu ).

# 7. CONCLUSIONS AND RECOMMENDATIONS

## 7.1. Conclusions

### 7.1.1. Status quo: the variety and distribution of Smart Cities and Smart City initiatives

**The term Smart City covers a wide range of alternatives.** The initiatives that give Smart Cities their special status involve a similarly wide range of types and contexts, working arrangements and patterns of participation. **This richness highlights the constructive ambiguity of the term and the importance of relatively open, flexible and (above all) participant-defined terms of reference.** This freedom lets Smart City citizens further their own interests in a way that serves the collective interest, and enables them to take ownership of the city as a whole. If these stakeholders were merely restricted to property rights and fixed responsibilities, within a pre-defined programme or set of activities, their efforts would remain focused on their own interests. The success of the city (or the project) would then depend on the degree to which the original design (governance and accountability architecture) was appropriate. With a looser or more generative[162] framework, there is a greater chance that the structure will work in specific local conditions and mature as the city develops. This can be seen in the continued flow of new (and different) initiatives, even within relatively mature Smart Cities.

**The term Smart City also covers a wide range of situations.** These range from the literally descriptive (cities with a wealth of interlocking, ICT-enabled initiatives tackling a series of common problems and engaging the active participation of a wide range of stakeholders) to the primarily aspirational (cities that have just begun to develop Smart solutions). The meaning of 'Smart' is perhaps the most relevant aspect of these definitions. In most cases, it refers to the intensive use of ICT tools and methods to link city services or to tackle common problems in innovative ways. Other definitions emphasise the functional 'intelligence' of the city – its ability collectively to understand and respond to challenges in a holistic and sustainable manner. The implied distinction between ICT as a means and ICT as an end in itself is perhaps a matter of maturity. The greater emphasis on 'Smartness' as a way of improving welfare and sustainability seems to be associated with cities that have a more developed set of initiatives, including many where the use of ICTs is not the defining feature. This suggests that cities learn to be Smart through experience.

This leads us to define Smart Cities by what they do and why they do it. From the former perspective, **a Smart City uses ICT to optimise the efficiency and effectiveness of useful and necessary city processes, activities and services typically by joining up diverse elements and actors into a more or less seamlessly interactive intelligent system.** From the latter perspective, **a Smart City continually seeks to become and remain self-regulating by enhancing the collective intelligence of its citizens and communities and their well-being and quality of life**. It does this by informing and empowering them as individuals and as groups, and by encouraging the processes that make cities important to people and which might well sustain very different – sometimes conflicting – activities.

The research underlying this report was based on a specific set of requirements and criteria: cities had to be located in the EU-28 and have at least 100,000 inhabitants.

[162] Zittrain (2008) coins this term to refer to the potential of systems in which roles are flexible and resources easy to access, modify and re-use (e.g. the Internet) to generate positive innovation.

In addition they had to have plans, strategies, initiatives or other activities (see Section 3.1) showing evidence of at least one of six 'Smart City characteristics' (Smart Governance, Smart Economy, Smart Mobility, Smart Environment, Smart People, and Smart Living – see Section 2.3). Approximately half of the cities meeting the size and location criteria (240 out of 468) could be classified as 'Smart' in this way. This was not correlated with city size.

Cities were also classified by maturity. This is the extent to which planned initiatives have been implemented. Despite the relative novelty of the Smart City concept, almost half of the Smart Cities had achieved some level of implementation (Figure 5); the largest cities tend to have the greatest level of maturity (Figure 8).

**The characteristics defining a Smart City were not evenly represented. Environment and mobility were the most prevalent characteristics, possibly because the associated challenges are more commonly shared, and more naturally tackled, in a collective fashion.** Larger cities tended to have more diverse activity portfolios, showing a greater range of characteristics.

Smart Cities are present in almost every EU-28 country, with the exceptions of Cyprus, Luxembourg and Malta (which had no cities above the minimum size threshold). **Virtually all cities with a population of over 100,000 in Nordic Member States can be characterised as Smart Cities, as can the majority of cities in Italy, Austria and the Netherlands and approximately half of British, Spanish and French cities. Germany and Poland have relatively few Smart Cities. Eastern European countries generally have a lower incidence of Smart Cities than the rest of EU-28.**

Further insight into the development and potential contributions of Smart Cities (to the solution of their own problems and to broader national or European objectives) can be gained by considering the initiatives associated with Smart City status. A selection of initiatives was used to generate a typology in order to gain insight into specific objectives, participants (stakeholders), funding, level of success and potential for 'scaling' (see Chapter 4 and – for a discussion of scaling – Section 7.1.3). The population of initiatives for which suitable information was available was clustered into five general types. The most numerous are:

- Smart City neighbourhood units
- intelligent traffic systems
- resource management systems.

Less common, but still important, are:

- testbed micro infrastructures
- participation platforms.

The attributes of these projects are discussed in more detail in Table 8. The neighbourhood platforms tend to concentrate on sustainability in a holistic sense; intelligent traffic system initiatives emphasise mobility and its associated sustainability impacts; and resource management projects address sustainability indirectly by concentrating on efficiency and resilience in the supply of utilities (primarily electricity, including renewables in some cases, but also water and gas). The other projects types tend to be defined by their modality of operation (testbed or open platforms) and address a broader range of objectives.

**All the initiatives involved some degree of participation by government, private sector entities and civil society, but their roles and influence differed.**

Citizens tend to have more influence in the neighbourhood and participation platform initiatives; government units are important drivers of intelligent traffic systems and participation platforms, and businesses are most influential in resource management systems.

**There is a mixture of public and private support. Public funding is most important in intelligent traffic system and non-energy-related resource management system initiatives. The energy-related resource management projects often rely on major private financial support. Private sector stakeholders tend to provide in-kind support for testbed micro infrastructures and intelligent traffic systems**. Most participation platform projects are based on **reuse of common and readily available ICT resources**, and so the primary 'support' comes in the form of the time donated by users, participants and operators drawn from across the stakeholder population.

These aspects of participation and funding are closely connected with orientation ('whose objectives have priority?') and governance ('how are choices made, implemented and enforced?'). The special character of Smart City initiatives is reflected in the high prevalence of PPPs and the participation of a wide range of commercial, technical, user group and government parties. Because these parties are so different, and the time horizon over which the Smart City benefits develop is so long, conventional contracting arrangements are unlikely to work. Indeed, in many areas they have been tried and have been shown to have failed. The variable geometry of these Smart City arrangements can be seen in the range of financing and in-kind contributions on offer. This suggests that the implicit contracts are essentially incomplete and thus able not only to adapt to local circumstances, but also to adjust as those circumstances change and the initiative (or the city) develops.

Beyond these structural aspects, we sought to evaluate the degree to which Smart City initiatives, and Smart Cities as a whole, could be considered to have succeeded. The overarching intention was to see whether specific forms were more likely to succeed and to identify good practices. This was difficult both in principle and in practice, and only a limited assessment is possible at this stage.

Conceptual difficulties stem from the multi-stakeholder, open nature of Smart Cities and initiatives. There is a wide range of stakeholders, each with their own objectives, making criteria for success difficult to identify, let alone aggregate or compare. This inherent difficulty is compounded by the fact that some of the most important criteria from a policy perspective derive from the national or European level. By definition, these criteria may influence the incentives of participants, but do not define their obligations.[163]

On a practical level, evaluation is complicated by matters of design (objectives tend not to be stated in concrete, measurable terms, and baselines for comparison are rarely identified) and practice (necessary data are not always collected, made available or up to necessary levels of quality and coverage). Assessment and benchmarking are also limited by maturity. Currently more than two-thirds of Smart City projects are in the planning or pilot testing phases; neither soundly tested business cases nor comprehensive hard evidence of impacts are widely available. This hinders the development of, and ability to learn from, successful projects.

However, some types of projects have produced a flow of concrete results consistent with their initial objectives. Most of the testbed micro infrastructures have been implemented and

[163] For example, the analysis of resource management system initiatives revealed an often stark disparity between the incentives of major power suppliers (whose commercial interests lie in more efficient energy use as a means of reducing switching, improving capacity use and attaining favourable regulatory treatment) and others potentially more interested in reducing energy consumption, bidding down prices and increasing the ease with which users can discover and switch to alternatives. An initiative that succeeds for one party could easily fail for another; moreover, an initiative that 'succeeds' in the short run by increasing the energy efficiency of a neighbourhood could fail in the long run if the resulting price reduction encourages greater use of energy as an input to production and service delivery.

have already begun to reduce service management costs and $CO_2$ emissions. They are regarded as contributing positively to their city's economic competitiveness.

Similarly, nearly half of the sampled resource management system initiatives have been implemented and are producing spill-over benefits such as increased real estate values, quality of life and tourism, and the revitalisation of local business life (in addition to the expected efficiency improvements).

There are indications of components or attributes that are associated with these concrete indicators of success and with the more qualitative or subjective assessments found in the literature review. Some of these are typical of any major public–private initiative. **Most successful projects have had clear objectives, goals, targets and baseline measurement systems in place from the outset. Strong governance, a sound business case, and a benefit realisation framework also appear important in many cases.**

Other aspects are more particular to Smart City initiatives:

- Having a strong local government partner as a key player is typically very important, for strategy and co-funding.
- Successful projects tend to be embedded in a comprehensive city vision.
- A suitably diverse range of participants is necessary, especially where private partners can contribute necessary expertise, finance and technology capabilities. Local university involvement can also be important.
- The efficacious engagement of citizens and local representatives and the implementation of efficient processes across the initiative are important, for legitimacy, accountability, buy-in and trust.

### 7.1.2. Alignment: the relationship between Smart City characteristics and policy objectives

**The objectives of the Smart City initiatives are generally aligned with those of the city innovation and development strategies, as well as with the overarching Europe 2020 targets.** This is not surprising, because the problems are widely recognised, and agenda-setting at both city and European level consciously strives for openness and wide participation. What is more interesting is the way the characteristics align with the (measured) situation of the city. There appear to be three distinct elements – the inclusion of characteristics:

- Recognised as hallmarks of a Smart City and thus necessary conditions for any city seeking Smart status (e.g. environment and innovative use of ICTs)
- Aligned with areas where the performance of the city or the country is particularly weak – in effect using the critical mass, economies of scale and scope, and political halo effect to use this 'special' and visionary vehicle to tackle issues that have (on the evidence) resisted solution through 'normal' channels
- Aligned with areas of particular local strength, which provide fruitful platforms for Smart City coalition-building because risks are relatively low (even if the solution does not succeed, the cost in performance terms is modest and in any case solution development starts from a solid and effective base including technologies and working arrangements). Such initiatives can prime the pump of knowledge-sharing with other domains (in an ideal world, a city with strengths in a particular area might package them as a Smart City solution, in order to pair with another city whose complementary strengths match the problems faced by the first city).

The match between Europe 2020 targets, the objectives of city strategies and the objectives of the specific initiatives is only approximate. The overall alignment found in Chapter 4 suggests that policy chapeaux such as Europe 2020 exert a harmonising and stimulating influence.

The residual variance (aligned to local circumstances as indicated in the previous point) shows evidence of: local responsiveness; the design as well as input and activity contribution of local stakeholders; size effects (comparing the portfolios and characteristics covered by large and small cities, and the different scaling and internationalisation opportunities of large and small industrial participants); and the interaction of different stakeholders' different objectives and agendas. We should also remember that there are less instrumental motives for participating (what we call 'halo effects'). For example, businesses may do this to test technologies, build loyalty and form alliances, and to generate corporate social responsibility points in their relationships with local governments and the citizenry (customers, workers, financiers).

However, we cannot definitively say whether this alignment is caused by targeting Europe 2020 or simply reflects the fact that issues of mutual concern are recognised both by the community and by the cities themselves, who recognise that they can effectively be tackled by Smart City initiatives. The sampled Smart Cities tend to form clusters in terms of the numbers and variety of characteristics. There seem to be distinct differences among these clusters. Some cities pursue a diverse mix of characteristics though a large number of holistic initiatives. Others favour a differentiated portfolio of specialised initiatives. There are those with only a few 'global' initiatives and those with only a small number of initiatives tightly focused on the most salient characteristics. This phenomenon is consistent with a dichotomous view of Smart City initiatives, which may be viewed as an instrumental means of tackling specific problems or a way to build a community of interest or overarching awareness of the potential of such joint initiatives to provide a platform for continued progress that adapts to changing circumstances.

There is also a degree of selectivity in the potential contribution to the Europe 2020 targets. In design terms, almost all initiatives aim to contribute towards Smart, sustainable and inclusive growth. Across the five different priority areas of Europe 2020, environmental issues and green solutions appear to be the key concern for the majority of European Smart City initiatives. **Nearly 50% of the initiatives address environmental problems either through implementing technologies to improve energy efficiency in buildings or by developing smarter city transportation options.**

**However, energy solutions are pursued by most cities across Europe, regardless of national incentives and national political and social circumstances. This is driven to a large extent by transnational multi-city initiatives (especially NiCE).** When these initiatives are removed, the prevalence of environmental concerns diminishes. **This reinforces the impression that environmental concerns are more likely to be shared and addressed through joint action (among cities) than the more localised issues of employment, social inclusion, and so forth.**

As mentioned in the previous section, the early stage of development of most Smart City initiatives and the difficulties of attributing their contributions to concrete wider objectives means that the **notion of a 'successful' Smart City must be rooted in the objectives and characteristics associated with current initiatives.**

We examined three measures of the extent to which the portfolio structure of a Smart City reflected an even balance across characteristics, or one linked to the Europe 2020 objectives applicable to that country.

Comparing the top 10 cities by each of these scorings, it is evident that coverage is much more even than the balance of characteristics within each city – **some cities specialise on a specific set of characteristics while others cover a larger range.**

Some of this can be explained by the severity of specific problems, measured by the distance between current performance and the relevant Europe 2020 targets. In many cases, characteristics are used where the need is greatest. However, **in another set of cases (e.g. many Nordic Member State Smart Cities), specific characteristics are used where the need is less, possibly to produce striking results or to build networks of cooperation. However, there are examples where needed characteristics are not present, where concerted efforts to strengthen use of particular characteristics would be warranted.**

**In view of this variety of outcomes, an overall recommendation is that the design of Smart City initiatives and portfolios (city strategies) should begin with a needs assay of the city's performance against relevant targets. The results of such scorecards or audits could be used to locate cities in similar circumstances for mutual cooperation or learning.** Considering the differential impact of NiCE initiatives on the measures considered here, the potential contributions of this sort of alignment may be widespread and substantial.

Note, however, that **initiatives and solutions that can be identified in the context of a Smart City programme do not all contribute to the Europe 2020 targets.** Conversely, many initiatives that do contribute to Europe 2020 targets are not based on ICT. Therefore, it may be important to adopt a wider perspective than that taken in this study, especially when considering the contribution of the Smart City movement as a whole to European policy objectives.

Overall, the aim of Europe 2020 is to create 'a Smart, sustainable and inclusive economy', and this, in part, is what Smart City initiatives deliver. Initiatives that link to the environment encourage sustainability. Those which increase citizens' access to information through the provision of skills and resources such as free public Wi-Fi encourage inclusiveness. The overall use of ICT to facilitate and advance these initiatives highlights the Smart element of each characteristic by which we define a Smart City initiative (e.g. Smart People, Smart Governance, etc.). This is backed up by a recent report of the meeting of the advisory group on ICT infrastructure for energy-efficient buildings and neighbourhoods for carbon-neutral cities held at the EC in September 2011.[164] The report states: 'There is general agreement that the primary objective of Smart Cities is the achievement of the 2020 energy objectives.' However, Smart City initiatives offer more than economic benefits; they also provide facilities, such as traffic and route guidance, interaction of citizens with the governance of their city which encourage relevance and ownership, and access to online resources, which all create a space that people want to live and work in and therefore contribute to.

To properly understand the potential of these initiatives and Europe's growing network of Smart Cities, we must consider the potential for scaling and dissemination, to which we now turn.

[164] European Commission (2011b).

### 7.1.3. Scaling and dissemination

Being locally based, Smart Cities constitute a natural experiment. They can learn from each other, and can collectively be analysed to yield general lessons for the circumstances in which specific strategies are appropriate, and the forms of localisation that can best contribute to success. This is especially true when more information about their real outcomes, wider impacts and long-term consequences becomes available.

At a casual level, we may think of this as a matter of scalability, transplanting the Smart City idea from the city (or even neighbourhood) level to Europe as a whole. But this is insufficiently precise. There are many forms of scaling, and not all are equally feasible or desirable.

To put the findings of this study in perspective, it is useful to distinguish between replication, scaling and ecosystem seeding.

**Replication** essentially means **repeating successful Smart City initiatives in another locale or replicating the same type of Smart City in other cities.**

These replicas would be based on matching the aggregate characteristics (population, income distribution, local economic characteristics, socio-economic outcomes), and deliberately creating a similar strategic vision and portfolio of (locally relevant) initiatives.

**Scaling** means **transforming a small initiative into something bigger**. This may involve increasing the volumetric size of a given project by involving more stakeholders, funding, services, and so on.[165] Alternatively, for initiatives operating below city scale, it may simply involve increasing the geographic footprint within the same city.[166]

**A more ambitious form of scaling involves changing the basis of an initiative from individual city projects to multi-city projects.[167]** In this case, a degree of explicit and designed deviations from replication are an explicit part of the experimental design, intended to produce relevant (control and treatment) alternatives and thereby to maximise the reliability, quality and generalisability of the lessons learnt. This may also involve transfer from a city (or cluster of cities) to EU 'hosting'.

**Another form of scaling involves offering the data, services and technologies used to provision the Smart City initiative on a national or pan-European scale.** Potentially, the Smart City-specific aspects could be scaled in this way to create pan-European 'Smart City services'. There are several possible models:

- a service provider organisation analogous to existing ICT and electricity service provider organisations which do not necessarily own the infrastructures (wires, generators, etc.) but take care of the service aspects;
- a dedicated 'angel' support programme to assist the transformation of the business models of key participants to allow them to become Smart City service integrators[168];
- a cloud-based model whereby Smart Cities can be helped to offer specific services on public clouds (offered by governments or major private providers), and the cloud

[165] More concretely, this may mean adding sensors and streets to an intelligent traffic management initiative or deploying more smart meters in a resource management project.
[166] For example, scaling up Smart City neighbourhood units or testbed micro infrastructures to cover the whole city.
[167] Examples include the NiCE initiative and Competitiveness and Innovation Programme (CIP) large-scale pilots, which generally involve a number of local initiatives linked by overall design, common funding, shared standards, and/or use of a common platform, set of shared services or service providers.
[168] Business service providers such as SAP and providers of turnkey e-health service packages could branch out into this area.

platform would them become host to a Smart City app ecosystem; this model has the advantage of allowing the best or most easily reusable aspects of many Smart Cities to be unbundled from their original settings and allowed to compete on a common platform, which in turn provides:

- a powerful form of competitive selection of the best solutions in a way that does not undercut the cooperation used to develop them in their original project or city context;
- reduced entry barriers for start-up Smart Cities and Smart City projects[169];
- a chance to create innovative mash-ups of services from different cities, thus generating new 'recombinant' Smart City technologies, solutions, standards and processes;
- immediate access by Smart City solution developers to a diverse critical mass of potential users, providing more attractive commercial prospects and a chance to crowd-source innovation and lessons for dissemination to other contexts;
- a network of Smart Cities across the EU linked using the common services and Smart City cloud strategies described above.

Note that these forms of scaling could be used in conjunction with recommendations 4 and 5 (creating a Smart City Use Case for the FI-PPP and strengthening the Smart Cities and Communities European Innovation Partnership (SCC-EIP)[170] actions, see Section 7.2.5).

**Ecosystem seeding** is a specific form of scaling. It works by **creating a diversified ecosystem of Smart entities as a complex system linked at different levels.** Our analysis clearly shows a rich pattern of interactions among activities at the project, city and inter-city level. Such a complex system is unlikely to retain a fixed geometry and hierarchy.

Rather, it will constantly re-wire itself, showing the usual features of self-organising systems like emergence,[171] motif formation,[172] synchronisation[173] and the generation of localised diversity.[174]

A number of conclusions regarding scaling are possible for the broad types of initiatives present in the sample studied here. First, a number of factors make the need for strong governance, sustained sponsorship and the right stakeholder mix particularly acute for large-scale expansion or wide replication. These factors include:

- the vagaries of the current financial climate;

[169] They only have to pay the OPEX and not the CAPEX of putting the service layer of necessary ICT in place.
[170] http://ec.europa.eu/energy/technology/initiatives/doc/2012_4701_smart_cities_en.pdf
[171] The creation of structures and functionalities (including forms of 'smartness') at the network level that cannot be perceived or controlled at city level.
[172] The recurrence of similar structures (e.g. hub-and-spoke arrangements (with a single coordinating entity) or small world structures (with dense local interaction combined with short paths 'through the network' by means of a backbone of highly connected organisations or cities. Note that these 'connector' roles are formed through voluntary (mutual) association and can change when patterns of collaboration change; they are thus unlikely to lead to strong asymmetries of power or influence.
[173] The simultaneous adoption of given approaches or project types by cities or stakeholders with no direct connection. Such synchronisation helps in the formation of beneficial new linkages and in the generation of large sets of comparable data, reflecting the experience of cities under the same macroeconomic and temporal conditions.
[174] This is the way such self-organising networks can lead to local variations that reflect local circumstances, compared with the alternatives of tipping or lock-in to a generic solution that might not be appropriate or fragmentation into approaches that are too different to interoperate, coordinate or learn from each other.

- the often substantial risks associated with specialised fixed capital investment in infrastructure-based projects;
- the joint and long-term nature (shared with other stakeholders with much smaller sunk investment) of benefits;
- the complexities of monetising returns (especially for societally orientated initiatives).

Second, **the role of citizens should not be forgotten.** In general, citizens can be important stakeholders and should, where possible, be involved strategically in development and execution phases. Examples include the (re)use of Smart Cities as platforms for innovation, the role of citizens as co-producers of services (open data), and the potential for Smart City participation to enable and encourage citizens to play a more active part as active contributors to the future of the city. In some cases, citizens have also acted as funders or co-financers of cooperative activities in the development and operation of city services. Citizens, consumers and users can thus be useful conduits and advocates for the dissemination of Smart City projects. Moreover, by ensuring that the interests of civil society are incorporated into the design and business model of the initiative, and by participating in the incorporation of 'consultation by design' elements, such initiatives are likely to prove more acceptable to citizens in other cities under a replication, Smart City Services or ecosystem seeding model.

Third, **the participation of a private company (ideally a national or pan-European company) as a key player alongside the city authorities and local firms can provide an institutional base for scaling.**

Fourth, cooperation among cities to create common ground (such as **Smart City platforms**) for the development and testing of Smart solutions on a large scale is likely to make dissemination easier and more convincing for new stakeholders in collaborating cities, especially if such cooperation is conducted on open terms.

On the other hand, some types of initiative (especially neighbourhood units and resource management systems) are heavily dependent on the extent and quality of local networks and capabilities, and may be difficult to extend under any of the models described above. By the same token, initiatives that lack evidence of success and/or sound business cases will be difficult to scale or extend.

Finally, a word of caution about scaling success: **even though our analysis has indicated that some practices and structures are (currently) associated with success, we should not assume that reproducing them in other areas will produce further success.** Other areas may be different, and it may also prove to be the case that a network of Smart Cities can support (and needs) more variability between cities than would be optimal if the cities were more isolated. This is the specialisation of labour or comparative advantage argument; autarchic systems may resemble each other for purely technical reasons, or because they learn from each other through codified knowledge. When they are linked, and able to interoperate more dynamically and symmetrically, they will often tend to diverge under certain conditions: their needs are the same but their capabilities differ; their capabilities are the same but their needs differ; or one has started earlier than another. Moreover, **with specific reference to volumetric scaling and formation of multi-city initiatives, what works with the small scale and limited diversity of individual Smart City initiatives may not be viable when numbers are larger.** As the potential for conflicts of interest expands, so the small-scale business models and relationships are stressed, in particular when the new initiative crosses the boundaries of local jurisdictions and market areas.

## 7.2. Recommendations

The analysis in the foregoing chapters has identified a number of specific, and often implementation-level recommendations. Below we present some more general recommendations based on a summative view of the evidence and analysis. These are grouped into five categories:

- Understanding Smart Cities: research and evaluation
- Designing Smart City initiatives and strategies
- Smart City governance
- Supporting the development of Smart Cities
- From Smart Cities to a smarter Europe: replication, scaling and ecosystem seeding.

**Table 19 : List of Recommendations**

| Recommendation | Intended for |
|---|---|
| **Understanding Smart Cities: research and evaluation** | |
| Detailed panel of longitudinal case studies with city-level funding and outcome data | DGCNECT, DG JRC |
| Standardised evaluation and assessment methods to measure success at internal, city and European level for impact assessment and benchmarking | The European Commission (EC) and Impact Assessment Board (IAB) |
| Develop methods and structures for a needs assay of the city's performance against relevant targets and presentation scorecards | Collective effort led by existing Smart City clusters[175] |
| **Designing Smart City initiatives and strategies** | |
| Mandate specialised impact assessment guidelines for Smart City strategies and initiatives to include: SMART objectives, issues of timing and uncertainty, and assessment of experimental variation (differentiation from existing solutions and knowledge transfer arrangements) | Funding bodies,[176] IAB, Smart City clusters |
| Promote local modularity for early-stage initiatives | Funding bodies, Smart City clusters; additional specific funding from EC, local government stakeholders |
| Facilitate exit and change of participation during the latter stages of an initiative | Funding bodies, Smart City clusters, local government stakeholders |
| Structural conditionality in funding for Smart City initiatives | Funding bodies |
| Specific design procedure for structuring Smart City initiative components | IAB, Smart City clusters, local government stakeholders (as monitoring hosts) |

[175] To include for example Concerto, Civitas, Covenant of Mayors, Green Digital Charter.
[176] To include European, Member State and local funding sources.

| Recommendation | Intended for |
|---|---|
| **Smart City governance** | |
| European-level Smart City platform with brokerage or intermediary functions | EC |
| Privileged or low-cost access to existing infrastructures | Local government stakeholders, infrastructure operators, national regulatory agencies |
| Mandatory multi-stakeholder governance with lay users represented and on integrated project teams | Funding bodies and government authorities and participants |
| Encourage industry-led public–private partnership consortia | Funding bodies and government authorities and participants |
| **Supporting the development of Smart Cities** | |
| Use demand-side measures to stimulate demand for city-based 'Smart solutions' | Member State and local government procurement agencies, Horizon 2020, service users, standards bodies, national regulatory agencies |
| Selective use of regulatory forbearance and/or pro-competitive sourcing | Procurement agencies, national regulatory agencies, European Parliament |
| **From Smart Cities to a Smarter Europe: replication, scaling and ecosystem seeding** | |
| Periodic assessment of scalability potential and identification of instruments and activities to optimise pan-European dissemination of good practices and solutions | EC (platform), IAB (guidelines), local authority participants |
| Include Smart Cities as a future internet public–private partnership (PPP) use case or involve Smart City stakeholders in large-scale pilots, standards bodies, etc. | Future Internet Public–Private Partnership (FI-PPP), Horizon 2020, EC (supporting standards body engagement with additional specific funding) |
| Expand support for Smart Cities and Communities – European Innovation Partnership | EC |
| Additional resources for Smart City translation and transfer | EC, Member States |
| Create and encourage Smart City-specific new intellectual property ownership rights and contract forms | EC, Council, Parliament; possible WIPO |

### 7.2.1. Understanding Smart Cities: research and evaluation

**Recommendation 1A**: **Further research is required to produce detailed longitudinal case studies**, based on a) recruiting a stratified and structured sample of initiatives; b) implementing specific quantitative and harmonised monitoring measures to track participation, contributions (including specific and joint finance), activities, outputs and outcomes from the initiatives; (changes in) linkages and joint activities among

participants and between participants and third parties; and time-series data on progress towards project-specific and study-wide objectives at neighbourhood and/or (as appropriate) city level. This quantitative evidence should be complemented by interviews with individuals and businesses that have contributed to or benefited from initiatives. This will advance our understanding of the most important factors behind the success or failure of smart city initiatives.

**Recommendation 1B**: There is a **need to develop new and standardised evaluation and assessment methods to measure internal (project-specified), city level and European level success appropriately.** Ideally, this would be extended to **develop more robust tools for impact assessment and benchmarking of Smart City strategies and associated projects.**

**Recommendation 1C**: **The design of Smart City initiatives and portfolios (city strategies) should begin with a needs assay of the city's performance against relevant targets.** The results of such scorecards or audits could be used to locate cities in similar circumstance for mutual cooperation or learning. Considering the differential impact of NiCE initiatives on the measures considered here, the potential contributions of this sort of alignment may be widespread and substantial.

### 7.2.2. Designing Smart City initiatives and strategies

**Recommendation 2A**: **Designers of Smart City strategies and initiatives should ensure that they are based on explicit, specific, measurable, achievable, realistic, and time-dependent (SMART) objectives, clearly aligned to city development and innovation plans and (as need dictates) to Europe 2020 targets.** The initiatives should include a sound business plan, explicit governance arrangements and a clear performance measurement and assessment strategy.

Some barriers to successful Smart City initiatives stem from the timing of returns. Typically, the benefits of 'Smartness' take time to develop, and may be highly uncertain. In these cases, and especially when large up-front investments (e.g. in infrastructure) are required, local experimentation is likely to focus on the most obviously promising approaches. These will tend to be the same everywhere.[177] This is reflected in the homogeneity of objectives and (some) characteristics across our sample.

As a result, such 'experimentation' is likely to overlook innovative and/or disruptive (but heterodox) solutions. This increases the risks of lock-in to a second-best solution and the loss of diversity and resilience. As Porter's analysis of global competitiveness points out,[178] a firm or initiative based in a defensible 'home' market with a high degree of cooperation may be better able to compete more effectively in larger arenas, since the local market can discover the hidden potential of technologies and services that might not have time to develop in a more myopically and fiercely competitive environment, but can be the basis of sustainable advantage once sufficiently mature.

This is particularly true of solutions that require innovation and changed working arrangements from all stakeholders. This leads to a pair of recommendations to insulate early-stage development and to encourage wider exposure of later stage initiatives.

[177] A partial exception is provided by initiatives in which small and innovative firms can use the Smart City as a testbed and demonstration window to extend technological and service-based extensive competition (competing on the basis of differentiated offers, rather than cheaper or better versions of the same thing).

[178] Porter (2008).

**Recommendation 2B**: Smart Cities and Smart City initiative designers should promote local modularity for early-stage initiatives. **If switching costs are low, users and customers may not be able to contribute to the co-creation of new solutions, because they may not participate for long enough or invest enough of their own efforts.** This can lead to excessive switching.[179] In this sense, the geographical concentration of 'unscaled' Smart Cities reduces mobility during the early phases.

**Recommendation 2C**: Smart Cities and Smart City initiative designers should facilitate exit and change of participation during the latter stages of an initiative**. If switching costs are high,[180] stakeholders may be reluctant to become engaged for fear of stranded investments[181] or leave if the initiative does not meet their needs.** A Smart City strategy based on collective development and ownership and on extending the local stakeholder network may provide an exit channel for individual players. Such a channel would have to ensure that the scrapping the entire enterprise is not required. The implementation of the initiative will generate a community of entities (people, firms, government offices) who can make use of aspects of the project and are therefore willing to sustain its continuation or step in when early participants leave.

**Recommendation 2D**: **Funding support for Smart City initiatives should incorporate structural conditionality.** The 'power of the purse' may be used to encourage Smart City initiatives designed to take advantage of the correlates of success identified in this survey by encouraging the inclusion of specific characteristics, favouring diversified or holistic initiatives and phasing the external development and linkages of projects.

- Local communities are likely to resist copying even good practice from elsewhere on the grounds that it was 'not invented here'. In this respect, and especially under current conditions for local government finance, national and community-level assistance tied to the use of successful Smart City characteristics may be particularly useful.

National or international initiatives may not reflect local conditions or may represent an unwanted transfer of sovereignty. If so, multi-city project scaling may be preferred to replication (see Section 7.1.3). However, it may be difficult to extend to initiatives embodying more localised characteristics. Economic and societal problems may be strongly localised; problems related to education and economic stimulus may be insufficiently 'embedded' in the local economy to generate adequate returns (if people trained at great expense move elsewhere to work); problems of mobility may be strongly linked to physically fixed infrastructures and to policies that are poorly coordinated between the cities that are responsible for most of the congestion. One approach is to encourage projects with a greater range of characteristics; the common problems provide a platform for engagement, but each stakeholder group can use their participation to link up with others sharing the same specific concerns and thereby serve their own as well as the collective agenda. In the process, such projects are likely to generate solutions that are more effectively 'joined up', alleviating some of the fragmentation that limits the effectiveness of non-integrated transport policies, or mobility strategies that are not coordinated with separately developed education or economic development strategies.

[179] Katz and Shapiro (1985) refer to this as 'excess volatility'.
[180] For example, if the initiative requires large investments or major changes in business models, processes and arrangements are needed that cannot be swiftly or cheaply reversed.
[181] Katz and Shapiro (1985) refer to this as 'excess inertia'.

Another approach is to phase the regional, national and European connection of projects, so that they are given space to develop their own unique approaches (acting as consumers of good ideas from elsewhere) before joining collaborative initiatives (like the NiCE network) and contributing their knowledge and expertise to others.

**Recommendation 2E:** Specific design procedure for structuring Smart City initiative components. **To ensure efficient and effective implementation, maximise additionality and ensure alignment of participants' capabilities and objectives, the design of an initiative (or an overarching Smart City strategy) should be rooted in the specifics of the city involved, including the stakeholders and their interests**.

- Assemble a working group of stakeholders to debate the results of a needs audit (see Recommendation 1C) in order to scope a potential initiative (identifying roles, potential participants, characteristics and specific objectives);
- Conduct a 'component audit' to see which building blocks are present, how well they work, how much capacity they currently provide and which stakeholders control them;
- Develop a 'components requirement' to accompany the implementation plan for the initiative;
- Compare the audit with the requirement to identify gaps, determine the stakeholders best placed to provide contributions in kind or able to invest in and benefit from the development of components in a specific initiative; and
- Assess the impacts of component development and inclusion and incorporate this into the business case for the initiative.

### 7.2.3. Smart City governance

**Recommendation 3A**: **The Commission should support a platform with brokerage or intermediary functions based on existing Smart City networks** (e.g. NiCE, but also the general network and others that are not fixated on the environment or multi-city projects) that could help provide guidance on objectives, facilitate multi-stakeholder engagement and sponsor a repository of business plans, case studies, and so forth.

**Recommendation 3B**: **Government and business infrastructure providers should ensure that Smart City initiatives have privileged (or at least relatively unconstrained and low-cost) access to existing infrastructures.** Business model innovation can be stimulated by providing Smart City initiatives with access to necessary infrastructure and service inputs, especially when these are publicly owned or controlled.

These infrastructures could be broadly interpreted to include providers of generic or reconfigurable services (e.g. telecommunications or energy service companies[182]), cloud-based storage, processing and data repository capabilities, and so forth.

Barriers to entry and exit: the development of solutions to the problems tackled by Smart Cities by purely private entities or by government entities operating on national or international scale leads to barriers that threaten Europe's ability to develop, deploy and benefit from innovative solutions.

[182] Bertoldi, Rezessey and Vine (2006).

**Recommendation 3C**: Smart City support providers should insist on multi-stakeholder governance with lay (user) representation and on integrated project teams.[183] Private firms are likely to prefer proprietary models or closed architectures. This can lead to net loss of welfare and economic distortion that is magnified when their solutions are scaled up or rolled out to wider contexts. However, more multi-stakeholder or cooperative modes of operation (the forms of PPP used in Smart Cities and the 'smart citizen' *modus operandi* that accompanies them) will internalise these externalities at the design and pilot stage and build openness and user-centrism in from the outset.

**Recommendation 3D**: **Smart Cities and other stakeholders should encourage industry-led PPP consortia.** An imbalance of power between public and private entities may also complicate development and roll-out. In this respect, and to minimise public costs, public-private partnerships should be the preferred mode of organisation. At the same time, the potential for market distortion and capture should be minimised by the inclusion within the consortium of representatives of regulatory bodies (or commercial rivals, as mentioned above).

### 7.2.4. Supporting the development of Smart Cities

**Recommendation 4A**: **Public authorities at all levels should consider ways to use demand-side measures to stimulate demand for city-based 'smart solutions'.** Such measures[184] are a familiar part of innovation and industrial policy. The most relevant ones in this context are:

- support for business model innovation (by users of Smart City services)
- public procurement (pre-competitive procurement, e.g. of roles in Smart City initiatives, recommendation of a 'city-level-first' preference in municipal or regional procurement of specific types of services)
- standard setting based on Smart City outputs or adapted to Smart City needs (stimulated by participation of Smart City players in standards bodies, rewiring standardisation activities by Smart City-themed Horizon 2020 projects and/or the incorporation of such standards in tender requirements)
- improving regulatory frameworks to accommodate Smart City organisations and networks and to minimise burdens on (especially early-phase) local experiments with innovative approaches.[185]

**Recommendation 4B**: **Regulatory and procurement authorities should encourage Smart City initiatives by selective use of regulatory forbearance and/or pro-competitive sourcing.** Large firms (e.g. energy suppliers) may resist initiatives that threaten their current business models (e.g. by reducing overall demand).

This resistance can, to some extent, be overcome by regulatory concessions in exchange for participation or changes to constraints to ensure that the benefits of more efficient use of (infrastructure) capacity, for example, are shared among all participants. To the extent that it cannot, such initiatives may specifically seek to involve potential rivals in order to overcome market power.[186]

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[183] These involve customers, suppliers and other stakeholders, which evolve throughout the project life cycle.
[184] See e.g. Wilkinson et al. (2005).
[185] For example, an initiative to explore active demand management for energy and other utilities might aim to empower consumers to the point where existing regulatory burdens on distributors and generators are no longer appropriate or necessary; such initiatives could not be explored within many existing regulatory regimes.
[186] This is a key aspect of the 'new industrial policy' – see Aghion et al. (2011).

### 7.2.5. From Smart Cities to a Smarter Europe: replication, scaling and ecosystem seeding

**Recommendation 5A**: **Methods are needed to assess the potential for scalability** at project inception, re-evaluate it when the results are known and identify the instruments and activities necessary to optimise the dissemination of good practices and solutions on a pan-European scale. Scalability potential should also be included in the evaluation methodology referred to above.

Further recommendations at European Community level can be based on the position that 'Smart City services' constitute public goods, and therefore that special arrangements could be made to encourage their provision. Recommendations aligned with European competence and ongoing initiatives at European Community level include our Recommendation 5B.

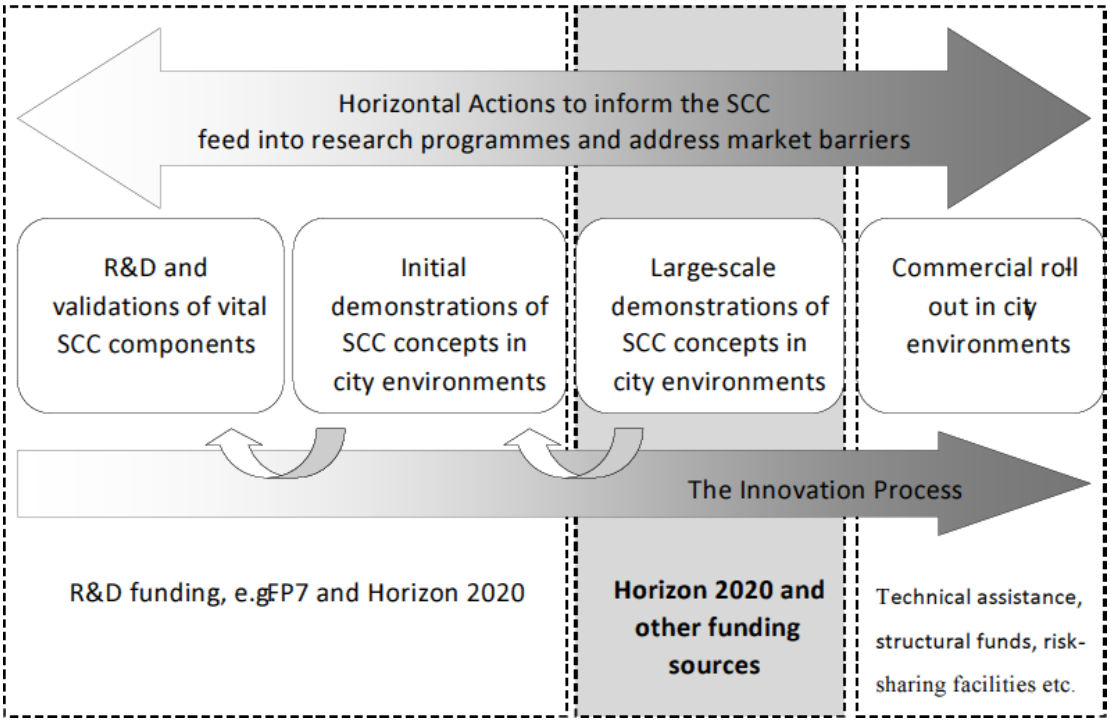
**Recommendation 5B**: **The Commission should consider including Smart Cities as a use case in the context of the future internet PPP or requiring or urging the inclusion of Smart City stakeholders in large-scale pilots**, standards bodies, and so on. This recommendation would exploit the synergies between Smart Cities and EC-level 'solution development'.

The possible gateway role of Smart City consortia for small and locally based businesses links them to other forms of SME support.

In this regard, the **EC should also consider ways to further support the Smart Cities and Communities – European Innovation Partnership[187] (SCC-EIP)**. This initiative, undertaken in conjunction with the EC's Innovation Union agenda,[188] is based on three pillars (urban energy production and use (Smart Energy), urban transport and mobility (Smart Mobility) and urban ICT (which in this report serves as a horizontal or defining characteristic for Smart City initiatives). It seeks 'a way to scale up in a comprehensive and integrated way the efforts undertaken by the related urban energy efficiency component of the Strategic Energy Technology Plan in 2011'. Its framework for action, which includes many of the measures at European Community level recommended here, is shown in Figure 25).

[187] See European Commission (2012b)
[188] http://ec.europa.eu/research/innovation-union/index_en.cfm

**Figure 25: The SCC-EIP framework**[189]




Specific actions under this recommendation include:

- drawing attention (through the platform) to the relevant parts of Horizon 2020
- supporting Lighthouse projects that address common (but local) problems – in particular, underwriting linkages between Smart Cities and the most relevant Lighthouse projects and providing financial support for the transposition of project results to municipal contexts.

Further recommendations arise directly from the economic and government contexts within which Smart City participants operate. These sources of market failure include the size of the task. Much of the urban housing stock is old, energy-inefficient and difficult or costly to upgrade swiftly, especially in the current economic climate. But speed and pace are of the essence – not only are the environmental and societal problems addressed by Smart Cities challenging in their own right, but failure rapidly to attain critical mass will damage the sustainability, competitiveness and effectiveness of current initiatives. (This can be seen in the Chapter 4 analysis of the different types of initiative.) **This means that the portfolio of Smart City projects across the Single Market should be carefully structured.**

**Recommendation 5C**: **European Community resources should be allocated to facilitate translation and transfer.** The risks and disincentives of learning from others are well known.[190] In order to make appropriate decisions, local stakeholders must be able to assess the potential and opportunity cost of learning from others. This involves discovery (addressed by Recommendation 2A-D) and the negotiation of rights, control access and payment (where needed). **To strengthen this market in Smart solutions, the EC could use risk capital participation instruments or direct grants to overcome initial financial hurdles or underwrite risks.**

189 Source: European Commission (2012b) http://ec.europa.eu/energy/technology/initiatives/doc/2012_4701_smart_cities_en.pdf

190 Van Oranje and Weehuizen (2009).

**Recommendation 5D**: **Public authorities and commercial participants in Smart City initiatives should explore the creation and use of specific new intellectual property ownership rights or contract forms.** To minimise costs and encourage sharing, the European Community could also explore new forms of ownership (extending to local government entities as well as commercial entities, financial backers and citizens). This would give it a modest stake in the further application and exploitation of the intellectual property (including case material) they generate. This would facilitate dissemination and encourage the creation and codification of useful human and social capital tied to the Smart City experience. The particular advantage is that it can relieve tensions between the essentially collaborative or joint nature of Smart City initiatives (which are generally less structured and more fluid than conventional service contract relationships) and the proprietary or individual nature of economic and other property rights.[191]

[191] Intellectual property right can include rights of identification (to be named as a creator or author), control (of use or modification) or participation (e.g. in further development or application) that do not have a monetary expression. Examples include the classical *droit morale* or modern Creative Commons, Copyleft or GPL licences.

# REFERENCES


- Achaerandio, R., Bigliani, R., Curto J. and Gallotti, G. (2012) 'Smart Cities Analysis in Spain 2012 – The Smart Journey', IDC. Available at: http://www.portalidc.com/resources/white_papers/IDC_Smart_City_Analysis_Spain_EN.pdf (visited 25 July 2013).
- Aghion, P., Dewatripont, M., Du, L., Harrison, A. and Legros, P. (2011) 'Industrial Policy and Competition', NBER Working Paper 18048. Available at: http://www.nber.org/papers/w18048 (visited 25 July 2013).
- Alcatel-Lucent (2012) 'Getting Smart About Smart Cities'. Available from http://www2.alcatel-lucent.com/knowledge-center/public_files/abs-smart-cities-market_opportunity.pdf (visited 4 September 2013).
- APA (2013) 'Häupl und Bures wollen Wien noch smarter machen' ['Häupl and Bures want to make Vienna smarter']. Available at : http://science.apa.at/rubrik/politik_und_wirtschaft/Haeupl_und_Bures_wollen_Wien_noch_smarter_machen/SCI_20130724_SCI40111351013842644 (visited 1 August 2013).
- Batty, M., Axhausen, K. W., Giannotti, F., Pozdnoukhov, A., Bazzani, A., Wachowicz, M., Ouzounis, G. and Portugali, Y. (2012) 'Smart Cities of the Future', European Physical Journal Special Topics, Vol. 214, No 1.
- Bertoldi, P., Rezessey, S. and Vine, E. (2006) 'Energy Service Companies in European Countries: Current Status and a Strategy to Foster Their Development', Energy Policy, Vol. 34, No 14, pp. 1818–1832.
- Caragliu, A., Del Bo, C. and Nijkamp, P. (2009) 'Smart Cities in Europe', Serie Research Memoranda 0048, VU University Amsterdam, Faculty of Economics, Business Administration and Econometrics.
- Chourabi, H., Taewoo, N., Walker, S., Gil-Garcia, J. R., Mellouli, S., Nahon, K., Pardo, T. A and Scholl, H. J. (2012) 'Understanding Smart Cities: An Integrative Framework', System Science (HICSS) 45th Hawaii International Conference.
- The Climate Group et al. (2011) 'Information Marketplaces: The Economics of Cities'. Available at http://www.theclimategroup.org/what-we-do/publications/information-marketplaces-the-new-economics-of-cities/ (visited 04 September 2013)
- The Climate Group (2013) 'Agile Cities – Faster, Smarter, Greener'. Available at: http://www.theclimategroup.org/what-we-do/publications/faster-smarter-greener-the-state-of-city-innovation-on-climate-change-and-other-urban-challenges/ (visited 25 July 2013).
- Cohen, B. (2012a) 'The Top 10 Smart Cities On The Planet', Co.Exist, 11 January. Available at: http://www.fastcoexist.com/1679127/the-top-10-smart-cities-on-the-planet (visited 22 July 2013).
- Cohen, B. (2012b) 'The Top 10 Smartest European Cities', Co.Exist, 11 November. Available at http://www.fastcoexist.com/1680856/the-top-10-smartest-european-cities (visited 27 September 2013).
- Cohen, B. (2012c) 'What Exactly is a Smart City?', Co.Exist, 19 September. Available at http://www.fastcoexist.com/1680538/what-exactly-is-a-smart-city (visited 27 September 2013).

- Dekkers, M., Polman, F., te Velde, R. and de Vries, M. (2006) 'MEPSIR – Measuring European Public Sector Information Resources: Final Report of Study on Exploitation of Public Sector Information – Benchmarking of EU Framework Conditions', report for the European Commission.
- Dempsey, N., Bramley, G., Power, S. and Brown, C. (2011) 'The Social Dimension of Sustainable Development: Defining Urban Social Sustainability', Sustainable Development, Vol. 19, pp. 289–300.
- Desmet, K. and Rossi-Hansberg, E. (2013) 'Analyzing Urban Systems: Have Mega-Cities Become Too Large?', Princeton University Working Paper. Available at: http://www.princeton.edu/~erossi/WBChapterKD%26ERH.pdf (visited 25 July 2013).
- Dirks, S., Gurdgiev, C. and Keeling, M. (2010) 'Smarter Cities for Smarter Growth: How Cities Can Optimize Their Systems for the Talent-Based Economy', IBM Global Business Services, Somers, NY. Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2001907 (visited 25 July 2013).
- The Economist (2012) 'Mining the Urban Data', The Economist, 2 June. Available at: http://www.economist.com/printedition/2012-06-02 (visited 1 August 2013).
- EurActiv (2013) 'Europe Looks to Tech Hubs to Lure Foreign Investment', 5 February. Available at: http://www.euractiv.com/specialreport-internet-europes-f/europe-looks-tech-hubs-lure-fore-news-517569 (visited 25 July 2013)
- European Commission (2011a) 'eGovernment Benchmark Pilot on Open Government and Transparency', prepared by Capgemini, IDC, Rand Europe, Sogeti and DTi. Available at: http://ec.europa.eu/information_society/newsroom/cf/dae/itemdetail.cfm?item_id=10145 (visited 25 July 2013).
- European Commission (2011b) 'Report of the Meeting of Advisory Group ICT Infrastructure for Energy-Efficient Buildings and Neighbourhoods for Carbon-Neutral Cities: Strategic Priorities for the New Framework Programme for Research and Innovation Covering the Period 2014–2020', 16 September. Available at: http://ec.europa.eu/information_society/activities/sustainable_growth/docs/smart-cities/smart-cities-adv-group_report.pdf (visited 25 July 2013).
- European Commission (2011c) 'The Urban and Regional Dimension of Europe 2020: Seventh Progress Report on Economic, Social and Territorial Cohesion', report from the Commission. Available at: http://ec.europa.eu/regional_policy/sources/docoffic/official/reports/interim7/interim7_en.pdf (visited 25 July 2013).
- European Commission (2012a) 'Energy Efficient Buildings'. Available at: http://ec.europa.eu/research/industrial_technologies/energy-efficient-buildings_en.html (visited 25 July 2013).
- European Commission (2012b) 'Smart Cities and Communities – European Innovation Partnership'. Available at: http://ec.europa.eu/energy/technology/initiatives/doc/2012_4701_smart_cities_en.pdf (visited 25 July 2013).
- European Commission (2013) Europe 2020 Targets. Available at: http://ec.europa.eu/europe2020/europe-2020-in-a-nutshell/targets/index_en.htm (visited 27 September 2013).

- European Parliament (2013) 'Ubiquitous Developments of the Digital Single Market'. Available at: http://www.europarl.europa.eu/RegData/etudes/etudes/join/2013/507481/IPOL-IMCO_ET(2013)507481_EN.pdf (visited 25 November 2013).
- Eurostat (2008) 'Urban Audit 2004'. Available at: http://www.urbanaudit.org/CityProfiles.aspx (visited 25 July 2013).
- Giffinger, R. and HGudrun, H. (2010) 'Smart Cities Ranking: An Effective Instrument for the Positioning of Cities', Architecture, City, and Environment, Vol. 4, No 12, pp. 7–25.
- Giffinger, R. and Pichler-Milanovic, N. (2007) 'Smart Cities: Ranking of European Medium Sized Cities', Vienna University of Technology, University of Ljubljana and Delft University of Technology. Available at: http://www.smart-cities.eu/ (visited 5 July 2013).
- Gorski, J. and Yantovsky, E. (2010) 'Zero Emissions Future City'. Available at http://cdn.intechopen.com/pdfs/11938/InTech-Zero_emissions_future_city.pdf (visited 30 September 2013).
- Haque, U. (2012) 'Surely There's a Smarter Approach to Smart Cities?', Wired, 17 April. Available at: http://www.wired.co.uk/news/archive/2012-04/17/potential-of-smarter-cities-beyond-ibm-and-cisco (visited July 2013).
- Hollands, R. G. (2008). Will the real smart city please stand up? Intelligent, progressive or entrepreneurial?. City, 12(3), 303-320.
- Jerath, A. (2011) 'Delhi-Mumbai Industrial Corridor to Spawn 7 "smart" cities', Times of India.
- Katz, M. and Shapiro, C. (1985) 'Network Externalities, Competition, and Compatibility', American Economic Review, Vol. 75, No 3, pp. 424–440.
- Kaul, I., Grunberg, I. and Stern, M. (1999) 'Global Public Goods: International Cooperation in the 21st Century', Oxford University Press, NY.
- Melchor III (2012) 'The European-wide and Worldwide Smart Cities Initiatives', 5 September. Available at: http://es.slideshare.net/budmelchor/the-europeanwide-and-worldwide-smart-cities-initiatives (visited 25 July 2013).
- MIT (2013) 'Smart Cities Group', Cambridge, MA. Available at: http://smartcities.media.mit.edu/frameset.html (visited 25 July 2013).
- Nam, T. and Pardo, T. A. (2011) 'Conceptualizing Smart City With Dimensions of Technology, People, and Institutions', from Proceedings of the 12th Annual International Digital Government Research Conference: Digital Government Innovation in Challenging Times, ACM New York, NY. Available at: http://smartcitiescouncil.com/system/files/resources/Conceptualizing%20smart%20city.pdf (visited 25 July 2013).
- Nijkamp, P. and Kourtit, K. (2013) 'The 'New Urban Europe': Global Challenges and Local Responses in the Urban Century', European Planning Studies, Vol. 21, No 3, pp. 291–315.
- Peck, J. (2005) 'Struggling with the Creative Class', International Journal of Urban and Regional Research, Vol. 29, No 4, pp. 740–770.
- Porter, M. (2008) 'Competitive Advantage: Creating and Sustaining Superior Performance', New York.

- Prothmann, H., Tomforde, S., Lyda, J., Branke, J., Hähner, J., Müller-Schloer, C. and Schmeck, H. (2012) 'Self-Organised Routing for Road Networks', Self-Organizing Systems, Springer, pp. 48–59.
- Schaffers, H., Komninos, N., Pallot, M., Trousse, B., Nilsson, M. and Oliveira, A. (2011) Smart Cities and the Future Internet: Towards Cooperation Frameworks for Open Innovation, Future Internet Assembly, LNCS 6656.
- Schuurman, D., Baccarne, B., de Marez, L. and Mechant, P. (2012) 'Smart Ideas for Smart Cities: Investigating Crowdsourcing for Generating and Selecting Ideas for ICT Innovation in a City Context', Journal of Theoretical and Applied Electronic Commerce Research, Vol. 7, No 3.
- Smart Cities and Communities (2013) 'Key Messages for the High-Level Group from the Smart Cities Stakeholder Platform Roadmap Group'. Available at: http://eu-smartcities.eu/sites/all/files/Final%20key%20messages%20to%20HLG%20from%20Stakeholder%20Platform_FINAL.pdf (visited 25 Jul 2013).
- StatSoft (n.d.) 'How to Group Objects Into Similar Categories: Cluster analysis'. Available at: http://www.statsoft.com/textbook/cluster-analysis/ (visited 27 September 2013).
- United Nations Statistics Division (2011) Demographic Yearbook 2009–2010, United Nations, New York, pp. 350–364. Available at: http://unstats.un.org/unsd/demographic/products/dyb/dyb2009-2010.htm (visited 25 July 2013).
- Van Beurden, H. (2011) 'Dynamics of Smart Cities: Inspiring Views from Experts Across Europe', Amsterdam.
- Van Oranje, C. and Weehuizen, R. (2009) 'Innovative and Adaptive Pan-European Services for Citizens in 2010 and Beyond'. Available at: http://www.euregov.eu/deliverables/reports/WP3_Indicators.pdf (visited 25 July 2013).
- Walravens, N. and Ballon, P. (2013) 'Platform Business Models for Smart Cities: From Control and Value to Governance and Public Value', Communications Magazine, IEEE, Vol. 51, No 6.
- Washburn, D. and Sindhu, U. (2009) 'Helping CIOs Understand "Smart City" Initiatives', Growth. Available at: http://c3328005.r5.cf0.rackcdn.com/73efa931-0fac-4e28-ae77-8e58ebf74aa6.pdf (visited 25 July 2013).
- Wilkinson, R., Georghiou, L., Cave, J., Bosch, C., Caloghirou, Y., Corvers, S. and Ward, E. (2005) 'Public Procurement for Research and Innovation: Developing Procurement Practices Favourable to R&D and Innovation', Expert Group Report EUR, 21793.
- World Health Organization (2013) 'Global Health Observatory. Urban Health' Available at: http://www.who.int/gho/urban_health/situation_trends/urban_population_growth_text/en/ (visited 25 July 2013).
- Zittrain,. J. (2008) The Future of The Internet – and How to Stop It, Yale University Press, New Haven.

# ANNEX 1: MATHEMATICAL DESCRIPTION OF THE WEIGHTED DISTANCE METRIC

This annex develops the weighted distance metric used in Section 5.1.4 and describes the procedures used to scale and compare the data from the dashboards.

## Computing the performance-weighted scores

The existing characteristics score measures a country's coverage of characteristics relative to an ideal of 100% coverage of all characteristics (Euclidean distance). In other words, if $n_i$ is the number of initiatives with characteristic $i$, $n$ is the number of initiatives and $k$ is the number of characteristics, the metric is:

$$\sum_{i=1}^{k}\left(1-\frac{n_i}{n}\right)^2 \Big/ k$$

So a country in which every characteristic is covered in every initiative would get a score of 1 ($n_i = n$ for each $i$).

If a country is 'behind' in relation to a specific characteristic, then it ought to weight the distance from the ideal more heavily. Therefore we replace the above formula by

$$\sigma = 1 - \sqrt{\sum_i \lambda_i \left(1-\frac{n_i}{n}\right)^2}$$

where the $\lambda_i$ are weights summing to 1 reflecting the 'relevance' if that characteristic to the city involved. To obtain the weights, we consider the country's actual performance on an indicator relative to a suitable comparator.

Note that there is not a one-to-one correspondence between the performance dimensions (which are aligned to the Europe 2020 target categories) and the characteristics. The relationship of characteristic $i$ to a performance dimension $j$ is summarised by a matrix $R$ (typical element $r_{ij}$ ) of non-negative coefficients: $r_{ij}$ is higher the more important characteristic $i$ is to target j. If they were perfectly aligned and characteristic $i$ corresponded exactly to target $j$, $r_{ij}$ would = 1; otherwise it would = 0. For the sake of normalisation, we assume that the sum of the $r_{ij}$ over j is always 1 (equivalently, we normalise by this sum). If the distance of the country's performance on target $j$ ($P_j$) from the relevant comparator or target ($T_j$) is denoted $d(P_j, T_j)$, we can express the weights as:

$$\lambda_i = \frac{\sum_j r_{ij} d\left(P_j, T_j\right)}{\sum_j r_{ij}}$$

This gives the following formula for the weighted characteristics score:

$$\sigma = 1 - \sqrt{\sum_i \frac{\sum_j r_{ij}\, d\left(P_j, T_j\right)}{\sum_j r_{ij}} \left(1-\frac{n_i}{n}\right)^2}$$

It only remains to specify the distances. If the results are not to be distorted by scale effects, it is important that the distances be of comparable size; for simplicity we normalise them to lie between 0 and 1. The model developed for this study (available on request) offers three choices for the distance metric $d$:

- the difference between $T$ and $P$
- the difference between $T$ and $P$ as a percentage of $T$
- an indicator variable denoting whether $P$ is less than, equal to or greater than $T$.

The model allows for differential treatment of cities that have already surpassed their targets; this option was not used in the analysis given in the main body of the report, but might be relevant if further information were available regarding the difference among further technology improvement, future-proofing, demonstration effects and coalition-building as motives for pursuing an initiative orientated to an area of relatively strong performance.

The models also allows the user to choose one of four options for each of *Pj* and *Tj*; the country's actual performance, the EU-27 average, the country-specific Europe 2020 target and the overall Europe 2020 target.

The numerical scaling of the comparators depends on the way *P* and *T* are measured. Some targets are naturally expressed as a percentage; in such cases it is reasonable to use any of the three distance metrics. For variables measured in natural units (e.g. tonnes of $CO_2$) only the percentage difference and indicator metrics are appropriate.

The appropriate procedure also depends on the nature of the target and the actual. In some cases, the performance data are in natural units (e.g. greenhouse gas or $CO_2$ emissions or primary energy usage), while the target specifies a percentage reduction or increase. In such cases, it is necessary to convert the target to natural units. For instance, if the actual level is currently *Y* and the target is an *s%* reduction, the target variable *T* should be *(1-s)*Y*.

## Preparing the data

In order to compute the performance-weighted multipliers for the characteristic counts, it was necessary to put the performance and national target data on a common footing.

The raw data were taken from the dashboard files, and modified as follows.

**Employment**: actual data were provided as a percentage of working population; target percentages were treated as a lower bound for acceptable performance. In other words, the weight increased, the further a country's rate was *below* its target.

**R&D**: actual data were provided in the form of Gross domestic expenditure on R&D (GERD) as a percentage of GDP; the target percentage was treated as a lower bound for acceptable performance. In other words, the weight increased, the further a country's rate was *below* its target. The exception was Greece, where no data were available from public sources – in consequence, this target was not included for this country.

**GHG emissions**: actual data were provided as a quantity (MT $CO_2$ equivalent, also in per-capita and per-GDP terms) and left in quantity terms; the target reduction was converted into a target level of emissions – if the target was *t*% reduction, the target *level* was *(1-t)**current level of emissions. This level was treated as an upper bound for acceptable performance. In other words, the weight increased, the further a country's rate was *above* its target. Note that it was necessary to use levels rather than percentages because there was no natural *numeraire*.

**Renewable energy**: the actual data were provided as a percentage of energy generation; the target percentage was treated as a lower bound for acceptable performance. In other words, the weight increased, the further a country's rate was *below* its target.

**Energy efficiency**: this was defined in the Europe 2020 scorecard as 'reduction of energy consumption in Mtoe'. The weighting computation used data on primary energy consumption (again in level, per capita and per-GDP terms). The target reduction was converted into a target level of primary energy consumption – if the target was *t*% reduction, the target *level* was *(1-t)**current level of primary energy consumption.

This level was treated as an upper bound for acceptable performance. In other words, the weight increased, the further a country's rate was *above* its target. Note that it was necessary to use levels rather than percentages because there was no natural *numeraire*.

**Early school leavers:** the actual data were provided as a percentage of relevant school population; the target percentage was treated as an upper bound for acceptable performance. In other words, the weight increased, the further a country's rate was *above* its target.

**Tertiary education**: the actual data were provided as a percentage of the relevant population; the target percentage was treated as a lower bound for acceptable performance. In other words, the weight increased, the further a country's rate was *below* its target.

**Population at risk of poverty**: This was based on data provided in the Europe 2020 website on populations at risk of poverty. The targets were stated in different ways for different countries; they were put into approximately comparable terms as follows:

- The targets were stated in terms of the desired minimum reduction in the numbers at risk of poverty for Austria, Belgium, Germany, Greece, Spain, Finland, France (also as a percentage), Hungary, Ireland, Italy, Netherlands, Romania, Slovenia, Netherlands and the EU-27 (this latter figure was used to generate targets for countries that did not set national targets). In this case, we computed the numbers of people at risk of poverty in the population by multiplying the population by the 'at risk of poverty' percentages from the dashboard, we then subtracted the target reduction and converted this back to a target maximum percentage of the population.
- Targets were stated as percentages for Estonia and Sweden:
    - For Estonia the 'at risk of poverty' rate was 21.7% and the population was 1,340,194, implying there were 290,822 people at risk of poverty; the target is to reduce the risk by a factor of 15%/17.5% (it was necessary to use the ratio because the reference population was 2010, when the at risk figure was 17.5% instead of the 21.7% figure given for 2011 in the dashboard, which was used for consistency with the other figures). This gives a target number of people at risk of poverty for 2011 of 290,822*(15%/17.5%) = 249,276. Dividing this by the population gives the target maximum percentage of people at risk of poverty.
    - For Sweden, the target was a 14% reduction in people 'not in the labour force' – for simplicity, this was treated as a 14% reduction in the number of people at risk of poverty. The current number at risk of poverty is 15% of 9,415,570 = 1,412,336, implying a target figure of 1,318,180 and a target maximum percentage of 14%.
- The UK declined to specify a target, so we applied the overall EU-27 target maximum percentage (20.22%) to the number at risk (applying the percentage from the actual data in the dashboard to the population).

Denmark used a complex alternative computation based on low work intensity households; we did not compute a target percentage, but instead assumed that the target was met.

# ANNEX 2: SUMMARY TABLE OF THE SAMPLE OF 50 SMART CITY PROJECTS ANALYSED AGAINST THE OBJECTIVES DESCRIBED IN CHAPTER 4[192]

| City | Country | Population | Smart Cities projects | Smart Governance | Smart Economy | Smart Mobility | Smart Environmen | Smart People | Smart Living | Size | Region |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Amsterdam | Netherlands | 779,808 | 2 | x | x | x | x | x | x | M | NW |
| Antwerp | Belgium | 480,721 | 1 | | | | x | x | x | S | NW |
| Athens | Greece | 789,166 | 1 | x | | | x | x | x | M | MED |
| Barcelona | Spain | 1,620,437 | 3 | x | x | x | x | x | x | L | MED |
| Bilbao | Spain | 354,024 | 1 | | x | x | x | | x | S | MED |
| Bremen | Germany | 547,340 | 1 | | | x | x | x | x | M | NW |
| Budapest | Hungary | 1,727,621 | 1 | | | x | x | x | | L | NE |
| Cologne | Germany | 1,007,119 | 3 | x | x | | x | x | x | L | NW |
| Copenhagen | Denmark | 541,989 | 5 | x | x | x | x | x | x | M | SC |
| Coventry | UK | 316,900 | 1 | x | | | x | | | S | NW |
| Dublin | Ireland | 506,211 | 1 | x | x | x | x | x | x | M | NW |
| Eindhoven | Netherlands | 216,036 | 1 | | | x | x | x | | S | NW |
| Enschede | Netherlands | 157,838 | 1 | | | x | | | | S | NW |
| Florence | Italy | 370,092 | 1 | x | | | x | x | | S | MED |
| Glasgow | UK | 592,820 | 1 | | | x | x | x | x | M | NW |
| Gothenburg | Sweden | 491,630 | 1 | x | | | x | | | S | SC |
| Hamburg | Germany | 1,786,448 | 2 | | x | x | x | x | x | L | NW |
| Helsinki | Finland | 588,549 | 2 | x | x | x | x | x | x | M | SC |
| Ljubljana | Slovenia | 272,220 | 1 | | | x | x | | x | S | SE |
| London | UK | 8,308,000 | 2 | x | x | x | x | x | | L | NW |
| Lyon | France | 474,946 | 1 | | | | x | | x | S | NW |
| Malmo | Sweden | 278,523 | 1 | x | x | | x | x | x | S | SC |

[192] 50 projects across 37 cities – where x denotes the presence of a given characteristic across the portfolio of initiatives in a given city

| City | Country | Population | Smart Cities projects | Smart Governanc | Smart Economy | Smart Mobility | Smart Environme | Smart People | Smart Living | Size | Region |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Manchester | UK | 503,000 | 1 | x | x | x | x | x | x | M | NW |
| Mannheim | Germany | 313,174 | 1 | | x | | x | x | | S | NW |
| Milan | Italy | 1,315,803 | 1 | x | | x | x | x | x | L | MED |
| Miskolc | Hungary | 168,651 | 1 | | x | | x | | | S | NE |
| Munich | Germany | 1,353,186 | 1 | x | | | x | x | | L | NW |
| Oulu | Finland | 141,671 | 1 | x | x | | x | x | x | S | SC |
| Stockholm | Sweden | 789,024 | 1 | x | | x | x | x | x | M | SC |
| Tallinn | Estonia | 399,816 | 1 | | | x | x | | | S | NE |
| Tampere | Finland | 213,217 | 1 | x | x | | x | x | | S | SC |
| Thessaloniki | Greece | 385,406 | 1 | x | x | x | x | | | S | MED |
| Tilburg | Netherlands | 206,240 | 1 | | | | x | x | | S | NW |
| Tirgu Mures | Romania | 143,939 | 1 | x | | | x | x | x | S | SE |
| Vienna | Austria | 1,714,142 | 2 | | | x | x | x | x | L | NW |
| Zaragoza | Spain | 674,719 | 1 | | | x | x | | | M | MED |
| Aarhus | Denmark | 310,801 | 1 | | x | | x | x | | S | SC |

# ANNEX 3: DISTRIBUTION OF SMART CITY PROJECTS ACROSS THE FIVE PROJECT TYPES

| Smart City neighbourhood units | Testbed micro infrastructures | Intelligent traffic systems | Resource management systems | Participation platforms |
|---|---|---|---|---|
| **Smart City characteristics typically covered**:<br>Smart Environment, Smart Mobility, Smart Economy and Smart Living<br>**Projects**<br>Blue Gate Antwerp<br>Metropolitan Bilbao<br>Copenhagen Nordhavn<br>Hamburg Hafen City<br>Mass-retrofitting London Neighbourhood Hackbridge<br>Lyon Smart Community<br>Oulu Arctic City<br>Stockholm Royal Seaport<br>Tampere ECO2<br>Vienna Aspern | **Smart City characteristics typically covered**:<br>Smart Environment, Smart Mobility, and Smart Economy<br>**Projects**<br>Amsterdam Climate Street<br>Smart Streets of Barcelona suburb Sant Cugat<br>Cologne Klima Strasse<br>Glasgow Smart Street Lighting<br>London Greenwich Peninsula OS<br>Milan Smart Light<br>Tilburg Smart Street Lights | **Smart City characteristics typically covered**:<br>Smart Mobility and Smart Environment<br>**Projects**<br>TIDE<br>Copenhagen Transportation Integration<br>Copenhagen Cycling Lanes<br>Coventry electric vehicle infrastructure<br>Dublin Road Congestion System<br>Eindhoven Traffic Flow System<br>Enschede Vehicle Inductive Profile<br>Civitas<br>Tallinn Smart Card System<br>Thessaloniki Smart Mobility<br>Zaragoza Traffic Monitoring | **Smart City characteristics typically covered**:<br>Smart Environment, Smart Governance, Smart Economy and Smart Living<br>**Projects**<br>Barcelona smart grids and smart metering<br>Barcelona solar powered hot water ordinance<br>Bremen Environmental Building Management<br>Cologne ship-to-grid<br>Cologne Smart metering<br>The Copenhagen Sewerage Management System (The Harbour Bath)<br>Copenhagen Middelgrunden Wind Power Project<br>Gothenburg Celsius<br>Smart Power Hamburg<br>Mannheim E Energy<br>Miskolc Geothermal Central Heating<br>Munich Smart Grid System<br>Vienna Citizens' Solar Power Plant<br>Aarhus Cities in Water Balance | **Smart City characteristics typically covered**:<br>Smart Governance, Smart Economy and elements of other characteristics depending on project scope<br>**Projects**<br>Amsterdam Opent.nl and Apps for Amsterdam<br>Periphea<br>Florence Open Data<br>Helsinki Digital Urban Services<br>Helsinki Developer Portal<br>Citadel<br>CitySDK<br>EU Platform for Intelligent Cities (EPIC) |

# ANNEX 4: ADDITIONAL INITIATIVES DESCRIBED IN CHAPTER 4

| | Description and Objectives | Stakeholders and governance | Funding | Benefits/impacts/achievements | Sources |
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| **Antwerp** | | | | | |
| Blue Gate Antwerp | "Blue Gate Antwerp is being developed into a water-linked eco-effective industrial park. With this site, the City of Antwerp and the Flemish Region want to attract innovative businesses – both domestic and international – marking a new milestone for Antwerp in its innovative history".<br>"Sound, professional park management will help companies achieve the ambitions of Blue Gate Antwerp and focus on their core business. A robust infrastructure with a smart grid for energy delivery and fibre-optic cable for ICT applications will also be available". | The development of Blue Gate Antwerp is led by the public administrations of Antwerp and Flanders in a participative public-private partnership with the private sector. | | "Blue Gate Antwerp offers the following specific economic advantages:<br>Its location on the river Scheldt and its proximity to the city make the site an ideal and unique base for city-regional distribution – the bundled delivery of goods to the city.<br>The nearness of the city, with its high knowledge and innovation capacity, will allow Blue Gate Antwerp to evolve into a cutting-edge industrial park that forms an 'eco-cluster' around production, research and development. Blue Gate Antwerp will help the companies on site with the recycling and/or removal of waste, the optimization of material cycles, the use as far as possible of renewable energy sources, and the application of open innovation to encourage the development of the site as an incubator/accelerator for new ideas and solutions". | http://www.bluegateantwerp.eu/en/what |
| **Bilbao** | | | | | |
| Strategic Plan for the Revitalisation of Metropolitan Bilbao | "The Strategic Plan, initiated in 1989 and launched in 1992 with the launching of Action<br>Programs, is an ongoing planning process without a predetermined deadline"<br>"Due to its methodology, and the constant change in the metropolitan environment, the Plan requires permanent updates and is therefore a dynamic process that is constantly | "Since its start, the Plan, Stressed the role of public-private partnership (over 300 people from the private sector and the public institutions were involved)".<br><br>"The Association for the Revitalization of Metropolitan Bilbao is an association of promotion | "Up to 1996, the total investment directly linked to the application of the plan amounted to over 16 billion Euro coming from local authorities, private bodies, and from European institutions". | "The open-ended character of the Plan only allows a partial assessment of the results based upon ex-post considerations on the interventions implemented. Moreover, the available information have not made it possible to carefully evaluate the mechanisms behind the coordination of such a multitude of bodies. However, the assessment states overall great achievements within land use, transport, mobility and governance".<br>"The methodology used for developing the Strategic Plan for the Revitalization of | http://www.eltis.org/studies/bilbao.pdf<br><br>http://www.dac.dk/da/dac-cities/baeredygtige-byer-2/alle-cases/groen-by/bilbao-fra-industriby-til-vidensby- |

| | Description and Objectives | Stakeholders and governance | Funding | Benefits/impacts/achievements | Sources |
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| | evaluated".<br>"The Strategic Plan envisions an "intelligent and integrated" urban growth where economic, social and environmental concerns must be carefully balanced. This approach is also fully aware of the crucial notion that urban expansion is closely related to transport priorities".<br>"The first phase of the Revitalization Plan identified eight critical issues:<br>1) Investment in human resources,<br>2) service metropolis in a modern industrial region,<br>3) mobility and accessibility,<br>4) environmental regeneration,<br>5) urban regeneration,<br>6) cultural centrality,<br>7) coordinated management by the public administration and private sector,<br>8) social action".<br><br>"Bilbao Metropoli-30 implements the Strategic Plan for the Revitalisation of Metropolitan Bilbao, which was drawn up in 1992, and the subsequent versions of the document. The original plan was drawn up by Bilbao Metropoli-30 in collaboration with more than 300 experts, most of whom were | and research, with full legal and patrimonial responsibility, established in May 1991. The Association, recognized as "Public Utility Entity" by the Basque Government in June, 1992, involves a variety of private and public actors:<br>• 29 local and regional authorities (including the Basque Government, the Bizkaia County, and the Bilbao Municipality) take part in the Association, becoming in this way the appropriate forum for the definition of the common projects in whose achievement public bodies can work in a coordinated manner;<br>• 2 universities located in Metropolitan Bilbao: The public University of the Basque Country and the private University of Deusto;<br>• 51 enterprises, either big, medium or small sized, are members of Bilbao Metropoli-30, | | Metropolitan Bilbao can be and has been transferred to other cities together with the evaluating tool, the Revitalization Indicator System, which was developed jointly by Bilbao Metropoli-30 and the University of Deusto. The power of public-private partnerships as a catalyst for change has been successfully proven in the Strategic Plan for the Revitalization of Metropolitan Bilbao". | med-sans-for-smarte-loesninger-1/?bbredirect=true |

| | Description and Objectives | Stakeholders and governance | Funding | Benefits/impacts/achievements | Sources |
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| | representatives from institutions and companies associated with the association". | which encourages the involvement of the private sector;<br>• 22 non-for-profit organizations are active members of the partnership;<br>• 26 Associates (embassies, foundations and museums)". | | | |
| **Cologne** | • | | | | |
| Klima Strasse | • "Optimized air building insulation (roof, facade, windows, etc.)<br>• Renewable energy (photovoltaic)<br>• Storing energy<br>• Innovative use of electricity (LED street lighting, smart meters)<br>• Intelligent energy management for the home (smart home for heat, light, electricity, security)<br>• Installation of additional measurement technology for better monitoring of power grids,<br>• Charging stations for electric mobility (car and pedelec) Use of electric vehicles as in the waste sector" | "While planners can give guidance only, it is the residents that shape the character of streets<br>The local residents are an essential part of the project, are not mere spectators but actors. The climate makes the street smart energy world, climate protection and energy efficiency experience able and experience" | | Reduction in CO2 emissions in general. Several buildings have undergone renovation already. Among others, these buildings are now equipped with smart meters and LED lighting. | http://www.smartcitycologne.de/klimastrasse/ |
| Ship-to-grid | "The diesel fumes of the Rhine ships pollute the air with pollutants and particulate matter | "By 2015, the owners equip their vessels "Ship-to-grid". This applies to | | "Result: While in port, the ship's diesel can be parked. The ships are powered by an environmentally friendly future energy mix of | http://www.smartcity-cologne.de/ship-to-grid/ |

| | Description and Objectives | Stakeholders and governance | Funding | Benefits/impacts/achievements | Sources |
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| | Cologne and the climate with a significant amount of $CO_2$. A large part of it does not arise during the trip, but while the ships are moored. Because their engines must also be running to generate the necessary power".<br>"Here is "ship-to-grid" (ships to the grid) remedy the situation: Both the ships and the Cologne docks are equipped with standard power outlets". | pleasure boats as well as for cargo. Several companies are supporting the project through the construction of new facilities. The Rhine energy provides the necessary network expansion".<br>"The first ship-to-grid plant will be built in the traditional Rheinauhafen. Through a collaboration of Smart City Cologne with the Federal Ministry of Transport and the Development Centre for Ship Technology and Transport Systems at the University of Duisburg-Essen is also a model for all German waterways are developed." | | the photovoltaic systems and the ultra-modern and efficient cogeneration plants of the Rhine energy." | |
| Smart metering | "The interactive "smart" meters transmit the consumption values for electricity, gas, water and heat to the energy supplier. This simplifies the payroll. This also benefits the customer".<br><br>"They can also via smart-phone, PC or display viewed at any time and thus the use of electrical consumer control much more targeted than it has so far been possible current consumption | Municipality of Cologne and RheinEnergie | | "In an unprecedented nationwide project RheinEnergie 30,000 smart meters has built in Cologne households and thus laid the foundations for the future". | http://www.smartcitycologne.de/smartmeter/ |

| | Description and Objectives | Stakeholders and governance | Funding | Benefits/impacts/achievements | Sources |
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| | values: for example, energy-intensive equipment can be like washing machines targeted at times (such as evenings or weekends) operate, where electricity is particularly cheap". | | | | |
| **Coventry** | | | | | |
| EV infrastructure | "A long-time supporter of alternative sources of energy, the city council bought its first electric vehicle (EV) back in 1995 and is now one of six UK authorities signed up to the government's Low-Carbon Vehicle Procurement Programme. It now runs 45 low-carbon vehicles, including a lorry used to deliver wheelie bins bought from Modec, a Coventry firm that makes EVs".<br>"E.ON has formed a city-wide energy partnership with Coventry City Council, to help improve the energy efficiency in the city, reduce fuel bills and help combat climate change. As part of the agreement, E.ON has already installed 6 car points and 2 bus charging points at the Coventry 2War Memorial Park and Ride site".<br>"This is the UK's first Park and Ride all electric bus infrastructure and 3 electric buses have also been provided for the Coventry South Park and Ride Scheme". | City council, E.ON, Modec, Microcab | | "Benefits include lower CO2 emissions than comparative, conventional transportation, reduced fuel bills, and cost savings through off-peak electricity charging".<br>"Professor David Bailey of Coventry University Business School says the city's low-carbon technology is flourishing because existing industries based around car production have succeeded in reinventing themselves: "Skills are being redirected into environmentally sustainable technologies of the future."" | http://www.guardian.co.uk/smarter-cities/five-routes-to-the-future |

| | Description and Objectives | Stakeholders and governance | Funding | Benefits/impacts/achievements | Sources |
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| | "Another local business, Microcab, is making cars powered by hydrogen. The city also boasts 18 electric charging stations and a hydrogen refuelling station, one of only a handful in the country". | | | | |
| **Enschede** | | | | | |
| Vehicle inductive Profile | "The system is used to collect actual travel times of vehicles by means of "smart" detection loops of traffic lights. In the test installation, this is done on three main roads in Enschede. The travel times are saved to a database, and after being processed, they are shown on four dynamic route information panels (DRIPs) on highway 35. The city of Enschede aims to utilise this technology to optimally use the available infrastructure"<br>"Every detected vehicle leaves a unique mass-induction profile, comparable to a DNA profile or fingerprint".<br>"All of the profiles are saved by the loop, intersection and exact time and are compared to other profiles. Based on whether the profiles match, travel times between intersections can be determined. The measuring system is very accurate; even vehicles of the same type and | The Municipality of Enschede and the citizens | | "The system enables large-scale and dense measurement, whereby the identification is completely anonymous, not affiliated to any person or vehicle. Changes in measured routes are easy to implement. Another advantage of this system is not just the collection of current travel time, but that this data can also be used to determine origins and destinations of the routes. By making use of the mass-induction profile, expensive street traffic surveys become superfluous".<br>"Enschede sees great possibilities for using the VIP system as opposed to the current travel time camera system. The city has decided to implement the system in 44 important junctions on main access roads in 2012. The VIP system uses anonymous data, is less prone to interference, more flexible, less sensitive to climatic conditions and vandalism proof. Also, most of the intersections have been equipped with detection loops, making large investments unnecessary".<br>"Next to this, the city of Ensched wants to use the data for the continuous monitoring and evaluation of the city policies for traffic". | http://imtech.com/EN/traffic-infra/Traffic-Infra-Newsroom/Divisie-Imtech-Traffic-Infra-Homepage-Newsroom-Highlights/City-of-Enschede-treats-road-users-as-VIPs.html |

| | Description and Objectives | Stakeholders and governance | Funding | Benefits/impacts/achievements | Sources |
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| | make can be distinguished from each other by something as small as a towing hook". | | | | |
| **Florence** | | | | | |
| Open data | "We aim to be completely transparent and have all data verified online so it is clearly presented to the public" | The Municipality of Florence | | "City of Florence's Open Data website (http://www.opendata.comune.fi.it)which to date includes 400 datasets. Open Data has become Italy's third biggest producer of data, following the National Statistics Agency, Istat, and the Region of Lombardy" | http://www.theflorentine.net/articles/article-view.asp?issuetocId=8342 |
| **Gothenburg** | | | | | |
| CELSIUS | "CELSIUS is the largest winning projects in the Smart Cities & Communities 2011 call. The four-year project is coordinated by the City of Gothenburg and presents best practice solutions in the area of smart district heating and cooling by taking a holistic approach to overcome technical, social, political, administrative, legal and economic barriers. The project brings together excellence and expertise from five European cities with complementary energy baseline positions: Cologne, Genoa, London, Gothenburg and Rotterdam".<br>One of the key ways to maximize carbon savings in cities is to maximize the unused energy saving potential by tackling ways to effectively and efficiently recover energy losses. This can | City of Gothenburg, partner cities, EU Commission. | "The total cost for the demonstrators are 69m EUR, of which the cities themselves will provide 55m EUR. The requested EU funding enables these activities laying the foundation for the successful large scale deployment of the CELSIUS City Concept across Europe and beyond 2020. District heating and cooling solutions are generally more capital intensive than conventional energy sources. The main driver of the high cost is the initial investment of network of hot water pipes".<br>"The European | "Already today, smart district heating and cooling systems can be realized supplying nearly 85 % of the heat demand in a city from secondary energy sources. Not using it would mean that energy would simply be lost to the atmosphere. CELSIUS has a clear strategy and a pro-active approach to deployment, which will result in 50 new cities committing to the CELSIUS roadmap by the end of 2016. When fully implemented in these cities, this will lead to at least a 100TWh reduction in the use of primary energy annually. This will reduce the CO2 emissions by approximately 20 m tonnes p.a. CELSIUS aims to be a corner stone in the large scale deployment of smart energy cities that will support the EU's ambitious 20-20-20 goals and beyond". | http://www.vartgoteborg.se/prod/sk/vargotnu.nsf/1/ovrigt,goteborg_pa_vag_att_bli_en_smart_city_inom_eu<br><br>http://eu-smartcities.eu/content/celsius-smart-district-heating-and-cooling-solutions |

| | Description and Objectives | Stakeholders and governance | Funding | Benefits/impacts/achievements | Sources |
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| | be done by identifying primary and secondary energy flows within the city and then boosting energy efficiency through the smart integration of competitive highly efficient heating and cooling systems that not only maximize efficient use of primary energy, initially targeting low carbon and then moving to zero carbon systems, but also enable the utilization of the secondary, or waste, energy that is generated within the city. | | Investment bank (EIB) will be supporting the CELSIUS project in developing the strategy for large scale roll out. It will look at how European Structural Funds and financial instruments, such as JESSICA, could play an important role in enabling deployment at the scale and speed that the CELSIUS project is aiming for. The market rollout strategies will identify what needs to be done to address the barriers and so create a fully functioning market with considerable city demand for its products and services" | | |
| **London** | | | | | |
| Mass-retrofitting Hackbridge | "Hackbridge is a largely residential suburb located within the London Borough of Sutton. Hackbridge has a population of approximately 8,000 people, living in a diverse range of house types".<br>"Transformation of Hackbridge as | "In adopting Hackbridge as an innovative case study, the research team analysed not only the potential impact of the project in terms of reducing energy consumption and carbon | "Full implementation of retrofit measures will cost on average £11,500 per property, resulting in an overall cost in excess of £20m"<br>"Retrofit costs will be | "For homes in private ownership, implementing all the recommended retrofit measures would result in an overall 51.2% reduction in carbon emissions and 56% reduction in energy consumption from a 1990 baseline. The social rented sector will be unaffected".<br>"With 80% of the UKs population living in a | http://eu-smartcities.eu/content/mass-retrofitting-equitable-and-inclusive-approach |

| | Description and Objectives | Stakeholders and governance | Funding | Benefits/impacts/achievements | Sources |
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| | a pilot area within the Borough, with the aim of creating the UK's first zero-carbon sustainable suburb by 2025".<br>"Mass-retrofitting, a process of improving energy performance through adaptation and renovation at a community scale, provides the opportunity to achieve significant end-user energy efficiency and carbon savings". | emissions, but also considered the *'institutional arrangement'* underpinning the mass-retrofit proposals. In developing a comprehensive profile of Hackbridge, the research team raised questions as to the equitable distribution of benefits arising from the project. In particular, concerns were raised as to the potential divisiveness of the projects participation criteria which, at present, excludes the social rented sector from involvement in the project. Whilst acknowledging the significant potential of mass-retrofitting to save energy and reduce carbon emissions, it is proposed that future mass-retrofit proposals should be more inclusive, capable of delivering equal benefits to all residents".<br>The strategy proposes to establish a project activity framework with identified partners so that Sutton Council and BioRegional can get into a state of | subsidised by the local authority".<br>"The finance and investment strategy is based on the concept of relationship building and partnership development. It aims to move away from reactive responses to bidding opportunities when they arise and towards developing relationships with major funders and other prospective investment partners:<br>• To help secure long-term funding commitments (3 years plus) of a higher overall level<br>• • To build links with other private and charitable bodies aimed at identifying long-term partnership arrangements that add value, finance and other investment to the work that we do whilst addressing the corporate objectives of the | suburban context, the Hackbridge project has widespread applicability".<br>"The Hackbridge project is intended to stimulate a wider revitalisation of the community through environmentally innovative mixed-use redevelopment schemes". | http://www.sutton.gov.uk/CHttpHandler.ashx?id=4366&p=0 |

| | Description and Objectives | Stakeholders and governance | Funding | Benefits/impacts/achievements | Sources |
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| | | readiness to take advantage of emerging financing and investment opportunities more quickly | host body". | | |
| Greenwich peninsula OS | "Living Plan IT has developed its Urban OS (Operating System) to provide a platform to connect services and citizens. "This is about connecting things that previously never did."<br>The idea is for the Urban OS to gather data from sensors buried in buildings and many other places to keep an eye on what is happening in an urban area. The sensors monitor everything from large scale events such as traffic flows across the entire city down to more local phenomena such as temperature sensors inside individual rooms".<br>The OS completely bypasses humans to manage communication between sensors and devices such as traffic lights, air conditioning or water pumps that influence the quality of city life.<br>Living Plan IT plans to implant thousands of sensors that will monitor external and internal conditions to create smart lighting and heating systems. It also plans to test smart lamp posts on the roads. | Living PlanIT and partners including Hitachi, Phillips and McLaren Electronic Systems. 8over8, Buro Happold and Greenwich council<br>Living PlanIT aims to use the Greenwich peninsula as a testbed for new technologies running on the system. | | Having one platform managing the entire urban landscape of a city means significant cost savings, implementation consistency, quality and manageability.<br>Independent developers will also be able to build their own apps to get data and provide certain services around a city.<br>Applications on smart-phones could hook into the Urban OS to remotely control household appliances and energy systems, or safety equipment to monitor the wellbeing of elderly people. | http://www.bbc.co.uk/news/technology-17940797.<br><br>http://living-planit.com/pr_Greenwich_Partner_Event.htm |

| | Description and Objectives | Stakeholders and governance | Funding | Benefits/impacts/achievements | Sources |
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| | Other technologies to be tested with the platform include smart vests that have microsensors embedded in them to monitor heart rate and other vital signs. | | | | |
| **Mannheim** | | | | | |
| E Energy | "The Model city of Mannheim project concentrates on an urban conurbation with a high penetration rate in which renewable and decentralized sources of energy are used to a large extent. Within the framework of the E-Energy project, a representative large-scale trial is being conducted both here and in Dresden to demonstrate the project can be applied and translated to other regions. The trial uses new methods to improve energy efficiency, grid quality, and the integration of renewable and decentralized sources of energy into the urban distribution network". | **Consortium:**<br>MVV Energie AG<br>DREWAG - Stadtwerke Dresden GmbH<br>IBM Deutschland GmbH<br>Power PLUS Communications AG<br>Papendorf Software Engineering GmbH<br>University of Duisburg-Essen<br>ISET - Verein an der Universität Kassel e.V.<br>ifeu Heidelberg GmbH<br>IZES gGmbH | | "The focus is on developing a cross-sectorial approach (involving electricity, heating, gas and water) to interconnect the consumption components with a broadband powerline infrastructure<br>Electricity is offered to customers close to the point of generation and directly when the power is generated. This avoids transporting power (and associated power loss), and includes the use of decentralized energy storage units.<br>Proactive users in the energy market ("prosumers") can gear their power consumption and their power generation towards variable pricing structures. Furthermore, real-time information and energy management components also aim to help the customer contribute to even greater energy efficiency" | http://www.e-energy.de/en/95.php |
| **Miskolc** | | | | | |
| Geothermal central heating | "In September 2010, results from the first well exceeded expectations, identifying it as one of the best low temperature wells in mainland Europe with hot water at 100°C available at an expected output of 70 to 90 litres per second. Five geothermal | The Muinicipality of Miskolc and ABB.<br><br>PannErgy, a Hungarian geothermal power company in partnership with Mannvit, an Icelandic geothermal engineering | | "Miskolc city's district heating system, reducing greenhouse gas emission by 40 percent compared with the previous gas-based heating system. The geothermal project produces 660,000-1,000,000 gigajoules (GJ) of energy annually providing nearly 32,000 households and 1,000 public amenities (university, swimming pool, etc.) | http://www.paneuro.net/abb-is-major-supplier-for-the-biggest-geothermal-power-plant-in-hungary-and-central- |

| | Description and Objectives | Stakeholders and governance | Funding | Benefits/impacts/achievements | Sources |
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| | wells have now been established in the surrounding area of Miskolc city, which is the largest geothermal investment in the region". | company<br><br>"In the future ABB hopes to work closely with PannErgy to help them achieve their goal to generate large volumes of heat energy and electric power through the exploitation of further Hungarian geothermal resources across the country. Their aim is to produce a minimum 60 – 70 MW capacity providing about 0.8 percent of Hungary's electricity and to heat at least 70,000 households (3.5 million GJ) with geothermal energy using the existing district heating systems of Hungarian cities and towns". | | with heat.<br>With low winter temperatures in the city recorded at -35 °C, the inhabitants of Miskolc will be comforted by the knowledge that they now have a new supply of clean sustainable heat energy for their city.<br>Besides being cost effective, using thermal water as a renewable source of energy will save the city of Miskolc 33,000 tons of CO2 emission each year. At the national level, Hungary aims to obtain 14.65 percent* of its energy from renewable sources, which means by 2020 the total amount of energy gained from geothermal energy is expected to reach 12,000,000 GJ. To date the geothermal project in Miskolc comprises about 10 percent of that target". | europe/ |
| **Munich** | | | | | |
| Smart Grid System | "The main aim of SWM is to improve the reliability of planning and forecasting for decentralized power generation sources"<br><br>"The companies have integrated a total of 20 megawatts of capacity from the 12 plants which include 5 hydro stations, 1 wind farm, and 6 "unit-type cogenerating stations" (the | "Utility company SWM (Stadtwerke München, or Munich City Utilities) has teamed with Siemens AG to operate a dozen small power stations, including six renewables installations, as one "virtual power plant" from which SWM balances loads and sells excess | | "The technology from Siemens helps the utilities to use spikes in renewable power generation (wind turbine production varies with the way the wind blows, for instance) that could otherwise go to waste or overload the grid".<br><br>"SWM is using a Siemens "distributed energy management" system called DEMS, which makes note of weather forecasts, current electricity prices, and demand, and then plans | http://www.smartplanet.com/blog/intelligent-energy/munich-smart-grid-for-smart-city/14802<br><br>http://www.robertsbridge |

| | Description and Objectives | Stakeholders and governance | Funding | Benefits/impacts/achievements | Sources |
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| | release does not elaborate on the fuels)". | generation to outside its grid area". | | production accordingly. A windy forecast, for instance, would cue more reliance on the wind farm". | group.com/what-we-think/smart-cities/ |
| **Stockholm** | | | | | |
| Royal Seaport | "The project is very extensive, constituting one of the largest city planning projects in Europe. As such, it is also very ambitious in its goals to create a district that can function as a model for other growing cities around the world".<br><br>"The project is serious about embracing all aspects of sustainability. Much effort is put into the most visible features; such as planting oaks for biodiversity and creating spectacular green-design buildings".<br><br>"Social sustainability solutions are rented flats mixed with tenant-owned, and mixed uses throughout the district".<br><br>"The program also mentions inspiring ideas that could work to create social sustainability in the longer run, such as programs for participation and engagement in the district".<br><br>"ICT is an important enabler for | "As the City of Stockholm is the owner of the land, high demands are being put on the project to be on the front lines of sustainability. The project is part of Stockholm´s plans to densify the city as well as branding" Stockholm as a leading city in green urban planning. | | "When finished, Stockholm Royal Seaport plans to hold 10.000 new apartments and 30.000 new work places. In addition to housing and offices, the area will also include urban parks, an art gallery and a harbour for cruise ships".<br><br>"The ambitious project includes goals such as being fossil fuel free, made possible through initiatives such as energy efficient transportation, food waste becoming biogas as well as reuse and circulation of water, waste and energy within the district". | http://www.dac.dk/en/dac-cities/sustainable-cities-2/all-cases/master-plan/stockholm-royal-seaport-aiming-for-world-class-sustainability/<br><br>http://smartict.swedish-ict.se/files/2012/06/SRS-SC-pre-study-final-report-2011-05-25-1.00.pdf |

| | Description and Objectives | Stakeholders and governance | Funding | Benefits/impacts/achievements | Sources |
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| | many of the mechanisms that contribute to the implementation of the sustainability vision and goal of Stockholm Royal Seaport. Many of the environmental technologies build directly on ICT solutions, such as software for logistics and transport optimization. In other cases, ICT enables the communication of for example energy use feedback from the smart grid to people living and working in the district. Meetings and social activities are traditionally a matter of urban planning of places where people get together and perform activities, like public squares and places for sport activities and recreation. However, as people tend to distribute their social network to an increasingly greater degree, in many cases over areas that greatly exceed the Royal Seaport, ICT solutions for mediating social activities without requiring a lot of transportation is highly relevant". | | | | |
| **Tampere** | | | | | |
| ECO2 | "A strategic 10-year project ECO2 was started by the City of Tampere in 2010. In this project climate and energy objectives of Tampere are implemented, the city development practices are changed to support a low-carbon | "The city's political establishment has committed itself to the project, which in its initial stages will also be supported by Sitra;, The Finnish Innovation Fund" | The implementation of the project in 2010-2012 is supported by Sitra, The Finnish Innovation Fund | "2012: The greenhouse gas emission is to be reduced 3 %".<br><br>"Tools for energy-efficient city planning will be adopted and the Information Centre for Sustainable Construction and Housing will be opened". | http://www.dac.dk/en/dac-cities/sustainable-cities-2/all-cases/energy/tampere- |

| | Description and Objectives | Stakeholders and governance | Funding | Benefits/impacts/achievements | Sources |
|---|---|---|---|---|---|
| | and carbon-neutral urban structure and sustainable business"<br>"Among the 16 sub-projects and the activities and achievements within the framework of ECO2 in 2010 are the following:<br>Development of the city planning tool "Ecocity Evaluator"<br>City buildings required to be built in class A energy efficiency<br>Preparation of instructions for energy-efficient renovations<br>In the Vuores housing fair area houses required to be class A energy efficiency, reduced plot rent to passive energy houses<br>Initiation of the planning process for the light rail system" | | | "2020: The share of sustainable energy sources in the energy delivered by the local energy company is 30 %" | eco2/?bbredirect=true<br><br>http://www.sitra.fi/en/projects/eco2-eco-efficient-tampere-2020 |
| **Thessaloniki** | | | | | |
| Smart mobility project | "The new services urge the citizens to move fast and smart while protecting the environment, by visiting the website http://www.mobithess.gr, via their computer or their Smartphone"<br><br>"The system informs in real time, providing three alternative routes: the shortest, the most economical one, and the most environmentally friendly. It also covers all possible ways of commuting around Thessaloniki | "The system was created with the technical support of CERTH's IMET. The Region of Central Macedonia acted as coordinator, while the Municipality of Thessaloniki, the Council of Thessaloniki Urban Transport, the National Observatory of Athens, and the Norwegian Institute for Transport Economics (TOI) also took part" | | "This new system includes:<br>• The "intelligent" Control Centre for the traffic lights system.<br>• 12 traffic lights controllers that will be installed in specific junctions along Tsimiski street, accompanied by the necessary control software for their dynamic management.<br>• Traffic records, incidents' report cameras and measurement systems for the traffic load in 65 lanes.<br>• Software, servers, and the rest of the equipment of the new Urban Mobility Centre.<br>• Five VMS in central points of downtown that will inform for the traffic condition". | http://www.et-online.gr/default.asp?pid=11&la=1&arc=12&art=166&nwID=14 |

| | Description and Objectives | Stakeholders and governance | Funding | Benefits/impacts/achievements | Sources |
|---|---|---|---|---|---|
| | (on foot, by car, by the city transportation services, or by combination of the above)". | | | "The new Control Centre can:<br>manage incidents with real time information, dynamically estimate the traffic for the rest of the day, assess and confirm the estimated travel times, dynamically manage traffic lights".<br>"All new systems are connected to the existing ones in an integrated and comprehensive control system providing all information necessary for commuters". | |
| **Tilburg** | | | | | |
| Smart street lights | "The Dutch city of Tilburg has introduced 'smart' interactive (LumiMotion range) streetlights by Philips. They provide light on demand, whenever activity is registered on the road". | Municipality of Tilburg and Philips | | "This allows energy savings up to 80 percent". | http://community.lighting.philips.com/thread/1950?start=0&tstart=0 |
| **Zaragoza** | | | | | |
| Traffic monitoring | In 2010 and in the beginning of 2011, Bitcarrier implemented its Citysolver solution in the city of Zaragoza (Spain)<br>Bitcarrier's Citysolver solution gives city traffic information in real time and makes it possible to manage traffic efficiently and provide citizens with that traffic information.<br>• "150 sensors set up in the city<br>• 700 segments analyzed<br>• 90% of the urban routes monitored<br>• 30% of traffic monitored daily"<br>"The information on travel times goes directly to the Traffic Management Centre (TMC) of | Municipality of Zaragoza, Bitcarrier and Agora Networks | | "The analysis of the data collected by the Bitcarrier sensors improves understanding of the complexity of roads, neighborhoods and events so that local authorities can now intervene in traffic flow by diverting traffic to secondary arteries, adjusting phase positions and signal lights timing at road crossings and by sending patrol officers to control and manage the situation. Besides the travel time information, Citysolver is offering daily information in real time of the origin-destination matrixes in the city of Zaragoza, which is very useful for the urban planning policies".<br>"Moreover the Zaragoza City Council also publishes the information on a public website so that citizens may check the information and plan their urban trips | http://www.bitcarrier.com/zaragoza |

| | Description and Objectives | Stakeholders and governance | Funding | Benefits/impacts/achievements | Sources |
|---|---|---|---|---|---|
| | Zaragoza City Council and it is displayed on a web interface for management purposes". | | | accordingly. The information is also available for smartphones thanks to the mobile application developed by the company Agora Networks" | |
| **Aarhus** | | | | | |
| Cities in Water Balance | "The project 'Cities in Water Balance:. The project develops systems aimed at dealing with the consequences of climate change and at ensuring sustainable utilisation of water resources".<br>"In addition, the project's objective is that the city is to create a strong green structure that will manage rainwater, counter the consequences of climate change, improve urban nature and increase the wellbeing of city dwellers".<br>"A lot of investment for the company is going into the division of the drinking water supply system. There are 1500 km of pipes in the water system and they are all connected. "This means if we have pollution in the drinking water system it will, theoretically seen, go out in the whole municipality, so now we are spending money on dividing the system in smaller areas," says Schrøder, Head of the Department of Water and Wastewater. To make monitoring | "The consortium behind Cities in Water Balance, which has the character of an innovation alliance, consists of Denmark's four largest utility companies, the three largest municipalities, leading enterprises in the field of water-related facilities, products and nature management, as well as leading knowledge institutions within water infrastructure". | City of Aarhus | "The city contributes actively to improving the quality of water circulation by removing environmentally damaging substances before rainwater and wastewater is diverted out of the city" | http://www.stateofgreen.com/en/Profiles/City-of-Aarhus/Solutions/Aarhus-%E2%80%93-A-Part-of-%E2%80%98Cities-in-Water-Balance%E2%80%99--Which-Addresses-Climate-Change<br><br>http://www.energydigital.com/company-reports/%C3%A5rhus-vand |

| | Description and Objectives | Stakeholders and governance | Funding | Benefits/impacts/achievements | Sources |
|---|---|---|---|---|---|
| | wells in the pipe system means having 17 monitoring wells plus information areas with data on such things as how slow the water is running, temperature, pressure, and if there is any changes in the water quality somewhere in the system". | | | | |

# ANNEX 5: DETAILS OF THE FIVE TYPES OF SMART CITY INITIATIVES ANALYSED IN CHAPTER 6

## Smart City neighbourhood units

### *Description and objectives*

Smart City neighbourhood units are characterised as ICT-enabled carbon neutral and sustainable neighbourhood-sized units having a complete infrastructure of Smart Environment, Smart Mobility, Smart Economy and Smart Living. Examples include the London suburb of Hackbridge, Hafencity in Hamburg, Nordhavn in Copenhagen, Stockholm Royal Seaport, Oulu Arctic City (Finland), Lyon Smart Community and Aspern in Vienna. These neighbourhood-scale Smart Cities, typically built for 10,000 to 40,000 inhabitants, are being implemented either on green field sites or as retrofitted development projects, and are usually used for expanding city capacity to meet urbanisation and boost economic development by showcasing the city as a tech and sustainability frontrunner. The projects are holistic in scope; the different neighbourhood units demonstrate complete visions of a future Smart City by incorporating infrastructure, Smart Living and sustainability – only on a smaller scale. Besides energy consumption objectives, the projects all have a strong emphasis on a complete energy infrastructure: smart grids, alternative and renewable energy and water and waste management. All projects focus on Smart Living and enhancing people's quality of life, as well as creating smart traffic infrastructures especially with regard to Smart Mobility within the public transportation and cycling infrastructure.

### *Stakeholders and governance*

All projects have set up public–private partnerships, which in most cases reflect local municipalities' need for additional finance and/or technology capability. The projects therefore rely heavily on external partnerships to bring in developer expertise, financial power and technology – typically a large number of private companies within the finance, development and utility sectors, as well as local universities. The local municipality typically backs the project with a holistic and comprehensive city strategy and co-funding. Quite a few of the projects also emphasise governance mechanisms and the active role of citizens in developing and maintaining these neighbourhood units (Smart Cities as platforms).

### *Funding*

As mentioned above many of these projects are financed with both government and private investment. The projects are part of a central city strategy despite being at sub-city or neighbourhood level; local municipalities have supplied co-financing and addressed the projects as part of an overall long-term vision for the entire city. Funding is obtained from municipalities, companies and citizens.

### *Benefits, impacts and achievements*

The Smart City neighbourhood units are all currently in the planning or development stage; most will not be in service before the late 2020s. Therefore, evaluating and assessing the success by outcomes is not currently possible, but the targets, funding, and stakeholders within these Smart City neighbourhood units could be looked at. All projects aim to become fossil-fuel free and $CO_2$ neutral when finished, but the projects generally lack clear targets for energy savings (for example, compared with baseline energy consumption or using $CO_2$ green accounting). An example of a project with clear energy consumption reduction targets is the London Hackbridge Retrofitting Project.

Here, implementing all the recommended retrofit measures for homes in private ownership should reduce carbon emissions by 51.2% overall and energy consumption by 56% compared with the 1990 baseline.

The projects strongly emphasise potential positive externalities: happier citizens, improved real estate markets, attracting tax payers or public savings. Moreover, a few focus on mixing different environments within these neighbourhood units in order to enhance social cohesion. The Nordhavn project in Copenhagen, for example, aims to mix freehold and rented flats in order to avoid luxury ghettoes and encourage a more vibrant and cosmopolitan milieu.[193] These indirect effects particularly benefit citizens and the local municipalities.

*Success vis-à-vis objectives*

The objectives of the Smart City neighbourhood unit projects and initiatives have similar (long) time horizons, expected outcomes and positive externalities. It is still too soon to say anything about real and definitive successful outcomes. However, the projects all expect to deliver the same kind of energy reduction and increased efficiencies outcomes, as well as a vast number of positive externalities including citizen satisfaction, area development, improved real estate value and an increased tax base.

*Scaling potential at EU level*

The extent of external partnerships and technology expertise brought into each project makes them extremely participant dependent. Other cities may not have the same expertise to hand. Also, the lack of sound business cases, probably due to the length of time required to see results and the lack of clear targets, is likely to hinder government granted appropriations and private investments in other cities.

On the other hand, the size and scope of the projects could provide opportunities to identify good practices. Other cities may thus benefit from reduced error rates and implementation requirements. Also, international private partners (e.g. IT or utility management) will be able to transfer knowledge to other cities more easily than local private partners only operating in one city can. On a smaller scale, the size and scope of such neighbourhood projects might make them ideal cases for copying and scaling within the same city. The city strategy and technology expertise already present in the city should make them ideal for such copying.

## Testbed micro infrastructures

*Description and objectives*

The second group of projects are what we have called testbed micro infrastructures. These projects are small city entities used for piloting or showcasing Smart City technology, with an emphasis on Smart Environment, Smart Mobility and Smart Economy. The objective is to connect as many entities, sensors and physical objects as possible in order to create and test micro infrastructure. These operation systems aim to manage communication between sensors and devices and thereby bypass direct human involvement. In most cases the entity is a so-called Smart or climate street, in which as many physical objects as possible are linked by means of ICT and sensors – for example Smart streets in the Barcelona suburb of Sant Cugat, Milan, Amsterdam and Cologne. In other cases, these networks are at larger scale, such as the Greenwich Peninsula OS in London or the Glasgow intelligent street light system.

Technologies applied include intelligent energy management systems, parking sensor monitoring systems, mobility sensor monitoring systems, garbage sensor monitoring systems, environmental (temperature, humidity, pollution) sensor monitoring systems, street light sensor monitoring systems, free Wi-Fi and electric vehicle charging stations, most typically in combination. These are real-life laboratories for companies to demonstrate technology, and learn how to integrate, communicate and share data with other management systems in order to permit the city to take advantage of the integration and synergies created. In the Sant Cugat Project, for example, the solutions deployed are sensor network monitoring systems in parking areas and outdoor areas of commercial buildings and mobility sensor systems for vehicles with the aim of achieving efficiency and avoiding traffic jams. Solar energy allows automatic garbage compaction to reduce the volume of waste to a fifth, and volume sensors allow efficient garbage collection. Environmental sensors (temperature, humidity and pollution) provide additional information on waste collection and management of the irrigation system for intelligent urban green areas, and the presence of sensors to control lighting intensity in pedestrian areas.[194]

The testbed micro infrastructure cases reveal some common traits. In all cases the objectives are manifold, e.g. to reduce $CO_2$ emissions, save money, foster economic development and strengthen the technological base of local businesses (also to increase exports) and, most importantly, to find ways to expand and scale these micro infrastructures to a city level.

### *Stakeholders and governance*

All projects are public–private partnerships where local government has teamed up with a large number of technology-heavy companies interested in testing their technologies in real-life settings. In most cases, private co-financers are also part of the partnership agreements. Local government therefore relies heavily on the industrial partners to test and validate micro infrastructures and their promised effects. This is a symbiotic relationship; at the same time, the private companies get access to public space in order to test and commercialise their products and services.

### *Funding*

Funding is provided by the municipalities and (in some cases) private co-finance, with in-kind contributions from the industrial partners.

### *Benefits, impacts and achievements*

With the exception of the Greenwich Peninsula OS, which is currently being planned and implemented, all projects included in this category are up and running; this provides useful indications on outcomes and effects. In the Sant Cugat Project, the intelligent solutions will reduce the costs of management and help reduce $CO_2$ emissions, as well as help promote the economic competitiveness of the city, based on new technologies and companies with entrepreneurial talent. Estimated savings for municipality services, based on early results, are around 20–30% of the actual cost of the service. In Milan, the lighting of the smart street adjusts to the level of natural daylight to bring cost savings of 70%; if extended to the whole city, expected savings would be EUR 9 million – and 18 tonnes of $CO_2$ – per year.There are also expectations of a number of indirect effects and positive externalities once these projects are scaled up to city level. Traffic management and parking systems should be able to save time for citizens, and should further provide environmental and personal finance improvements.

[193] http://www.nordhavnen.dk/~/media/NordHavnen/PDF/rhusgade_folder_070611_6.ashx
[194] http://smartcity.santcugat.cat/?lang=en .

An accessible city with enhanced traffic safety should save public money and improve citizen satisfaction. Further, intelligent street lights and garbage cans should be able to optimise and make leaner public authority processes. Finally, these projects will strengthen the competitiveness of the companies involved.

*Success vis-à-vis objectives*

In most cases the projects present proven outcomes and effects. Therefore, the testbed micro infrastructures group of projects appear likely to reach their direct targets and goals, starting from small scales and expanding. Moreover, these projects are likely to demonstrate a range of indirect effects and positive externalities once rolled out on a city level.

The main objective of the testbed micro infrastructure projects is to test these small entities in order ensure successful scaling to the whole city level. Estimated savings and other proven effects and hence a good business case will be the key to expansion throughout the city, and to other cities. Most of the current testing of these infrastructures has shown that the projects lead to significant outcomes, making intra- and even inter-city scaling more likely. Almost by definition, the companies involved would be interested in expanding their expertise and experience to other cities based on the testbed approach. Additionally, the original test cities will have an interest in securing increased exports and improving technology clusters based on their own testbeds.

## Intelligent traffic systems

*Description and objectives*

Traffic management Smart City projects are ICT-enabled systems typically based on road sensors or GPS, focusing on Smart Mobility and Smart Environment. The objective is to monitor real-time traffic information in order to manage city traffic in the most efficient and environmentally friendly way possible. Examples include the Zaragoza traffic monitoring system, Dublin road congestion system, Eindhoven traffic flow system, Enschede vehicle inductive profile, the Thessaloniki Mobility Project and Cardiff sustainable travel city.

This objective is to be achieved by speeding up the resolution of road network issues, reducing congestion and improving traffic flow. Although the general and specific objectives are very similar across projects, the technological solutions employed are very different. For example, Zaragoza has chosen a sensor-based solution in order to obtain real-time city traffic information to support efficient traffic management decisions and to provide citizens with relevant information so they can make their own choices. With 150 'urban' sensors over the urban grid of Zaragoza, 90% of all urban routes are monitored and 30% of all traffic is audited daily. Travel time information goes directly to the Traffic Management Centre of Zaragoza City Council and is displayed on a web interface specially intended for management purposes.

In Eindhoven 200, on the other hand, participating pilot cars are equipped with a device containing a telematics chip 'ATOP', which gathers relevant data from the central communication system of the car (CAN-bus). Relevant sensor data, for example indicators of potholes or icy roads, are collected in-vehicle and transmitted to the cloud-enabled traffic centre. The Enschede system collects actual travel times of vehicles by means of 'smart' detection loops of traffic lights. The test installation covers three main roads in Enschede. Travel time savings are stored in a database, processed and shown on four dynamic route information panels on Highway 35. The city of Enschede aims to utilise this technology to optimise the use of the available infrastructure.

In Thessaloniki, two different systems have been put into place. First, a new traffic control centre manages incidents with real-time information, dynamically estimates traffic for the rest of the day, assesses and confirms estimated travel times, and dynamically manages traffic lights.

The second system is a mobility planner that provides citizens with real-time traffic condition data, enabling them to choose between the shortest, most economical and most environmentally friendly route.

### *Stakeholders and governance*

As is the case with the Smart City neighbourhood units and testbed micro infrastructures, Smart City traffic management systems rely heavily on public–private partnerships. In all cases, such partnerships have been put in place in order to bring in advanced technology to solve complex city problems.

### *Funding*

In contrast to the earlier project types described, intelligent traffic system projects are primarily financed directly by the public sector (municipalities and EU funding); private companies are more likely to provide technology and other in-kind support.

### *Benefits, impacts and achievements*

The different intelligent traffic system projects examined differ in maturity and time frame. The Cardiff Smart City Hub Project is currently being planned. The systems in Eindhoven, Dublin and Enschede are being pilot tested and Zaragoza and Thessaloniki are already rolling out full-scale city-wide systems. Even though most systems have been implemented, they seem so far to lack evidence of proven effects. Currently, no clear targets (besides efficient and environmentally friendly traffic) have been put forward. This makes it difficult to assess the outcomes based on the cities' own projections, but we expect to see a number of indirect effects and positive externalities from these traffic management systems, including time savings for citizens, positive environmental effects, increased road safety, and a beneficial impact on insurance companies and their customers. However, seen in isolation such systems might have the potentially negative and unintended rebound effect of increasing private motoring by making driving a car in the city more convenient. Therefore, such systems might work better in combination with an integrated and holistic transport plan, taking cycling and public transportation into consideration in combination with a traffic management system, as has been done for instance in Copenhagen's project on transport integration.[195]

### *Success vis-à-vis objectives*

It might be hard to prove effects in these projects in a way that might impress potential investors. Citizens would benefit from such investments, but the cities which invested in them will have a harder time collecting evidence on real benefits and seeing this in their bottom line.

### *Scaling potential at EU level*

The main objectives of the traffic management systems are to be rolled out on a city level, which makes within-city scaling a top priority. Dissemination to other cities will depend on proven effects and a sound business case. Since evidence of these effects is at present poor or non-existent, other local governments might hesitate to introduce such schemes. The wide range of technological solutions within the different traffic management systems makes it extremely important to assess which technological solutions might lead to which outcomes and limits generalised 'halo effects'.

[195] http://www.cphcleantech.com/media/2113602/integrated%20transport.pdf .

## Resource management systems

### *Description and objectives*

A large number of Smart City projects within the EU-28 address ICT-enabled resource management systems such as smart grids, smart meters, Smart Energy and solar, wind and water management systems.

Resource management initiatives primarily involve Smart Environment, but Smart Governance, Smart Economy and Smart Living are also important characteristics. Examples include Smart Power Hamburg, Barcelona smart grid and solar hot water ordinance, the Copenhagen wind power and smart grid system, the Copenhagen waste water management system, Cologne smart metering, Mannheim E Energy and the Gothenburg managed Celsius Project.

### *Stakeholders and governance*

As with the foregoing types, resource management systems within Smart Cities rely heavily on public–private partnerships, in this case, partnerships with energy or other resource suppliers as well as the specialist companies and sometimes local universities, which bring in advanced technology for solving complex city problems.

### *Funding*

In most cases, private partners also finance parts of the projects, but some – typically non-energy-related – projects are purely publicly financed. Interestingly, a few projects have used a cooperative approach to enable user funding. For instance Copenhagen's Middelgrunden Project is based on a partnership between the municipality and local shareholders. Middelgrunden wind power park is 50% financed by 10,000 stockholders in Middelgrunden Vindmøllelaug and 50% financed by the municipal energy supplier, Copenhagen Energy. In the Mannheim E Energy Project proactive users in the energy market ('prosumers') can tailor their power consumption and generation in response to optimal pricing structures, using real-time information and energy management components to attain even greater energy efficiency. The Vienna Solar Power Project offers citizens the chance to buy whole or half panels at a price of EUR 950 or EUR 475 respectively. Wien Energie rents the panels back from the individual purchasers in exchange for an annual profit of 3.1% on their investment, paid directly into their accounts annually. Once the service life of the plant ends after approximately 25 years, Wien Energie repurchases the panels and the original investment is returned to the citizen.

### *Benefits, impacts and achievements*

Slightly less than half of the projects have been fully implemented and in service for a number of years, making them seem more mature than the other types of Smart Cities project. This makes it easier to assess their effects and outcomes. Though the technological solutions differ, the objectives are very similar: to reduce energy consumption, increase the amount of renewable energy or raise environmental standards through resource management. These goals are being met through smart power systems with intelligent management of energy mixes, smart grids, smart metering, heat storage, solar energy management systems and surveillance management systems for resources such as clean tap water or wastewater or heating efficiency systems.

For those projects in the planning or pilot testing phase – the Smart Power Hamburg, Barcelona smart grid and smart metering, Munich Smart Grid, Cologne ship-to-grid, Mannheim E Energy, Cologne smart metering and Gothenburg Celsius Project – outcomes are harder to assess. Of these, only the Gothenburg managed Celsius Project has laid out clear savings targets; to supply nearly 85% of the heat demand in an average city from

secondary energy sources by means of smart district heating and cooling systems.

If fully implemented across 50 such cities, it is estimated that this would lead to at least a 100TWh annual reduction in the use of primary energy and a corresponding yearly reduction in $CO_2$ emissions of approximately 20 million tonnes.

The resource management system projects produce a number of positive externalities. For instance, as a result of the municipal strategies and investments involved in the Copenhagen waste water management system, the water in the Port of Copenhagen is as clean as the water in the Sound outside the port.

Fish, wading birds and benthic vegetation have returned and the people of Copenhagen are able to use the port for swimming and other leisure pursuits. This has had benefits in other areas of the city, including increased real estate values, quality of life and tourism, and the revitalisation of local business life. Not all of these effects were intended when the project was initiated. In general, resource management systems expect to optimise energy use, appeal to consumers to change behaviour (for example use electricity during the night) and save public resources, for instance through smart metering.

### *Success vis-à-vis objectives*

Four projects are fully implemented: Barcelona's solar hot water ordinance system, Copenhagen's wastewater management system, Middelgrunden offshore wind farm and the Bremen building management system. All of these projects have proven effects related to their initial objectives. The Barcelona solar power system, initiated in 2005 with 31,050 m² of installed solar panelling, has led to annual energy savings of 24,840 MWh. The city of Copenhagen's modernisation of the ICT-enabled sewerage system has reduced discharges of diluted sewage into the port from 1.6 million $m^3$ in 1996 to 350,000 $m^3$ in 2007. The amount of material in suspension annually discharged into the port has been reduced from 161 tonnes to 35 tonnes and the oxygen consumption of the material discharged has decreased from 280 tonnes to 61 tonnes. Similarly, pollution with heavy metals has fallen from 450 kg to 100 kg. The offshore wind farm Middelgrunden of Copenhagen provides more than 3% of the total electricity consumption of Copenhagen through a centrally managed smart grid. Finally, in Bremen, energy consumption is down by 15% to 18% and cost savings of more than EUR 30,000 per year are expected as a result of the building management system.

### *Scaling potential to EU level*

As with the Smart City neighbourhood initiatives, it may be difficult to copy and scale these projects at a European level. The extent of external partnerships and technology expertise brought into each project makes them extremely participant dependent. Other cities may not have the same expertise to hand. Also, sound business cases are insufficient in some of the projects, probably because of their long time horizons and lack of clear targets. This is likely to hinder government grants and private investments in other cities. Also, energy suppliers and technology companies might have conflicting scaling objectives. Technology companies would have an interest in expanding their technology to other cities while energy suppliers are often based in one city only. Moreover, local energy suppliers might resist Smart Environment projects, especially if initiated by other cities, because of the likely decrease in total energy consumption. Finally, a number of the projects depend on city attributes – whether a city is linked with a harbour, a river, or the fact that some places receive more wind or sunshine than others.

On the other hand, the projects should provide rich possibilities for lessons and good practice. This might also lead to other cities being able to greatly reduce the implementation process, although this depends on developing sound business cases and proving the effects of public and private investments.

Nevertheless, a few projects have a sound business case, and the fact the Gothenburg Celsius and Mannheim E Energy projects for instance clearly state that scaling to other cities is one of the main targets should increase the likelihood of successful dissemination. Local resistance due to conflicting interests over lowering energy consumption between technology companies and city governments as opposed to some local energy suppliers on the other will likely need to be met with legislation, planning rules and regulation in order to benefit consumers. As with the Smart City neighbourhoods above, international technology companies will have an easier time than local energy suppliers scaling to other cities following economies of scale and scope.

Often the technology will determine energy delivery and savings; as many energy suppliers lack sufficient technological capabilities, the technology companies should find it easier to scale their projects. Finally, scaling will depend on the size and number of projects. For instance, smart metering could potentially be easier to implement than large-scale energy supply or waste water management projects.

## Participation platforms

### *Description and objectives*

ICT-enabled citizen participation platforms cover open data strategies and platforms, crowdsourcing and co-creation platforms and other forms of citizen participation and ideation. Open data Smart City projects include competitions to develop apps and other citizen-produced digital services, often based on public data, in order to develop better public services and engage citizens taking part in the development and co-production of services. Open data Smart City projects usually provide better outcomes of Smart Governance and Smart Economy, but elements from the other characteristics occur depending on the project scope and the preferences and capabilities of participants. London, Amsterdam, Helsinki, Barcelona and Florence are noteworthy cities developing ICT-enabled citizen participation platforms.

Overall, the strategic objective of these projects is to develop better public services based on input from citizens obtained by providing ideation platforms to develop a better city (the Amsterdam Smart City platform) or competitions to take advantage of open public data to develop apps, useful data mash-ups or new services. For example, the city of Helsinki is looking for new ways to encourage developers to exploit open data in order to create digital services and useful applications for citizens. The underlying themes of the Helsinki project are transparency of city decision-making and enabling better feedback from citizens to civil servants. Smart City services are thereby tested in the Helsinki Metropolitan area as part of people's everyday life.

### *Stakeholders and governance*

Most projects receive in-kind backing from the local municipality, which generally provides the platform and access to public data. The finance required is usually provided by the municipality, but in a few cases public–private partnerships have been initiated, typically with technology or platform providers.

### *Funding*

In general, these projects are not very costly and most resources required are citizen inputs and municipality administration, making the citizen often the prime partner.

### *Benefits, impacts and achievements*

Most of these projects are in an early or pilot testing stage. In the open data cases, many datasets have recently been released.

Therefore, either no services using these data have been built or released or those services that have been initiated have yet to show any positive effects arising from citizen created services. For instance, the citizens of Amsterdam and Helsinki have created several citizen apps which are in use, but it is still too early to determine any real outcome of this activity.

### *Success vis-à-vis objectives*

The goal is to develop citizen participation platforms as one of the leading testing environments for digital services. For example, Florence has recently made public data available to the public in order to increase transparency rather than develop services. Other cities have the same basic objective of opening up as much data as possible without necessarily linking the data to specific services.

The intention is to see if any services or apps produced from the open data will eventually lead to improvements in the service development process rather than specific service outcomes.

### *Scaling potential at EU level*

Disseminating citizen participation platform projects is likely to be relatively easy once there is a solid business case. Most cities have data that can be opened to the public, and digital solutions and infrastructures are easier to scale than complex resource management systems or specific neighbourhood infrastructures. The likely effects will accrue to governments, citizens and businesses. Governments and citizens will receive better public services, which are resource-optimised and meet the needs and fit the circumstances of citizens. Businesses will be able to develop services and products that are relatively easily scalable to other cities with the same or similar public data.

# ANNEX 6: CASE STUDIES

## CASE STUDY: SMART CITY AMSTERDAM

### Smart City Amsterdam

*Description*

The city of Amsterdam is ranked third in the European rankings by Cohen.[196] Amsterdam is the capital city of the Netherlands and has a population of around 800,000 inhabitants.[197] Amsterdam set out its sustainability targets in the Structural Vision 2040[198] and the Energy Strategy 2040.[199] In these documents they stated the ambitions of:

- climate-neutral municipal organisation in 2015
- 40% reduction in $CO_2$ emissions in 2025, compared with 1990 levels
- 75% reduction in $CO_2$ emissions by 2040.

To help achieve these targets, the Amsterdam Innovation Motor (AIM), now Amsterdam Economic Board,[200] the city of Amsterdam, net operator Liander and telecom provider KPN started the Amsterdam Smart City platform in 2009.

The Amsterdam Smart City (ASC) platform is a partnership between businesses, authorities, research institutions and the people of Amsterdam that initiates, stimulates and advances Smart City projects in Amsterdam. This platform has one central office with several people working on the Smart City platform. In 2013 this platform has grown into a partnership with over 70 partners who are engaged in 37 different Smart City projects.[201] These Smart City projects deal with a variety of topics and cover all characteristics of a Smart City (see dashboards in Annex 10) including energy transition, Smart Mobility solutions and open connectivity.[202] Several other (European) Smart City initiatives, such as Citadel[203], Common4EU, NiCE, Digital Cities[204] and Open Cities,[205] also have a link with the city of Amsterdam. Altogether, all Europe 2020 targets are covered by all Smart City initiatives in Amsterdam (see dashboards in Annex 10).

*Assessment*

The main objective of the ASC platform is to help to achieve the targets set out in the Energy Strategy 2040 and to reduce carbon emissions in Amsterdam. In 2011 the report *Smart Stories* was published, which evaluated Smart City projects running from 2009 to 2011. This evaluation included contributions from various research institutes, engineering and consultancy firms.[206]

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196 Cohen, B. (2012) 'The Top 10 Smart Cities On The Planet', Co.Exist, 11 January. Available at: http://www.fastcoexist.com/1679127/the-top-10-smart-cities-on-the-planet

197 City of Amsterdam, 'Stand van de Bevolking', City of Amsterdam Dienst Onderzoek en Statistiek, 2013, available at: http://www.os.amsterdam.nl/tabel/8244/, last accessed 1-8-2013.

198 City of Amsterdam, 'Economically strong and sustainable Structural Vision: Amsterdam 2040', PlanAmsterdam, No. 1-2011, City of Amsterdam, Dienst Ruimtelijke Ordening, Amsterdam, 2011.

199 City of Amsterdam, 'Amsterdam a different energy 2040 Energy Strategy', City of Amsterdam, Klimaatbureau, Amsterdam, 2011.

200 http://www.amsterdameconomicboard.com/english

201 www.amsterdamsmartcity.com

202 Ibid.

203 http://www.citadelonthemove.eu/

204 http://www.digital-cities.eu/

205 http://opencitiesproject.com/

206 ASC, 'Smart Stories', Amsterdam Smart City, Amsterdam, 2011.

The report states that the ASC projects generated projected savings of 12.7 kiloton $CO_2$ per year, which account for a reduction of 0.5% of overall $CO_2$ emissions of Amsterdam per year.[207] Because most projects were small scale, the direct savings resulting from them are small compared with the total potential of reductions in case of full deployment of the projects. Full up-scaling to city level has not been achieved in any of the projects, but *Smart Stories* estimated that when expanded to city scale the projects would lead to a reduction of 6%, 148 kiloton.[208]

Most Smart City projects developed in the ASC dealt with energy management systems for businesses. These projects tended to create most impact, primarily because businesses are more sensitive to energy costs than consumers.[209] According to a recent article in *The Economist*, one of the successes of the ASC project is that it didn't come up with a master plan but uses a combination of institutions and infrastructure that helps businesses and citizens develop and test green projects.[210] The starting point of the ASC is not the (technical) solutions but the collaboration, co-creation and partnering of stakeholders within the city of Amsterdam;[211] stakeholder management and assessment were essential to the deployment and implementation of the ASC platform.

### *Economics*

The initial ASC project that ran from 2009 to 2011 had a EUR 3.4 million budget and was supported by the European Fund for Regional Development (40%), private funding (40%) and government funding (20%). Overall the highest impact was achieved in projects where a transformation from 'grey' electricity to 'green' electricity was made (see ship-to-grid solution).

## Solutions deployed in the Smart City Amsterdam

## Climate street

### *Description*

The 'Klimaatstraat' (climate street) is a holistic concept for shopping streets with a focus on a number of different aspects: public space, logistics and entrepreneurial spaces. This project combines physical and logistical initiatives in the public space, as well as sustainable initiatives within present businesses.

Objectives of the Klimaatstraat Project, as defined by *Smart Stories*, include the reduction of $CO_2$ emissions and energy consumption in Utrechtsestraat.[212] This was to be achieved through a combination of sustainability initiatives (sustainable waste logistics, energy displays, LED lighting, smart meters and energy management systems) and the related changes in user behaviour.

### *Assessment*

The results of the Klimaatstraat Project in the pilot phase (2009–2011) were energy savings of 661 ton $CO_2$ per year. These reductions are very limited, as discussed in the Amsterdam

[207] Ibid.
[208] Ibid.
[209] Ibid.
[210] The Economist (Siegele, Ludwig), 'Mining the urban data', The Economist, No. June 2nd, The Economist Newspaper Limited, London, 2012, available at: http://www.economist.com/printedition/2012-06-02, last accessed 1-8-2013.
[211] Baron, Ger, 'Amsterdam Smart City Duurzame energie en breedbandconnectiviteit', PlanAmsterdam, No. 2-2012, City of Amsterdam, Dienst Ruimtelijke Ordening, Amsterdam, 2012.
[212] ASC, 'Smart Stories', Amsterdam Smart City, Amsterdam, 2011.

Centrum district administration.[213] However, the expected savings of the Klimaatstraat Project scaled up to other streets in Amsterdam would be 35 kiloton $CO_2$ per year in case of a realistic scaling up scenario.[214]

Smart Stories states that the main success factor of the Klimaatstreet Project was the presence of a local visionary pioneer, the manager of the local business association, serving as champion for the project.[215] Another key factor for success was the process of first gaining support with a small group and subsequently making use of the spill-over effect to other groups in the street leading to a full-scale adoption.[216] This small group of early adaptors served as ambassadors for the project and promoted its benefits, thereby supporting the uptake of the project by other entrepreneurs in the street.

Although the effect of one 'climate street' on total $CO_2$ emissions of a city are still relatively low, these kind of projects play an important role in creating more local awareness for Smart City projects and the sustainability goals for energy consumption they aim to achieve.

### *Economics*

The Klimaatstreet Project was partly funded by the Amsterdam Centrum district administration. Evaluation of the project by the Amsterdam Centrum district administration reports that the costs of the project did not outweigh the $CO_2$ emission reduction benefits.[217] However, the project was deemed successful by the district administration because the pilot provided a blueprint for other locations, and created awareness among citizens and local stakeholders.

## Ship-to-grid (green energy)

### *Description*

The Port of Amsterdam has the ambition to become one of the most sustainable harbours in Europe by 2020 and has invested in the ship-to-grid electricity project to achieve this.[218] This project allows inland ships in the harbour of Amsterdam to use green energy from the grid instead of their own stationary diesel generators. This reduces $CO_2$ emissions and leads to less noise and air pollution. The ICT component of this project is that ship owners can pay via a telephone payment system. In total, 195 ship-to-grid connection points are installed in the Amsterdam harbour.

### *Assessment*

The technology itself is not that innovative, and the collaboration involved was one of the major challenges of the project as explained in *Smart Stories*.[219] For the deployment of the ICT and power infrastructure, a close collaboration between Utiliq (ICT infrastructure), Joulz (construction and engineering of the ship-to-grid boxes), Royal Haskoning (main engineering and project supervision) and Liander (the grid operator of Amsterdam) was required. In addition, the Port of Amsterdam had to work closely with the National Port Council, the Port of Rotterdam and the World Port Climate Initiative to obtain the standardisation for its ship-to-grid solution.

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[213] City of Amsterdam, 'Vragen over: Resultaten pilot Klimaatstraat Utrechtsestraat (In English: Questions regarding: Results pilot Klimaatstraat Utrechtsestraat)', Publicaties Stadsdeelbestuur 2011, City of Amsterdam Stadsdeel Centrum, 2011.
[214] Ibid.
[215] Ibid.
[216] Ibid.
[217] City of Amsterdam, 'Vragen over: Resultaten pilot Klimaatstraat Utrechtsestraat (In English: Questions regarding: Results pilot Klimaatstraat Utrechtsestraat)', Publicaties Stadsdeelbestuur 2011, City of Amsterdam Stadsdeel Centrum, 2011.
[218] ASC, 'Smart Stories', Amsterdam Smart City, Amsterdam, 2011.
[219] Ibid.

Because a number of different organisations with different levels of commitment were involved in the project, the evaluation report recommends that these type of projects are organised in a top-down manner.[220]In total about 9.1 kiloton $CO_2$ emissions per year are avoided through the use of green energy. This is three-quarters of all $CO_2$ emissions avoided by the ASC platform and the projects they initiated between 2009 and 2011. However, the scalability for this project in Amsterdam is not possible because all inland shipping and mooring places are already supplied with the solution, leaving no further room for expansion. In comparison with other Smart City projects the total potential of the solution applied in this sector is limited.

In general, the conversion from grey energy to green energy is a very effective Smart City solution. The solution does not involve innovative technological solutions but requires effective stakeholder collaboration. The promise of this solution is mostly in the application to other sectors, e.g. building energy supply, where a high impact on $CO_2$ emission reductions can be expected.

## Smart building management systems (ITO Tower Project)

### *Description*

The Smart Building Management System Project was aimed at reducing energy use and operating costs for office buildings. This pilot project ran in the ITO Tower, the head office of Accenture in the Netherlands, where various Smart Energy management solutions were deployed. The main objective was to reduce energy consumption by collecting, analysing and visualising data about the amount of energy consumed and applying energy saving strategies based on this information.[221] The smart building management system pilot project consisted of the installation of smart plugs and LED lightning. Smart plugs can measure energy use within an outlet and switch off electronic devices automatically. Around 360 smart plugs where installed in the office floors. The second part (less 'smart' but an effective measure for office buildings) was the installation of LED lighting on the office floors.

### *Assessment*

The energy savings resulting from the automation of the smart plugs, which in combination with switching off lighting and appliances outside office hours reduced electricity consumption by 18%, was an annual reduction of 20 MWh. The replacement of lamps with LED lamps had an even bigger impact: 300 lamps were replaced leading to annual savings of 47 MWh, which is comparable to the total annual energy consumption of 15 households.[222] One of the key success factors of this pilot project was the establishment of a business case that not only made it an interesting investment for the building owner, but also encouraged the tenant to co-develop this project with the building owner. Close cooperation between both stakeholders proved to be vital for the success of the project.[223] This pilot project also showed that the success of the project during the operating phase was also attributed to having a building manager (the local champion of the project) who was properly trained and very engaged with the project.[224]

### *Economics*

Comprehensive economic analysis of the project is not available but *Smart Stories* stated, 'Automatically switching off lighting and energy intensive appliances outside office hours and

[220] Ibid.
[221] Ibid.
[222] Ibid.
[223] Ibid.
[224] Ibid.

large-scale implementation of energy-efficient lighting solutions can easily be scaled up, as long as the financial benefits are balanced between tenant and building owner.'[225]

## Health Lab

### *Description*

Health Lab is a network of living labs in the Amsterdam region bringing together researchers, government, practitioners and healthcare users in the field of ICT technologies and innovative healthcare solutions. The programme was initiated by the AIM (ASC platform founder) and various research, business and governmental partners.[226] The programme focuses on increasing the efficiency of technological innovation in the health sector and circulates around scientists, practitioners and entrepreneurs. End-users play a central role and ICT is considered the most important enabler.[227] The three goals of Health Lab are:

- to create a platform where all those involved can meet, discuss and share developments in and implementation of new solutions in care
- to support and stimulate the setting up of several living lab locations where new solutions can be tested and improved, together with users
- to create new curricula focusing on the implementation of these solutions in educational settings.[228]

### *Assessment*

The approach of the Health Lab was to assign a central role to end-users. The evaluation report produced by the Health Lab Consortium explains that open living labs with continuous end-user involvement in the development of solutions works very effectively.[229] The aim of the Health Lab programme was explicitly not to be technology pushed, but was centred on real value creation for healthcare users in their own local context and for their own needs. The programme produced various outputs, from research developments to technical solutions enabling elderly people to live longer in their own (smart) house. The same report identifies two interesting factors contributing to the success of the Health Lab: the use of a multi-disciplinary team and end-user involvement in the process of solution development.[230]

### *Economics*

No specific information was readily available on the economics and financial aspects of solutions. Although specific attributions are not available at this stage of the project the European Commission acknowledges that improving the health of EU citizens is an integral part of the Europe 2020 targets because it stimulates smart and inclusive growth.[231]

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[225] Ibid.

[226] Amsterdamse Innovatie Motor (AIM), the University of Amsterdam (UvA), Free University (VU), University of Applied Sciences Amsterdam (HVA), INHolland, Sigra, AMSTA, Waag Society and the municipalities of Amsterdam and Almere. The province of Noord-Holland and the Ministry of Economic Affairs support health lab.

[227] ASC, 'Amsterdam Smart City ~ Health-Lab', Amsterdam Smart City, 2013b, available at: http://amsterdamsmartcity.com/projects/detail/label/Health-Lab, last accessed 1-8-2013.

[228] Health-Lab, 'About Health-Lab', Health-Lab, 2013, available at: http://www.health-lab.nl/index.php?option=com_content&view=article&id=73&Itemid=531, last accessed 1-8-2013.

[229] Health-Lab, 'Innoveren in de zorg samen met de eindgebruiker – Ervaringen en aanbevelingen vanuit het Living Lab Amsterdam, In English: Innovate in healthcare together with the enduser – experiences and recommendations from the living lab Amsterdam', Amsterdam Region Zorg & ICT, Amsterdam, 2013.

[230] Ibid.

[231] EC, 'Europe 2020 – for a healthier EU', 2013, available at: http://ec.europa.eu/health/europe_2020_en.htm, last accessed 1-8-2013.

# CASE STUDY: SMART CITY HELSINKI

In 2012, the Economist Intelligence Unit ranked Helsinki seventh in the liveability ranking.[232] In 2011, *Monocle* magazine declared Helsinki to be one of the 'best cities to live and work, featuring the most innovative and sustainable urban development policies'.[233]

## Smart City Helsinki

The network of Smart City initiatives and projects in Helsinki is coordinated by Forum Virium, a private non-profit organisation owned by the city of Helsinki.[234] As an urban innovator and initiator of public–private partnerships, it has the aim of developing new urban digital services in collaboration with the private sector, the municipality, public sector organizations and Helsinki residents.[235]

In addition, Helsinki participates in various European Smart City initiatives running in Helsinki (see dashboards in Annex 10). A review of these initiatives show that Helsinki's Smart City developments focus primarily on the development of digital services, mobile applications and open data services. Most local Smart City initiatives aim to open up public data and activate citizens in their civic participation.[236] Only one of these initiatives (the NiCE initiative) directly impacts Europe 2020 targets (increasing energy efficiency). Most of Helsinki's Smart City initiatives do not directly contribute to Europe 2020 targets, but they do contribute indirectly by creating a specific environment in which Smart City services and solutions can be developed and achieve a reduction in $CO_2$ emissions or improve energy efficiency. This is an expectation and because comprehensive evaluation studies providing evidence for this are still absent further details cannot be provided at this stage.

## Smart City Solutions in Helsinki

### Open data platform (Helsinki Region Infoshare)

*Description*

Opening up public data plays an important role in Helsinki's Smart City developments. The Helsinki Region Infoshare Project aims to make regional information from public organisations more easily accessible to the public.[237] The data are free of charge and can be used by businesses, academia and research institutes, governmental institutes or citizens. In July 2013, over 1,030 databases were available at the website, covering a wide range of urban phenomena, such as living conditions, employment, transport, economics and well-being. Geo-referenced, geographic information system data are well represented in this dataset.

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232 http://www.eiu.com/site_info.asp?info_name=The_Global_Liveability_Report

233 http://monocle.com/film/affairs/most-liveable-city-helsinki/

234 GSMA Connected Living, 2012. available at: http://www.gsma.com/connectedliving/wp-content/uploads/2012/12/cl_forum_virium_12_12.pdf, last accessed 1-8-2013.

235 GSMA, 'Finland: Forum Virium Helsinki', GSMA Connected Living, 2012. available at: http://www.gsma.com/connectedliving/wp-content/uploads/2012/12/cl_forum_virium_12_12.pdf, last accessed 1-8-2013, Forum Virium, 'Organisation | Forum Virium Helsinki', 2013, available at: http://www.forumvirium.fi/en/introduction/organisation, last accessed 1-8-2013. and GSMA, 'Finland: Forum Virium Helsinki'

236 Forum Virium, 'Organisation | Forum Virium Helsinki', 2013, available at: http://www.forumvirium.fi/en/introduction/organisation, last accessed 1-8-2013. and GSMA, 'Finland: Forum Virium Helsinki'

237 Helsinki Region Infoshare (HRI), 'About | Helsinki Region Infoshare', 2013, available at: http://www.hri.fi/en/about/, last accessed 1-8-2013.

### *Assessment*

The Helsinki Region Infoshare Project is one of the pioneering open, urban data platforms. The platform has recently been rewarded with the European Prize for Innovation in Public Administration in the category of empowering citizens.[238] The jury report suggests that the opening up of decision-making information via an electronic case management system gives citizens a great opportunity to be more involved in public decision-making. This is considered one of the major success factors of the Helsinki Region Infoshare Project. According to Sitra (the Finnish Innovation Fund and co-financer of the project), opening up of public data can make the society more functional and create better services.[239]

For example, in 2009 the Helsinki Region Transport Authority opened up all its data, leading to approximately 50 mobile applications by developers to serve different needs and create value for commuters and travellers.[240] These new services contribute to decreasing traffic congestion and mitigating negative environmental impacts of the Helsinki traffic system.

### *Economics*

The project is funded by the city of Helsinki and a couple of surrounding cities in the Greater Helsinki region. The Finnish Innovation Fund Sitra and the Finnish Ministry of Finance have also contributed financial support to the project by means of grants. It is expected that in 2013 the open data platform will become part of the municipality and its operations.

In general terms, several studies demonstrate the economic potential of opening up public data. For example, *Measuring European Public Sector Information Resources* suggests that the public sector information market has a huge potential, estimated for EU and Norway to be between EUR 10.3 billion and EUR 44.9 billion.[241] It is still too early for a full assessment of the contribution of these activities to Europe 2020 targets, but early indications suggest that new services are contributing to Europe 2020 targets such as $CO_2$ emission reduction (for example, the Helsinki Region Transport Authority mobility applications).

[238] European Commission (EC), 'Winners of the European Prize for Innovation in Public Administration 2013', MEMO/13/503, European Commission, 2013.

[239] Finnish Innovation Fund (SITRA), 'Helsinki Region Infoshare awarded Euro prize for innovation', 2013, available at: http://www.sitra.fi/en/news/open-data/helsinki-region-infoshare-awarded-euro-prize-innovation, last accessed 1-8-2013.

[240] GSMA, 'Finland: Forum Virium Helsinki', GSMA Connected Living, 2012. available at: http://www.gsma.com/connectedliving/wp-content/uploads/2012/12/cl_forum_virium_12_12.pdf, last accessed 1-8-2013.

[241] Dekkers, Makx, Femke Polman, Robbin te Velde and Mark de Vries, 'MEPSIR - Measuring European Public Sector Information Resources: Final report of study on exploitation of public sector information - benchmarking of EU framework Conditions', report for the European Commission, 2006.

# CASE STUDY: SMART CITY BARCELONA

Barcelona seems to be a very active city with a lot of smart initiatives (see dashboards in Annex 10) and its success factors and solutions are analysed below. Boyd Cohen ranked Barcelona tenth in a list of the world's Smart Cities.[242] In the European ranking it was listed eighth.[243]

## Description of Smart City Barcelona

The city of Barcelona wants to become the first self-sustaining city in the world.[244] One key element is the so-called 'Smart City Campus' (22@Barcelona), which is meant to:

> *transform the city into an experimentation and innovation laboratory, […] a cluster where companies, universities, entrepreneurs and research centres can set up in the spheres of information technologies, ecology and urban development. One of the possible joint proposals is the establishment of a pioneering research centre for exploration of new technological possibilities in the service of the city and people.*[245]

ICT is a core element in the city's approach to becoming a Smart City. For example, it is applied to change processes in public business management so that they are 'more accessible, efficient, effective and transparent'.[246] Moreover, all aspects of living are touched by Barcelona's Smart City approach.[247] As already stated in Chapter 5, Barcelona fulfils all characteristics of a Smart City.

## Success factors of Smart City Barcelona

*Vision*

The city of Barcelona has got the ambition to become a model Smart City for the whole world. Its vision is to:

- integrate the information technologies in the city
- relate the different areas and sectors
- find synergies and added value
- generate transversality and cooperative knowledge.[248]

The overall aims are:

- to be efficient in city management and existent public services
- to be environmentally sustainable
- to create new opportunities for people and companies.[249]

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[242] Cohen, B. (2012) 'The Top 10 Smart Cities On The Planet', Co.Exist, 11 January. Available at: http://www.fastcoexist.com/1679127/the-top-10-smart-cities-on-the-planet

[243] Cohen, B. (2012) 'What Exactly is a Smart City?', Co.Exist, 19 September. Available at: http://www.fastcoexist.com/1680538/what-exactly-is-a-smart-city (visited 27 September 2013).

[244] Krempl, S., 'Smart City: Barcelona will erste sich selbst versorgende Stadt werden' [Barcelona wants to become first self-sustaining city], available at: http://www.heise.de/newsticker/meldung/Smart-City-Barcelona-will-erste-sich-selbst-versorgende-Stadt-werden-1387668.html, 2011, last accessed on 18/07/2013, available in German language only.

[245] Trias, X., Mayor of Barcelona, Speech held at Smart City EXPO 2012, available at: http://www.fastcoexist.com/1679017/barcelona-a-smart-city-model-for-the-planet, accessed on 18/07/2013.

[246] Ajuntament de Barcelona, 'Smart City Barcelona, BCN Model', available at: http://de.slideshare.net/IFIF/20110328-model-smart-city-bcn-presentaci-rgb-angles1-8244403, 2011, last accessed on 18/07/2013.

[247] Ibid.

[248] Major Cities of Europe, 'Barcelona Urban Habitat, The vision, approach and projects of the City of Barcelona towards smart cities', Vienna, 6th June 2012.

The representatives of Barcelona are heavily publicising its reputation as a Smart City, mainly by attending conferences where the Smart City of Barcelona is promoted.[250]

*People*

The Smart City initiative is actively communicated by the major of the city. There are three commissions (Smart City Commission, Infrastructures Commission, Urban Design Commission) in which all city departments (e.g. economy, business and employment; urban planning, infrastructures, environment and ICT; culture, knowledge, creativity and innovation) are involved. Furthermore, many well-known enterprises are engaged, particularly from the ICT sector.

Citizens' engagement is ensured through different initiatives, e.g. the Fab Lab Barcelona, which brings ICT and Smart City technologies closer to the inhabitants and demonstrates their relevance to the 'real world'. The projects are funded by all citizens (crowd-funding) and the public is also involved in deciding which projects to follow.[251]

*Process*

Barcelona follows a comprehensive approach of applying ICT for the citizens' use and comfort. One success factor is the provision of open data. Making public service information available for everyone fosters private initiatives and business models for the collective good.[252] Open data is the basis for new products and services in the information business, e.g. new apps that build on the analysis of new data sources. In the long run, these business models will create more efficient solutions and jobs.

In 2012, Barcelona was again host of the Smart City Expo World Congress with more than 70 cities attending.[253] It will also be the host of this event in 2013.[254] The city is involved in many European projects (FIREBALL, OPENCITIES, iCity, Commons4EU, CitySDK, Open-DAI) and cooperates with other cities in many initiatives (METROPOLIS, UCLG, EUROCITIES, Covenant of Mayors, World eGovernment Organization, Major Cities of Europe).

## Solutions deployed in Smart City Barcelona

### Control of lighting zones

*Description*

This solution aims to tackle the problem of public street lighting being used inefficiently in a way that is harmful to the environment. The approach is two-fold: first, street lamps are equipped with LED technology, which needs much less energy than usual light bulbs. Second, the lamps are equipped with sensors to receive information on the environment (temperature, humidity, pollution) as well as noise and the presence of people.

[249] Ibid.

[250] e.g. Smart Cities Canada, 'Case Study: Barcelona - Your City Protocol: Engaging all Stakeholders to Realize a Smart City Model', Toronto, January 23rd, 2013 and Major Cities of Europe, 'Barcelona Urban Habitat, The vision, approach and projects of the City of Barcelona towards smart cities', Vienna, 6th June 2012.

[251] Achaerandio, R. et. al., 'Smart Cities Analysis in Spain 2012 – The Smart Journey', Madrid, 2011.

[252] Ajuntament de Barcelona, 'What is Open Data? ', available at: http://opendata.bcn.cat/opendata/en/what-is-open-data/, n.d. a, last accessed on 18/07/2013.

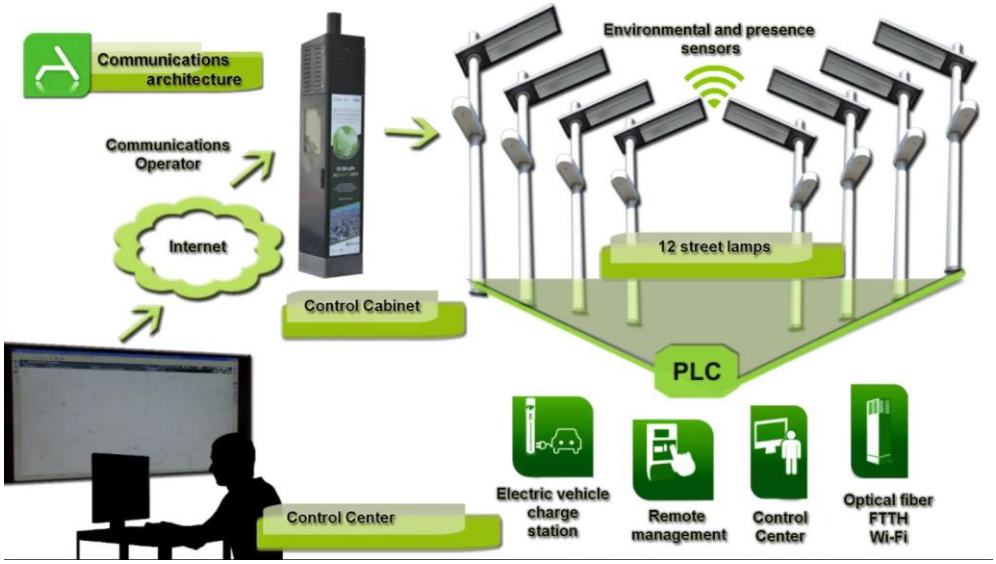
[253] Ajuntament de Barcelona, 'Barcelona is to host the world's most important smart city congress', available at: http://w110.bcn.cat/portal/site/Home/menuitem.14f90aeeb15793636d5d05f320348a0c/?vgnextoid=00000011880264372VgnV6CONT00000000000RCRD&vgnextchannel=0000000035144087VgnV6CONT00000000000RCRD&nomtipusMCM=Noticia&home=HomeBCN&accio=detall&lang=en_GB, 2012, 2012, last accessed on 19/07/2013.

[254] Smart City Expo, 'Smart Cities Change The World', Barcelona, available at: http://www.smartcityexpo.com/en/home, 2013, last accessed on 18/07/2013.

The lights communicate with a central unit in the street (the Control Cabinet), which also manages other services such as fibre-optic cabling to the home, Wi-Fi or electrical vehicle recharging stations.

The information is then sent to a central control centre.[255] At this control centre it is possible to see all activities and services taking place at a certain location (e.g. a street), monitor them, receive alerts and manage them from this single point. Sensors can adjust lighting depending on the time of day and the presence of people.

**The Integral Solution of Urban Infrastructure (SIIUR) Project[256]**




*Assessment*

The project has the following targets:

- to reduce emissions of carbon dioxide
- to reduce energy costs and consumption of electric outdoor lighting
- to provide new services and features to society
- to increase the quality of life of citizens
- to increase public safety
- to be a reference model for an intelligent city.[257]

At least the two first targets are measurable quantitatively. Public acceptance may be quite high because seven small and medium-sized Catalan enterprises are working on this project.

The solution contributes to energy savings of 40–60% and thus helps in reducing $CO_2$ emissions. It is also an investment in R&D and innovation.

*Economics*

In the long run it seems cheaper to invest in intelligent lighting technology than in 'dumb' lighting. Although there are no cost figures available, a power saving between of 40% and 60% allows for some investment costs. These are reduced by using the existing electric grid (power line).

[255] Ajuntament de Barcelona: 'Barcelona Smart City Tour', Barcelona.
[256] Source: http://lcabcn2012uo.files.wordpress.com/2012/07/screen-shot-2012-07-18-at-12-46-59-pm.png
[257] SIIUR project,' Proyecto > Proyecto Mostrador > Objetivos', available at: http://www.siiur.es/proyecto1.php?area=area1&npagina=2&ntitular=3, n.d. a, last accessed on 18/07/2013.

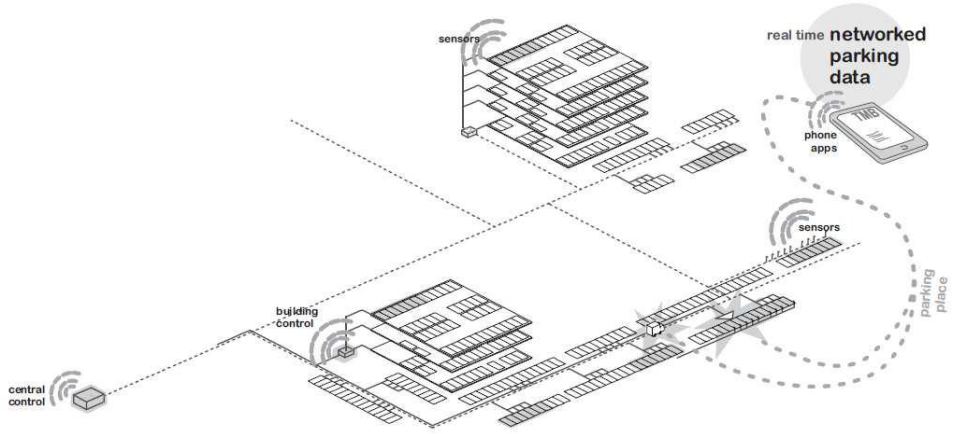
Taking a wider perspective, in Catalonia there are more than 700,000 points of lighting with an annual consumption of 400 GWh, with an expenditure of EUR 44 million and an emissions volume of nearly 100,000 tons of $CO_2$.[258] This makes clear the huge potential savings in money and $CO_2$. Increased safety of the citizens is another benefit of this solution. A wider roll-out of solution is possible in the mid-term.

## Smart parking

### *Description*

The introduction of wireless sensors at parking places can ease city traffic by showing car drivers where there are free parking spaces. The information is sent to a data centre and made available for smart phones sending real-time data to users. In this way the system guides the driver to the nearest parking spot.

**The Smart Parking Network Barcelona[259]**




### *Assessment*

The solution is still in the testing phase but is communicated as one of the cities' ten key projects,[260] thereby benefiting from support at the highest levels. An evaluation is not available yet, but the Smart City friendly environment has made it possible to carry out this pilot.

### *Economics*

According to the producer of this solution 'the average searching time in […] Barcelona, […] is 15.6 min. With instant real-time parking information […], this can be shortened down to 5 min.'[261]This means that people need less time searching for parking places, thus reducing noise and pollution.[262] Also, the need to build new parking spaces becomes obsolete and saves money as existing parking places are being used more efficiently.This solution may only be implemented in the mid-term because it will take some time to equip all parking places with sensors.

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[258] SIIUR project, 'Proyecto > Proyecto Mostrador > Alcance', available at: http://www.siiur.es/proyecto1.php?area=area1&npagina=2&ntitular=1, n.d. b, last accessed on 18/07/2013.

[259] Source: Major Cities of Europe, 2012. Major Cities of Europe, 'Barcelona Urban Habitat, The vision, approach and projects of the City of Barcelona towards smart cities', Vienna, 6th June 2012.

[260] Major Cities of Europe, 'Barcelona Urban Habitat, The vision, approach and projects of the City of Barcelona towards smart cities', Vienna, 6th June 2012.

[261] Worldsensing, 'Overview', available at: http://www.worldsensing.com/index.php?option=com_content&view=article&id=10&Itemid=7&lang=en, 2011, last accessed on 19/07/2013.

## Smart and sustainable architecture Media-tic Building

### *Description*

The Media-tic Building accommodates companies and institutions in information and communication technologies and the media and audio-visual sectors. It was designed as a communication hub and meeting point for these businesses.

The facade of the building is striking and at the same time functional. The translucent and innovative covering material ethylene tetrafluor ethylene acts as an external covering and a mobile sunscreen. The covering is activated using pneumatic mechanisms. These 'luxometer sensors' regulate levels of sunlight and temperature automatically and independently.[263]

### *Assessment*

The vision which was the basis for the construction of the building is that 'the cleanest energy is non-consuming energy', and using this measure the Media-tic Building is one of the most energy-efficient buildings in Barcelona.[264] It demonstrates that buildings can contribute to the reduction of global warming.[265]

The building was constructed with the goal to be 'a vehicle for disseminating new technologies that must be made available for all citizens'. It hosts Barcelona's most famous ICT and media enterprises and is open to the public at large. It covers spaces for companies, research and training as well as communal services and communications spaces on the ground floor.[266] The Mayor of Barcelona is the President of the Barcelona Zona Franca Consortium (BZFC), which commissioned the building.

Controlled by 300 sensors, ranging from presence sensors in the lobby to sensors controlling artificial light levels according to the distance from the window, the building has a distributed intelligent system. Everything, including the facade cushions, works automatically.[267]

### *Economics*

The Media-tic Building was designed to save energy, and an energy study concluded that the energy savings correspond to 114 tons of green house gas emission per year or, assuming that all energy comes from solar power plants, 700 photovoltaic captors would be necessary to produce such a quantity of energy. With regard to climate control, the costs of cooling are more significant than those related to heating. The innovative covering with ethylene tetrafluor ethylene allows savings of up to 20% on cooling costs.[268]

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[262] Ibid.

[263] Ajuntament de Barcelona, 'ICT-Cluster: Media-Tic Building', available at: http://www.22barcelona.com/index2.php?option=com_content&task=view&id=41&Itemid=427&pop=1&page=0, n.d. last accessed 01/08/2013.

[264] BZFC Barcelona Zona Franca Consortium, 'Media-Tic with the almost-finished works, is the new image of Barcelona digital, Barcelona, 2010', available at: http://www.google.de/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CC8QFjAA&url=http%3A%2F%2Fwww.22barcelona.com%2Fdocumentacio%2Fpdfangles.pdf&ei=Ekr6UcHaPIjDO4K9gDA&usg=AFQjCNFVYB6nMaJzUJ8orbHVDHkfASd2PA&bvm=bv.50165853,d.ZWU&cad=rja, last accessed on 01/08/2013.

[265] Bullivant, L., Cloud 9: 'Media-TIC building, Barcelona, Architecture Today', 2010, available at: http://www.architecturetoday.co.uk/?p=11018, last accessed 01/08/2013.

[266] BZFC Barcelona Zona Franca Consortium, 'Media-Tic with the almost-finished works, is the new image of Barcelona digital, Barcelona, 2010', available at: http://www.google.de/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CC8QFjAA&url=http%3A%2F%2Fwww.22barcelona.com%2Fdocumentacio%2Fpdfangles.pdf&ei=Ekr6UcHaPIjDO4K9gDA&usg=AFQjCNFVYB6nMaJzUJ8orbHVDHkfASd2PA

[267] Bullivant, L., Cloud 9: 'Media-TIC building, Barcelona, Architecture Today', 2010, available at: http://www.architecturetoday.co.uk/?p=11018, last accessed 01/08/2013.

[268] Ajuntament de Barcelona, 'What is Open Data? ', available at: http://opendata.bcn.cat/opendata/en/what-is-open-data/, n.d. a, last accessed on 18/07/2013.

EUR 28 million has been invested in the building. The BZFC leases the plot for the building from the city of Barcelona for a period of 50 years, and in this arrangement the City Council is granted 10% of the Media-tic Building free of charge. A further 40% of the building is rented to the Council. A further 35% is occupied by the Open University of Catalonia Foundation, which aims to develop the Internet Interdisciplinary Institute and eLearning Centre. The investment will be financed mainly by rental incomes.[269]

By being a pilot project the Media-tic Building promotes the chances of a smart building solution and creates awareness for its necessity. There might be potential for a wider roll-out, particularly as buildings have a high capability for energy savings and reducing CO2 emissions.[270]

## E-Governance

### *Description*

Barcelona has introduced many e-government services to improve access to and efficiency and transparency of public services,[271] including:

- *Open Data BCN*: In the context of this initiative public data are made available to the public. The internet portal contains more than 300 categories of data. The five main areas are territory, population, urban services, economy and administration.
- *Quiosc PuntBCN*: The city maintains kiosks that ensure a city-wide presence of the municipal authorities (For example, offices for public attention). These kiosks are located in a variety of frequented points of the city like shopping centres, libraries and so on, and are similar to self-service cash dispensers. It is possible for citizens to undertake most of their administrative procedures at the kiosks. The services are also available online.[272]

### *Assessment*

The vision of the e-government initiatives is to improve and simplify public services. It is "the main goal[s] of the Open Data BCN Project […] to increase the transparency of the City Council by putting public data within reach of all the players in society".[273] These players include citizens, businesses and institutions.

They can use the data to develop business models, create services and develop applications. Furthermore, society's open data needs can be analysed to reinforce the open data initiative

Corresponding to the aim of the initiative, relevant stakeholders, including citizens, businesses and institutions, are in touch with the city council to improve its services. The potential to influence the process is considerable.

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[269] Ajuntament de Barcelona, 'ICT-Cluster: Media-Tic Building', available at: http://www.22barcelona.com/index2.php?option=com_content&task=view&id=41&Itemid=427&pop=1&page=0, n.d. c, last accessed 01/08/2013.

[270] European Commission (EC), 'ICT for a Low Carbon Economy: Smart Buildings', Brussels, 2009.

[271] Ajuntament de Barcelona, 'e-Government', available at: http://w110.bcn.cat/portal/site/eGovernment/menuitem.5ef2b4a77290091515411541a2ef8a0c/?vgnextoid=beae929f2c056210VgnVCM10000074fea8c0RCRD&vgnextchannel=beae929f2c056210VgnVCM10000074fea8c0RCRD&lang=en_GB, n.d. d, last accessed 01/08/2013.

[272] Ajuntament de Barcelona: 'Barcelona Smart City Tour', Barcelona, n.d. b.

[273] Ajuntament de Barcelona, 'What is Open Data? ', available at: http://opendata.bcn.cat/opendata/en/what-is-open-data/, n.d. a, last accessed on 18/07/2013.

The structure and handling of e-government services should be user-friendly for citizens and businesses. The Quiosc PuntBCN is 'easy and intuitive to use and has been made possible by an innovative process based on a thorough pilot program and a rigorous public tender to study all the requirements'.[274] User involvement is important. Better access and easier contact with to the municipal administration can only be realised if there is acceptance of the kiosks and a high frequency of use.

Although the self-service machines are a good alternative for simple administration matters, personal contact with the administration's employees is sometimes important for citizens. This fact is taken into account by deploying the kiosks as an additional service, which involves some transfer of resource but not a complete substitution.

Both e-government services are ICT-based and also available via the internet as a self-service tool. Management is implemented by the city council, which also takes responsibility for feedback and improvement.

*Economics*

The improvement of Quiosc PuntBCN has made it easier to access administration services and saves citizens' time and travel costs, so there is less traffic and less demand on parking spaces. Energy savings and a reduction of greenhouse gas emissions can also be realised.

Open Data BCN makes public data in the hands of the city council available for everyone. This data access may serve as a basis for further business models and innovative solutions. Access to traffic state information, maps, car parks and bicycle stations may be interesting for the development of an integrated transport solution. From this view, the improvement of the open data initiative is a promising research and development investment. It is likely that the benefits will exceed the costs of this solution, because the data exist and must in any event be made available for those who are interested.

E-government solutions have a high scalability. A cost-benefit analysis would come to a positive result. Furthermore, they have an impact on Europe 2020 targets, although the direct impact is not very high. Nevertheless, based on the e-government services business models can be developed, which in turn might have an impact.

[274] Ajuntament de Barcelona, 'PuntBCN Kiosk, an innovative "cash machine" for faster municipal proceedings in more locations and with more flexible hours', available at http://www.22barcelona.com/content/view/802/1003/lang,en/, 2010, last accessed on 01/08/2013.

# CASE STUDY: SMART CITY COPENHAGEN

The city of Copenhagen is conducting a number of Smart City projects, whose success factors, solutions and economics are analysed below. In a meta-analysis, Boyd Cohen ranked Copenhagen in eighth place in a list of (Smart) Cities in the world.[275] In a European level ranking, Cohen found Copenhagen to be the Smartest City in Europe.[276] In the Quality of Life survey of *Monocle* magazine, Copenhagen was ranked in third place.[277]

## Description of Smart City Copenhagen

Copenhagen has a vision to become the world's first carbon-neutral capital by 2025.[278] Therefore the city is currently implementing a range of new and innovative solutions within the fields of transport, waste, water, heating and alternative energy sources to support this aim and improve sustainability, in a large number of initiatives (see dashboards in Annex 10).

By testing these solutions, the city hopes to attract innovative companies, which will in turn support the economy through the process of becoming greener and smarter.[279]

## Success factors of Smart City Copenhagen

### *Vision*

As stated above, Copenhagen aims to become carbon neutral by 2025.[280] At the same time, the city is working to increase growth and improve the quality of life of its inhabitants. This vision is supported by clear targets in different sectors.

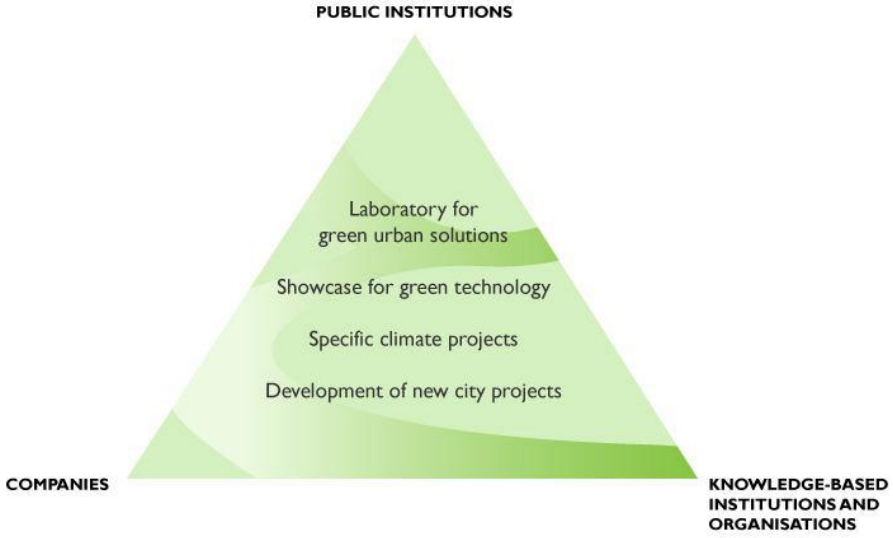
For example, Copenhagen has the objective to increase the number of people 'cycling to work and education from 35% in 2011 to 50% by 2050' and to reduce 'each Copenhagen citizen's [water] consumption from 100 litres per day to 90 litres per day in 2025'.[281]

### *People*

Increasing the Smartness of a city enables better connectivity between its stakeholders and therefore increases the effectiveness of the city. The task is to disperse gathered knowledge through cooperation between different fields.[282] The figure below illustrates this approach.

[275] Cohen (2012a).
[276] Cohen (2012b).
[277] http://monocle.com/film/affairs/most-liveable-city-helsinki/
[278] City of Copenhagen, 'Solutions for sustainable Cities', Copenhagen, 2012a, p. 46 et sqq.
[279] Mortensen, J., Rohde, F.J., Kristiansen, K.R., Kanstrup-Clausen, M., Lubanski, M., 'Danish Smart Cities: Publications', available at: https://smartcity.wien.at/site/en/das-projekt/publikationen/, last accessed 01/08/2013.
[280] City of Copenhagen, 'Solutions for sustainable Cities', Copenhagen, 2012a, p. 46 et sqq.
[281] Ibid.
[282] Ibid.

**Cooperation between stakeholders in the city of Copenhagen[283]**




In this context, it is important to develop new and integrated business models to bring together the interests of different stakeholders. Citizens should thereby be involved in political as well as business processes.[284] For example, the introduction of electric vehicles generates benefits both for utilities that can use them as power storages as well as for the public sector by energy savings and less air pollution.[285]

*Process*

The planning and coordination of different projects seems to be well organised as projects are clearly defined and appear in the context of different city vision documents. There are several contact persons for a 'sustainable city'. Among them two contacts are responsible for the Smart City. The mayor of Copenhagen, Frank Jensen, actively seeks partnerships and the transfer of knowledge to and from other cities.[286]

## Solutions deployed in the Smart City Copenhagen

The city of Copenhagen has deployed a number of concrete projects, which are described and assessed as potential solutions below.

## Cycling

*Description*

Copenhagen has an extensive network of cycle lanes, which is still being expanded.[287] In 2011, 35% of commuters went to work by bicycle.[288] Urban planning takes cycling infrastructure into account as a crucial parameter of the city's traffic concept. Cycle lines are built in a way to reduce time and improve safety.[289] This is achieved by installing

[283] Source: Billehøj, Smart City – the CPH Case, city of Copenhagen, 2011.
[284] City of Copenhagen (2012a)
[285] Copenhagen Cleantech Cluster, 'Integrated transport - The sustainable solution', Copenhagen, n.d., p 5.
[286] Jensen, F., 'A smarter city requires smart partnerships', The Copenhagen Post, available at: http://cphpost.dk/commentary/opinion/opinion-smarter-city-requires-smart-partnerships, Copenhagen, 7 February 2013, last accessed 01/08/2013.
[287] http://www.visitcopenhagen.com/copenhagen-tourist
[288] City of Copenhagen, 'Solutions for sustainable Cities', Copenhagen, 2012a, p. 46 et sqq.
[289] Ibid.

specific traffic lights for bicycles that (in the future) turn green when cyclists are travelling at a certain speed.[290]

At least in the medium term, multiple lane tracks will make it possible for cyclists to adjust their speed.[291] are to be mostly dedicated so that traffic time is reduced.[292]

Another feature of this solution is a project called The Copenhagen Wheel. This allows bicycles to become Smart by equipping them with sensors in their wheels. These sensors measure environmental data like 'noise pollution, congestion and road conditions'.[293] The collected data are sent anonymously to the city in order to analyse environmental factors and measure the impact of traffic on the city infrastructure; furthermore the data may be fed into the decision-making process when environmental or transportation issues are on the agenda.[294]

The cycling solution is embedded in the broader concept of improving traffic in the city, for example by easy switching from bicycles to public transport and the provision of sufficient parking spaces for bicycles.[295] Clearly visible 'bike counters along the cycle lanes reinforce the message that cyclists matter in Copenhagen. Simultaneously the counters provide real-time data to the City of Copenhagen.'[296] These may be used to analyse the traffic flow of bicycles in the city further.

### *Assessment*

The cycling solution in Copenhagen is based on clear sub-targets. By 2025, the city wants to reduce travel time for cyclists by 15% and reduce accidents by 70% compared with 2005 levels.[297] Within a shorter timeframe, by 2015, the city wants 50% of daily trips to places of work and educational institutions to be taken by bicycle.[298] Cycling is already recognised as a very popular mode of transport, as demonstrated by the fact that 63% of Danish parliamentarians commute to parliament by bicycle.[299]

An evaluation of activities, termed the Bicycle Account, is carried out biannually to compare what Copenhagen has achieved against its cycling objectives.[300] This generates useful information on improvements in the cycling infrastructure and helps to identify other areas for improvement. For example, the most recent evaluation, conducted in 2012, showed that since 2008 cyclists' sense of security had increased by 25% to 76%.[301] For the 2012 evaluation, 1,021 citizens responded to the survey. Of these, 677 were categorised as cyclists – they either use their bicycle at least once a week or declare the bicycle to be their preferred mode of city transport.[302] This shows that a large proportion of the population in Copenhagen consider the bicycle a convenient mode of transport.

This evaluation illustrates citizen involvement in the process of developing the cycling strategy and activities. Investments in cycling infrastructure are therefore based on the need of citizens and may be tagged as widely accepted.

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[290] Sustania, 'Guide to Copenhagen 2025, Copenhagen', n.d., p.48 et sqq.
[291] Ibid.
[292] City of Copenhagen, 'Solutions for sustainable Cities', Copenhagen, 2012a, p. 46 et sqq.
[293] Ratti et al., 'The Copenhagen Wheel', available at: http://senseable.mit.edu/copenhagenwheel/index.html, n.d., last accessed on 22/07/2013.
[294] Ibid.
[295] City of Copenhagen, 'Solutions for sustainable Cities', Copenhagen, 2012a, p. 46 et sqq.
[296] Ibid.
[297] Ibid.
[298] Ibid.
[299] http://www.visitcopenhagen.com/copenhagen-tourist
[300] City of Copenhagen, 'Copenhagen's Bicycle Strategy & Policies', available at: http://subsite.kk.dk/sitecore/content/Subsites/CityOfCopenhagen/SubsiteFrontpage/LivingInCopenhagen/CityAndTraffic/CityOfCyclists/CopenhagenCyclePolicy.aspx, 2013a, 14 June 2013, last accessed on 22/07/2013.
[301] Ibid.
[302] City of Copenhagen, 'Copenhagen City of Cyclists – Bicycle Account 2012', 2013b, May 2013.

*Economics*

The aim of this component is to make cycling the fastest and cheapest way of travelling in and around Copenhagen, and cycling has many benefits and relatively low costs. These benefits include:

- environmental benefits:
    - reduced noise
    - reduced air pollution
    - reduced $CO_2$ emissions[303]
- health benefits:
    - healthier citizens, with a reduction in health care costs at an estimated rate of EUR 0.77 per km cycled
- economic benefits:
    - creation of jobs
    - improved city life
    - low-cost form of transport
    - reduced journey times and traffic congestion, leading to increased economic productivity (88% of cyclists use this mode of transport because it is the fastest or most convenient way of getting to work).[304]

On the other hand, the yearly investment costs in cycling infrastructure in Copenhagen are estimated by Jensen to be up to EUR 10–15 million year, which equated to between 20% and 25% of the annual road budget.[305] Infrastructure included new bridges, new cycle tracks, new green cycle routes and improved cycle parking.

In total, Jensen states that the benefits described above are thought to outweigh the associated costs. In his analysis, Jensen writes that cycling benefits society by USD 0.25 per km cycled and that the health and life expectancy benefits of cycling are seven times greater than the accidents costs, while, on the flip side, the cycling costs of purchasing and maintaining a bicycle are EUR 0.05 per km cycled compared with car costs of EUR 0.32 per km driven.

The increase in cycling seems to have a positive cost-benefit result even in the short term. Investing in infrastructure and improving the cycling environment may also be mid-term and long-term solutions for a Smart City, depending on its existing infrastructure.

[303] Jensen (2009) state that "90,000 tons $CO_2$ [is] saved every year from cycling in Copenhagen – as compared with the same mileage driven by one person in a [European] car". http://www.gmfus.org/galleries/cdp-tcn/Jensen__Cyclings_High_Return_on_Investment.pdf

[304] City of Copenhagen, 'Solutions for sustainable Cities', Copenhagen, 2012a, p. 46 et sqq.

[305] http://www.gmfus.org/galleries/cdp-tcn/Jensen__Cyclings_High_Return_on_Investment.pdf

## Integrated public transportation

*Description*

The city of Copenhagen has built up a public transport system that tries to minimise travel times by connecting different transport modes in an optimal way. Buses, trains and the metro are part of an integrated concept alongside bicycles. Bus stops and bicycle facilities have been built near train stations to provide a smooth transfer between transport modes.[306] Bicycles are free of charge in S-trains and may also be carried on buses.

Travellers can buy a single ticket for all modes of transport electronically with a mobile phone (electronic ticket). It is also possible to use an ICT-based ticket – the so-called Travel Card.

At the beginning and the end of a journey the card is read by an electronic sensor. The cheapest price of the journey is calculated and debited from the Travel Card.[307]

An electronic journey planner delivers real-time information and calculates the best journey route for the traveller. Free internet is provided on S-trains and buses. 'Using radio and GPS technology enables traffic controllers to keep lights green if buses are approaching. This has brought improved accessibility and speed for buses.'[308]

For the future, the city wants to increase activities on the improvement of traffic flow through smart traffic management by the use of new technologies, thereby cutting $CO_2$ emissions.[309]

*Assessment*

The city has a general vision on transport that 'in the long term, […] at least one third of all trips in the city should be made by bike, at least one third by public transport and not more than one third by car'.[310]

Major goals for 2025 are:

- 75% of all trips in Copenhagen to be on foot, or by bike or public transport
- 50% of trips to work or school in Copenhagen to be by bike
- 20% more passengers to use public transport
- public transport to be carbon neutral
- 20–30% of all light vehicles to run on new fuels such as electricity, hydrogen, biogas or bioethanol
- 30–40% of all heavy vehicles to run on new fuels.[311]

These goals are verifiable and may therefore take efforts to be achieved. However, the approach is more top-down as transport is often covered within urban planning. It is not clear whether citizens are directly involved in the planning process. In fact, since 1947 the Copenhagen area builds on what is called the finger plan.[312]

[306] Copenhagen Cleantech Cluster, 'Integrated transport - The sustainable solution', Copenhagen, n.d., p 5.
[307] Ibid.
[308] City of Copenhagen, 'Solutions for sustainable Cities', Copenhagen, 2012a, p. 46 et sqq.
[309] City of Copenhagen, 'CPH 2025 Climate Plan', Copenhagen, 2012b, p. 46 et sqq.
[310] Ibid.
[311] Ibid.
[312] Copenhagen Cleantech Cluster, 'Integrated transport - The sustainable solution', Copenhagen, n.d., p 5.

As the city looks similar to a hand with its five fingers, all these fingers (or areas) are to be connected to the city centre by building urban rail line stations in each joint of the fingers. The rest of the city is served by the metro system and buses. The finger plan is therefore still valid and adhered to by urban planners today.[313] More and more people travelling by public transport seem to confirm this urban planning approach. It could therefore be said that users have shown their approval of the finger plan by voting with their feet.

There are frequent evaluations of the transport system: 'the local feeder bus routes are constantly and at least once a year being reviewed with the perspective of servicing the catchment areas and giving the best coordination and coherence in the public transport system'.[314]

High-ranking business people, politicians and so on use public transport and set an example for all citizens.[315]

### *Economics*

Running the bus system in Copenhagen costs DKK 930 million [EUR 125 million] annually, of which the city itself pays DKK 400 million [EUR 54 million]. The city requires a budget of about DKK 290 million [EUR 39 million] to achieve carbon neutrality in public transport until 2025. For the period 2013–2015, it is expected that DKK 300 million [EUR 40 million] will be invested in Smart traffic, excluding the costs for a traffic management system.[316] Benefits are the reduction of carbon emissions from traffic through planning, and managing traffic so that cyclists, bus passengers and car drivers can use an optimal integrated system. Bus journeys will only take 90% of the time they take today, and will run more frequently.[317]

The city also hopes to achieve 'a reduction in congestion and lost hours. The hours lost due to traffic congestion currently constitute EUR 0.76 billion per year for the Capital Region.'[318]

[313] Ibid.
[314] Ibid.
[315] Ibid.
[316] City of Copenhagen, 'CPH 2025 Climate Plan', Copenhagen, 2012b, p. 46 et sqq.
[317] Ibid.
[318] City of Copenhagen, 'Solutions for sustainable Cities', Copenhagen, 2012a, p. 46 et sqq.

# CASE STUDY: SMART CITY MANCHESTER

## Smart City Manchester

### *Description*

Manchester in the north west of the United Kingdom is a city with a rich industrial history. The city census counted 503,000 inhabitants in 2011 and the economic activity was estimated at UKP 31 billion in 2009.[319] The city of Manchester has changed radically over the last 25 years. From a main orientation towards manufacturing and the (textile) industry, a transition towards a more service economy has taken place.[320] These changes involved urban regeneration projects and investments in a more knowledge intensive, creative and innovative economy. At the turn of the millennium Manchester had been promoting itself as a leading city for digital developments. These ambitions have been established in Manchester's Digital Strategy in 2008, setting a local digital agenda for Manchester as a Smart City with three main priorities:

- to activate citizens across society and reengage people in civic participation through digital inclusion
- to generate employment opportunities by skill development and education of local people through digital industries
- to generate creative and innovative digital services by investing in next-generation digital infrastructures through digital innovation.[321]

In 2012 the Digital Strategy was updated with the objective of making Manchester one of the leading digital cities in 2020: 'The Vision for Manchester is to create a dynamic digital economy and a digitally inclusive city region which supports an enhanced quality of life for everyone who lives, works and studies here.'[322] Investments in the digital infrastructure, implementation of broadband for all inhabitants, and ICT education play an important role within this strategy.

In 2013, the city of Manchester has a wide coverage of knowledge-based industries and academia supported by an effective transport system and a high quality digital infrastructure.

The IT cluster in the city of Manchester and the region boasts over 8,000 companies employing 50,000 people.[323] The growth of the IT sector increased by 50% over the past ten years, which is more than five times the national average, according to IBM.[324]

### *Assessment*

To develop and implement the Digital Strategy the Manchester Digital Development Agency (MDDA) was initiated in 2008. The approach of the MDDA is to create partnerships between governments, business and industry, academia and citizens. An evaluation paper by Carter stated that the key determining factors for realising the Smart City strategy of Manchester are:

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[319] Manchester City Council, 'Manchester unveils ambitious plans for a digital city', 2012b, available at: http://www.manchester.gov.uk/news/article/6237/manchester_unveils_ambitious_plans_for_a_digital_city, last accessed 1-8-2012.

[320] Ibid.

[321] Manchester City Council, 'Manchester unveils ambitious plans for a digital city', 2012b, available at: http://www.manchester.gov.uk/news/article/6237/manchester_unveils_ambitious_plans_for_a_digital_city, last accessed 1-8-2012.Carter, Dave, 'Urban Regeneration, Digital Development Strategies and the Knowledge Economy: Manchester Case Study', Journal of the Knowledge Economy, No. 4, Springer, 2013, p.169–189.

[322] Manchester City Council, 'Manchester unveils ambitious plans for a digital city', 2012b, available at: http://www.manchester.gov.uk/news/article/6237/manchester_unveils_ambitious_plans_for_a_digital_city, last accessed 1-8-2012.

[323] IBM, 'IBM – MIDAS', 2013, available at: http://www.investinmanchester.com/case-studies/ibm/, last accessed 1-8-2013.

[324] Ibid.

- city leadership: get support from the highest level
- investments: in new digital infrastructures and services (even in economic crisis)
- exemplar projects: create awareness and inspiration among local stakeholders.[325]

The MDDA had several key success factors in developing as a Smart City, which can be applied to other cities and future strategies.[326] Most of them deal with the active and long-term involvement of local stakeholders in the development and implementation phase of Smart City projects:

- Active consultation of local people and detailed local research is essential.
- Public stakeholders should demonstrate their long-term commitment to community engagement and capacity building.
- Long-term, ongoing monitoring studies (including failures) should feed in to the strategy development process and be actively communicated to local stakeholders.
- Pilot projects should push boundaries to create awareness and inspiration among local stakeholders.

The MDDA also plays an important role in the coordination of several European Smart City initiatives, such as the EU Platform for Intelligent Cities (EPIC), NiCE, Common4EU, IREEN (FP7) CitySDK and SMARTiP (see dashboards in Annex 10). Some of these initiatives are directly aimed at Europe 2020 targets of decreasing carbon emissions (NiCE) or increasing energy efficiency (SMARTiP, IREEN). Other initiatives contribute indirectly to these targets. These initiatives create the fostering environment for local Smart City services or projects, such as Manchester's participation in the European Network of Living Labs, where good practices about co-creation can be shared. Internationally, Manchester plays a role in Europe by being Vice Chair of the Eurocities Knowledge Society Forum and Chair of the European Connected Smart Cities Network.[327]

## Solutions deployed in the Smart City Manchester

### Digital inclusion – EastServe

*Description*

Within Manchester's Smart City development strategies (the Digital Strategy), digital inclusion of citizens across society plays an important role.[328] Access to broadband internet and digital education of citizens are seen as essential elements for a fostering Smart City environment. In 2001 the Eastserve Project was established in East Manchester as a living lab community network for digital inclusion and seen as a major influence on the digitalisation of Manchester.[329]

In the city region of East Manchester, which has a rate of unemployment three times the city average, the Eastserve Living Lab was assisted in installing broadband connections and improving broadband connectivity and activity. The major premise is that ICT can be a catalyst to reduce crime, improve health and educational attainment and thereby contribute to the

[325] Carter, Dave, 'Urban Regeneration, Digital Development Strategies and the Knowledge Economy: Manchester Case Study', Journal of the Knowledge Economy, No. 4, Springer, 2013, p.169–189.
[326] Ibid.
[327] MDDA (Manchester Digital Develoment Agency), 'Smart City – Manchester Digital Development Agency, 2013, available at: http://www.manchesterdda.com/smartcity/, last accessed 1-8-2013.
[328] Carter, Dave, 'Urban Regeneration, Digital Development Strategies and the Knowledge Economy: Manchester Case Study', Journal of the Knowledge Economy, No. 4, Springer, 2013, p.169–189.
[329] Ibid.

Europe 2020 targets on employment, education and poverty. The living lab has run from 2001 up to the present day in various different forms.[330]

*Assessment and economics*

The Eastserve Living Lab made a contribution to increased digital inclusion in East Manchester. Residential broadband internet penetration increased from 2% of households in 2001 to 75% of residents in 2006.[331]

According to several evaluation studies the results of the living lab were broader: residents were more aware of job opportunities, more likely to participate in education, and more interested in starting a business.[332] Although the impact of the Eastserve Living Lab on Europe 2020 targets were not part of the evaluation, the evaluation results demonstrate that unemployment went down, contributing directly to the Europe 2020 targets of decreasing unemployment rates and increased attendance in tertiary education.

## The Digital Home Environment Energy Management System

*Description*

The Digital Home Environment Energy Management System (DEHEMS) is a FP7 project led by Manchester City Council and includes partners such as SMEs, academia and municipalities across Europe. The project aims to contribute to the Europe 2020 targets on reducing carbon emissions by supporting households in reducing their energy usage through better analysis and management of their energy consumption.[333]

The DEHEMS is a system of smart meters with a graphical user interface, enabling measurement of and feedback on energy performance rather than only measuring total consumption. The system uses real-time power measurement and provides feedback to users by incorporating aspects of human behavioural. The DEHEMS was tested in a living lab environment in Manchester in which about 250 households participated.

*Assessment and economics*

The first results of DEHEMS showed that use of smart meters has an immediate impact on the energy consumption of participants.[334] Although the living lab is still in the piloting phase and no ex-post evaluation is available, it is expected that the behavioural change will have a lasting effect.[335]

In this pilot phase the impact on energy savings was 20%, thus contributing to the Europe 2020 targets for reduction in energy use and $CO_2$ emissions. In general, with the rise of energy prices, the use of smart metering and insight into consumer behaviour can be very important as it can contribute to consumers' awareness of their energy consumption and potentially lead to a decrease in overall energy consumptions and $CO_2$ emissions.

[330] Eastserve, 'Technologies – Our background and history', 2013, available at: http://www.eastserve.com/about-us.html, last accessed 1-8-2013.
[331] Ibid.
[332] Carter, Dave, 'Urban Regeneration, Digital Development Strategies and the Knowledge Economy: Manchester Case Study', Journal of the Knowledge Economy, No. 4, Springer, 2013, p.169–189.
[333] Tommis, Martine, 'D1.3 Dehems Deliverable', DEHEMS Final Commission Report, 2011.
[334] Ibid.
[335] Ibid.

# CASE STUDY: SMART CITY VIENNA

Vienna was listed as the world's number one Smart City in 2011[336] and ranked fourth in the European list of Smart Cities of 2012.[337]

## Description of Smart City Vienna

The Smart City project of the Austrian Capital Vienna runs under the direction of the Vienna city administration. In order to reduce energy consumption and emissions without renouncing quality of life the city is continuously modernised. The project is long term and covers all areas of life, work and leisure activities. It includes infrastructure, energy and mobility as well as all aspects of urban development. The main objectives concerning Europe 2020 targets are:

- to reduce emissions significantly and in the long term create a zero emission city with zero emission buildings as standard
- to reduce energy consumption significantly so in the long term there will be nearly zero energy standards in new and existing buildings by 2020
- to increase use of energy from renewable sources significantly
- to raise awareness in the wider public about responsible use of resources
- to give citizens an active role
- to promote multi-modal transport systems by improving the public transport network, enhancing networking between individual transport carriers, and significantly reduce individual motorised transport
- to position Vienna as a model European environmental city and leading European centre for research and technological development at an international level.[338]

## Success factors of Smart City Vienna

### *Vision*

Smart City Vienna has far-ranging goals. It addresses a cross-section of the entire city and affects all areas of responsibility. The objectives promote the development of a city which is based on sustainability and the protection of resources. Through three key strategies – a vision of a sustainable future for Vienna in 2050, a roadmap for energy-efficient and climate-friendly urban development up to 2020 and an action plan for 2012–2015 – Smart City Vienna has developed a concept which provides a vision for the city's future.[339]

### *People*

The Smart City Vienna initiative was launched by the mayor of Vienna in March 2011. He emphasised that 'it is the Smart Cities that will enable the city to compete internationally and secure good quality of life for generations to come'.[340]One of the key elements of the Smart City initiative was a stakeholder process in the course of which all stakeholders inside and outside the city administration were asked to participate in either general

[336] Cohen, B., 'The Top 10 Smart Cities On The Planet', available at: http://www.fastcoexist.com/1679127/the-top-10-smart-cities-on-the-planet, 2012a, last accessed on 22/07/2013.
[337] Ibid
[338] City of Vienna, 'Objectives', available at: https://smartcity.wien.at/site/en/das-projekt/ziele, n.d. a, last accessed 01/08/2013.
[339] City of Vienna, 'Smart City Wien, Vision 2050, Roadmap for 2020 and beyond, Action Plan for 2012-2015', Wien, 2012.
[340] City of Vienna, 'Mission Statement', available at: https://smartcity.wien.at/site/en/das-projekt/mission-statement/burgermeister-dr-michael-haupl/, n.d. b, last accessed 01/08/2013.

consultation teams or teams focusing on specific issues. The six themes addressed by the platform were population development, environment, administration, economy, energy and mobility.[341]

For Smart City Vienna the involvement of the city administration is important, as is overarching cooperation with the associated business in the city, which is a prerequisite for the project. For this reason a clear identity and positioning within and outside the city is essential not only for the population but also for the city authorities.[342] The initiative seeks the involvement of citizens as partners, through several campaigns, for example: 'Basics of Social Awareness', 'Platform Smart Citizens in a Smart City', 'Smart City Participation Processes', 'Awareness of Energy Efficiency, Energy consumption and $CO_2$ emissions', 'Public Citizens Partnership for Municipal Functions', 'Experiences in Demonstration Projects' and 'Implementation of a Smart City Agency'. The 'Implementation of a Smart City Agency' campaign involves the further development of stakeholder interaction in the implementation phase of the project.[343]

*Process*

The project management of Smart City Vienna is in the hands of the Municipal Department for Urban Development and Planning to ensure a long-term process, which takes into account energy efficiency and technical matters as well as planning principles like sustainability, participation, diversity, resource efficiency, integrated regional development and economic growth. The detailed roadmap for 2020 and beyond, the result of comprehensive stakeholder involvement, includes sections on city development, mobility, new construction and refurbishment, energy infrastructure and energy consumption targets (for 2020), current activities and options for activities, which are in turn described in detail in the action plan.[344]

## Solutions deployed in the Smart City Vienna

### Mobility solution 'eMorail'

*Description*

eMorail is a demonstration project, which aims to produce a blueprint for an innovative, cost-efficient and environmentally friendly mobility solution for commuters. It has been implemented in the cities of Vienna and Graz. Core elements of the project are an integrated transport service and an intermodal e-car sharing and e-bike service. Commuters should have a ticket for the Austrian Federal Railways as well as access to the use of an e-vehicle at their place of residence and destination. Additional services such as information and repair are intended to complete the package. eMorail maintains a smart phone application, which increases accessibility for customers. One of the main functions is the potential to book a vehicle. Other features include information about train delays, possible kilometres to drive without charging the car or the bike, and checks on the remaining credit available for travel.

[341] City of Vienna, 'Publications', available at: https://smartcity.wien.at/site/en/das-projekt/publikationen/, n.d. c, last accessed 01/08/2013.
[342] City of Vienna, 'Strategy', available at: https://smartcity.wien.at/site/en/das-projekt/strategie/, n.d. d, last accessed 01/08/2013.
[343] City of Vienna, 'Smart City Wien, Vision 2050, Roadmap for 2020 and beyond, Action Plan for 2012-2015', Wien, 2012.
[344] Ibid.

An additional e-bike application contains a map with e-bike stations and shows the next station. Furthermore information about the availability of e-bikes is included.[345]

*Assessment*

The aim of this solution is 'to promote electric vehicles as a supplementary form of mobility that can be combined with public transport'.[346] Commuters may no longer need to own a car.

Comfort and a significant degree of extra value are essential for commuters to change their habits. For this reason user-friendliness and communication between those involved are critical factors for the success of this solution.

Coordination between technological factors such as infotainment, data recording, invoicing and the supply of electric power as well as the maintenance of a vehicle fleet requires streamlined processes and well-defined interfaces. The system will be updated continuously.

There may be the potential in future for wider roll-out throughout the country. The solution seems to be scalable for other cities, especially those with a similar structure to Vienna, regarding commuters and their existing transport system.

*Economics*

The project is still running and detailed financial information and market analysis will be available by October 2013. One of the first areas of feedback was that the price of the eMorail mobility package and included services is very important for commuters, and would influence the relative costs and benefits of a wider roll-out. Alongside the payment structure, some other criteria might also be critical for the roll-out of the project. The implementation of such a solution would lead to a reduction of greenhouse gas emissions, which result from a shift from individual mobility to public transport in combination with electric-based vehicle for first and last miles. The highest possible level of reduction will be reached if public transport and electric vehicles are supplied by power from renewable energy sources.[347]

## Integrated mobility concept 'SMILE'

*Description*

Smart Mobility Info and Ticketing System Leading the Way for Effective E-Mobility Services (SMILE) is the prototype of a multi-modal mobility platform. The platform aims to cover all public and individual mobility services for customers, providing comprehensive information on the various options for getting from A to B. It is developed in a joint research project by two city-owned enterprises (public utility company Wiener Stadtwerke and public transport operator Wiener Linien) and the Austrian Federal Railways (ÖBB).[348]

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[345] eMORAIL, 'Integrated eMobility Service for Public Transport', available at: http://www.klimafonds.gv.at/assets/Uploads/Themenprojekte/Leuchttuerme/eMORAIL/22052012EMORAILBeschreibung-EN.pdf, n.d. a, last accessed 01/08/2013. e-MORAIL, 'Die neue Mobilität', available at: http://www.emorail.at/emorail/importedContents/home/home.xhtml, n.d. b, last accessed 01/08/2013.

[346] eMORAIL, 'Integrated eMobility Service for Public Transport', available at: http://www.klimafonds.gv.at/assets/Uploads/Themenprojekte/Leuchttuerme/eMORAIL/22052012EMORAILBeschreibung-EN.pdf, n.d. a, last accessed 01/08/2013.

[347] Gara, S., 'Integrated (e-)Mobility', 2013, available at: http://eu-smartcities.eu/content/integrated-e-mobility, last accessed 01/08/2013.

[348] Wiener Stadtwerke AG et al., 'Smile – einfach mobil', available at: https://smartcity.wien.at/site/en/themen/bildung-forschung/smile-die-mobilitatsplattform-der-zukunft/, n.d., last accessed 01/08/2013.

*Assessment*

The project aims to contribute to the structural change of the transport sector by delivering the 'missing link' between public transport and electronic individual transport.[349]

Customer needs are placed at the heart of the SMILE platform. Particular attention has been given to ensuring that the interface is user-friendly. Another important factor for the success of SMILE is that it is implemented with the cooperation of the two largest public transport providers in Austria.

A further positive aspect of SMILE is that the mobility platform has open interfaces. Suppliers of relevant mobility services like e-car sharing, e-bike sharing, parking grounds and so on can also use the platform to provide their services.[350] Through the network effect of these additional services the platform becomes more attractive for users.

Customers choose a suitable connection from A to B, book a ticket electronically for all the necessary means of transport and make the payment electronically. This concept of 'one stop shopping' provides a high degree of user-friendliness.

The project has a scalability for further projects in other cities. It provides the base for other smart solutions and business models.

*Economics*

The multi-modal mobility platform itself is not able to contribute to the Europe 2020 targets but it has an impact and can assist in achieving a switch from individual mobility using personal private vehicles to trips using combined modes of transport. An integrated mobility concept aims to achieve time savings and energy savings, and to have a positive impact on greenhouse gas emissions by reducing traffic volume.

[349] Ibid.
[350] Ibid

# ANNEX 7: COVERAGE OF SMART CITY CHARACTERISTICS

| City | Characteristics covered (%) (Europe 2020 coverage score) | Initiatives including each characteristic (%) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | ECO | ENV | GOV | PEO | LIV | MOB | Variance |
| Amsterdam | 100% | 67% | 33% | 67% | 67% | 67% | 33% | 2.5% |
| Athens | 63% | 0% | 0% | 100% | 33% | 67% | 0% | 14.8% |
| Barcelona | 100% | 60% | 50% | 40% | 30% | 30% | 40% | 1.1% |
| Bremen | 75% | 0% | 33% | 0% | 33% | 33% | 33% | 2.5% |
| Budapest | 63% | 0% | 100% | 0% | 0% | 50% | 50% | 13.9% |
| Copenhagen | 100% | 14% | 100% | 14% | 43% | 14% | 43% | 9.3% |
| Dublin | 100% | 33% | 50% | 33% | 17% | 50% | 33% | 1.3% |
| Eindhoven | 63% | 0% | 50% | 0% | 0% | 50% | 50% | 6.3% |
| Glasgow | 75% | 0% | 100% | 0% | 67% | 33% | 67% | 13.6% |
| Hamburg | 88% | 20% | 80% | 0% | 60% | 40% | 60% | 7.2% |
| Helsinki | 100% | 75% | 13% | 38% | 50% | 38% | 50% | 3.5% |
| Ljubljana | 63% | 0% | 50% | 0% | 50% | 0% | 50% | 6.3% |
| Lyon | 63% | 0% | 100% | 0% | 100% | 0% | 100% | 25.0% |
| Malmo | 75% | 0% | 67% | 33% | 33% | 67% | 0% | 7.4% |
| Manchester | 100% | 20% | 30% | 40% | 60% | 60% | 20% | 2.8% |
| Milan | 88% | 0% | 83% | 17% | 33% | 33% | 33% | 6.5% |
| Oulu | 88% | 40% | 40% | 20% | 80% | 60% | 0% | 6.7% |
| Tallinn | 75% | 50% | 100% | 0% | 0% | 50% | 50% | 11.8% |
| Tirgu Mures | 63% | 0% | 0% | 100% | 100% | 100% | 0% | 25.0% |
| Vienna | 75% | 0% | 67% | 0% | 67% | 67% | 33% | 9.0% |

# ANNEX 8: THE EUCLIDEAN DISTANCE TO IDEAL FOR EACH SMART CITY CHARACTERISTIC

| City | Characteristic | | | | | | Europe 2020 characteristics score |
|---|---|---|---|---|---|---|---|
| | ECO | ENV | GOV | PEO | LIV | MOB | |
| Copenhagen | 73% | 0% | 73% | 73% | 33% | 33% | 64% |
| Oulu | 36% | 36% | 64% | 16% | 4% | 100% | 68% |
| Manchester | 64% | 49% | 36% | 16% | 16% | 64% | 69% |
| Barcelona | 16% | 25% | 36% | 49% | 49% | 36% | 74% |
| Amsterdam | 11% | 44% | 11% | 11% | 11% | 44% | 83% |
| Helsinki | 6% | 77% | 39% | 39% | 25% | 25% | 74% |
| Bremen | 100% | 44% | 100% | 44% | 44% | 44% | 53% |
| Tallinn | 25% | 0% | 100% | 25% | 100% | 25% | 66% |
| Milan | 100% | 3% | 69% | 44% | 44% | 44% | 62% |
| Dublin | 44% | 25% | 44% | 25% | 69% | 44% | 68% |
| Eindhoven | 100% | 25% | 100% | 25% | 100% | 25% | 53% |
| Glasgow | 100% | 0% | 100% | 44% | 11% | 11% | 67% |
| Budapest | 100% | 0% | 100% | 25% | 100% | 25% | 56% |
| Hamburg | 64% | 4% | 100% | 36% | 16% | 16% | 71% |
| Athens | 100% | 100% | 0% | 11% | 44% | 100% | 56% |
| Tirgu Mures | 100% | 100% | 0% | 0% | 0% | 100% | 63% |
| Ljubljana | 100% | 25% | 100% | 100% | 25% | 25% | 53% |
| Lyon | 100% | 0% | 100% | 100% | 0% | 0% | 63% |
| Malmo | 100% | 11% | 44% | 11% | 44% | 100% | 61% |
| Vienna | 100% | 11% | 100% | 11% | 11% | 44% | 65% |

# ANNEX 9: THE CORRELATION BETWEEN SMART CITY CHARACTERISTICS AND BETWEEN SCORES

It is important to note that where a characteristic is rare, its distance from (full) prevalence is high, so the portfolio of initiatives places relatively little emphasis on this characteristic and uses it only in a few initiatives. If a characteristic is common across all initiatives, it will have a fairly low distance from the ideal. For these characteristics, therefore, it is difficult to draw conclusions about their contribution to success as there is relatively little variance to explain. Characteristics that lie in the middle are used more selectively, and their correlation with the scores is more revealing.

**The correlation between Smart City characteristics and between scores**

| | ECO | ENV | GOV | PEO | LIV | MOB | Characteristic | Coverage | Performance |
|---|---|---|---|---|---|---|---|---|---|
| **ECO** | 100 % | | | | | | | | |
| **ENV** | -10% | 100 % | | | | | | | |
| **GOV** | 38% | -81% | 100 % | | | | | | |
| **PEO** | 7% | -53% | 59% | 100% | | | | | |
| **LIV** | 31% | -18% | 21% | -12% | 100% | | | | |
| **MOB** | 9% | 59% | -53% | -70% | -12% | 100% | | | |
| **Europe 2020 characteristic score** | | | | | | | 100% | | |
| **Europe 2020 coverage score** | | | | | | | 78% | 100% | |
| **Performance-weighted score** | | | | | | | 95% | 79% | 100 % |

The table above shows that the strongest positive correlations among characteristics are those between Smart Governance and Smart People, Smart Environment and Smart Mobility, and Smart Economy and Smart Living. This suggests there is a reassuring recognition of spillovers between related characteristics. The strongest negative correlations (an either/or choice or an incompatibility within individual initiatives) are those between Smart Governance and Smart Environment, Smart Mobility and Smart People, and between Smart Mobility on one side and Smart Environment or Smart Governance on the other. This does not mean that those characteristics are incompatible or unrelated, simply that they are rarely found together. As noted above, the performance-weighted and characteristic scores are more strongly related to each other than to the coverage score.

Of more direct relevance to this chapter are the correlations between the characteristics and the scores. The table below shows the scores for characteristics, coverage and performance of the six Smart City characteristics (the breadth of coverage).

**Correlations between the scores for characteristics, coverage and performance of the six Smart City characteristics**

| | Characteristic | Coverage | Performance |
|---|---|---|---|
| ECO | 70% | 56% | 55% |
| ENV | -19% | -1% | 14% |
| GOV | 34% | 15% | -6% |
| LIV | 35% | 14% | 33% |
| PEO | 5% | -1% | -16% |
| MOB | 2% | 3% | 28% |

Overall, a negative score indicates a situation where a characteristic is being included without strong evidence of a pressing need[351], or is not used when there is a need for the most closely related aspects of performance (relative to Europe 2020 targets). In the former case, it may be that the characteristic is being used to build on existing strengths (e.g. for demonstration or awareness-raising purposes); in the latter case, there is a strong argument for dedicated efforts to stimulate the deployment of the missing characteristics.

This shows that the breadth of coverage of the Smart Economy characteristic is strongly correlated with all three measures of success, but most strongly with the characteristic measure. This demonstrates that the country's economic performance is not a strong determinant of the inclusion of Smart Economy aspects. There is a degree of bimodality here. Countries with strong economic performance may be motivated to include this characteristic in order to consolidate their gains and move into a more globally competitive Smart Economy. Conversely, those in a weaker position may see Smart City initiatives as a partial solution to their economic problems. In either case, the characteristic correlation is strong, because the comparative rarity of Smart Economy characteristics means that they are more likely to show up in cities that are closer to the ideal configuration (in other words, as a city approaches the ideal, the economy characteristic may be the last to be included).

Because of the comparative rarity of Smart Economy initiatives, this characteristic has the weakest relationship with any of the scores. On the other hand, the comparative abundance of the Smart Environment characteristic means that too has a weak relationship (despite the differences in correlation coefficients).

In view of its high prevalence, Smart Environment is negatively correlated with the characteristic and coverage measures. More interesting is its positive correlation with the performance-weighted score. This tells us that those few cities that do not include Smart Environment in most of their initiatives are those with the best environmental performance (as would be hoped).

Almost the reverse is true of Smart Governance: it is positively correlated with the characteristic and coverage scores, but negatively correlated with the performance-weighted measure. Perhaps this is because this characteristic is most strongly linked to the economic, educational and societal targets. Smart City initiatives tackling governance are first and foremost public initiatives and are therefore more likely to be found in cities with reasonably good performance on the headline measures of good governance. This does not mean that this characteristic is inappropriate in those cities, only that additional measures

[351] By need we mean the city's position in relation to its Europe 2020 targets

to strengthen the inclusion of Smart Governance in Smart City initiatives in cities with weaker government performance is warranted.

Because living standards are closely related to economic outcomes, the picture for Smart Living is similar to that for Smart Economy, though the linkages are less strong because the prevalence of Smart Living characteristics is higher.

In contrast, the Smart People characteristic seems distinctly under-used in cities where it is most needed. This is perhaps because the associated actions (e.g. public provision of information) tend already to be present in advanced cities, and are thus prime candidates for application and further development in cities performing well against this target, but may be premature in cities with more serious problems.

Finally, in view of the strong associations with the multi-city NiCE initiative, Smart Mobility is only weakly associated with the unweighted scores, but is more strongly linked to performance-weighted score.

# ANNEX 10: DASHBOARDS

In order to analyse the inputs and processes involved in European Smart Cities, a series of dashboards were created for the shortlist of 20 Smart Cities building on information about the 37 cities considered in Chapter 5. The shortlist was selected to provide a good distribution of geographical location, status and city size, and a good spread of numbers of initiatives (including cities that concentrated on a few initiatives and those with a larger number and range). This shortlist included 88 initiatives spread across 20 cities.

The dashboards collected information on the following eight areas for each of the cities in the sample:

- basic data on the city
- position vis-à-vis the Europe 2020 targets
- city profile and innovation strategy
- ICT resources in place (capability to pursue Smart City initiatives)
- initiatives associated with the city
- Smart City characteristics displayed in a given city
- impacts expected from those initiatives
- alignment between the overall and national Europe 2020 targets.

They are described in the following paragraphs.

The *basic data* comprise the country of the city and its population.

The *position vis-à-vis the Europe 2020 targets* is described using city-specific indicators of the areas covered by the targets. City level data for these indicators are often absent or irrelevant, so national level indicators are used. While these do not fully capture the local situation, and obscure variation between different cities in a given country, it is assumed that – especially in light of Europe's growing urbanisation – the national situation represents the city situation to a degree; moreover, the drivers for Smart City initiatives are likely to be influenced by the problems of the nation. The socio-economic status of a city is described by six national indicators aligned with the Europe 2020 targets:

- employment rate (percentage of population aged 20–64), 2011
- expenditure on R&D as a percentage of GDP, 2011
- greenhouse gas emissions, base year 1990–2010
- share of renewable energy in gross final energy consumption (%), 2010
- early leavers from education and training (percentage of population aged 18–24), 2011
- tertiary educational attainment (percentage of population aged 30–34), 2011
- population at risk of poverty or exclusion (percentage of total population), 2010.

Below, these indicators are used to indicate the salience of specific targets by considering their *distances* from EU averages and national targets.

*The city profile and innovation strategy* describes how each city presents its priorities and the ways it plans to implement new technologies and achieve its goals.

The *country ICT baseline data* capture the city's ICT capabilities at a national level because of data limitations.[352] Note that weak performance does not necessarily mean that a city should not pursue Smart initiatives; although the *use* of ICT is a prerequisite, Smart City initiatives may be intended to catalyse ICT improvements. ICT development in each city is represented by five national indicators using 2008 and 2012 EU Digital Agenda Scoreboard data:[353]

- ICT schools – number of computers for educational purposes per 100 Grade 4 students
- internet access – percentage of households living in urban areas with access to the Internet at home
- broadband – percentage of households having a broadband connection
- e-commerce – percentage of internet users ordering goods and services online
- e-government – percentage of individuals interacting online with public authorities.

*Smart City* initiatives that have been or are currently being undertaken are described by their:

- characteristics according to the classification introduced in Chapter 2
- components obtained from the detailed analysis in Chapter 4
- objectives set by the initiative for itself (as distinct from those of the city innovation strategy or Europe 2020)
- sources of funding (the mixed nature of funding sources and the combination of grant, underwriting, in-kind and other forms of support mean that numerical data are not meaningful), as described in Chapter 4
- stakeholders involved, as described in Chapter 4
- sources of information.[354]

The *potential impacts on Europe 2020* section relates the aggregated objectives and expected impacts of Smart City initiatives to the achievement of objectives and targets of Europe 2020 for that country. The information is broadly structured around the three areas of Europe 2020: energy, poverty, and education and employment.

*Alignment to Europe 2020 targets* is described in terms of the national and overall levels of the Europe 2020 targets and whether the priorities of Europe 2020 are explicitly mentioned in the objectives of an initiative. These data are used to calibrate the actual situation in the country and to analyse the extent to which a city is expected to contribute to attaining particular targets, as discussed in Section 5.1.2.

[352] Data are available for a small subset of the cities from the urban audit (Eurostat, 2008), but national data were used for consistency and completeness. Population normalisation was used to eliminate scale distortions.
[353] Figures taken from the EU Digital Agenda Scoreboard (European Commission, 2013a).
[354] Data sources for this information included websites of city administrations, prevalent Smart City project websites cited in the relevant literature and information from the database created for Chapter 3.

| Manchester | |
|---|---|
| Country | United Kingdom |
| Population | 498,269 |

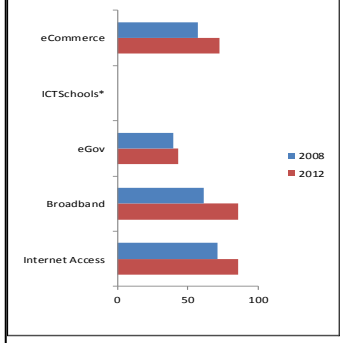
| National EU2020 | | |
|---|---|---|
| | National | EU |
| Employment rate (2011) | 73.6% | 68.6% |
| Expenditure on R&D (2010) | 1.8% | 2.0% |
| Greenhouse Gas Emissions (1990-2010) | 77 | 85 |
| Renewable Energy (2010) | 3.3% | 12.1% |
| Early Leavers from education/training (2011) | 15.0% | 13.5% |
| Tertiary educational attainment (2011) | 45.8% | 34.6% |
| People at risk of poverty/social exclusion (2010) | 23.1% | 23.6% |

**City profile - Innovation Strategy**

Manchester is already a leading city for digital technologies. Over the last 20 years we have seen the city centre and surrounding areas transform with new knowledge based industries, better transport, growing universities, and new schools, work places and homes, as well as an expanding international airport. After years when the city's population declined, this is now growing, as people live, work, study and go out in the city.

Source:
http://www.manchester.gov.uk/news/article/6237/manchester_unveils_ambitious_plans_for_a_digital_city
http://www.manchester.gov.uk/egov_downloads/DigitalManchester.pdf

**ICT baseline**




GOV ECO ENV MOB PEO LIV

| Smart City Initiatives | Characteristics | Components | Objectives | Funding | Stakeholders | Source |
|---|---|---|---|---|---|---|
| EU Platform for Intelligent Cities (EPIC) | GOV, LIV, PEO | Cloud computing, Innovation, E-services, Service delivery | "Aims to wed state-of-the-art cloud computing technologies with fully researched and tested e-Government service applications to create the first truly scalable and flexible pan-European platform for innovative, user-driven public service delivery" | European Commission-funded project (CICT PSP) | 17 project partners including city-level institutions, private companies, universities - across 4 cities | http://www.epic-cities.eu/ |
| Digital Cities | GOV, LIV, PEO | public available Wi-Fi, Training, Promotion, Mobile technology, Citizen as a sensor | "The project focuses on the problem of the low ICT adoption by European local authorities in non-metropolitan areas, geographically isolated areas and other areas of social exclusion" | European Union Interreg IVC | Manchester Digital Development Agency, Almere Knowledge City Foundation, City of Jesenik, University Transilvania of Brasov, Municipality of Brasov, Municipality of Xanthi, e-Trikala, Institute of Communication and Computer Systems (Athens), Malta Government Technology Investments Ltd, Paralimni Municipality | www.digital-cities.eu |
| Common4U | GOV, ECO, MOB, LIV | Mobile node, FreeEurope Wi-Fi pilot, Innovative Internet technologies, Fiber from the "X" approach (FFTX) , Open sensors networks, Open data portal | "Smart city initiative to 'close the gap' between cities and its citizens by 'fostering innovation' and 'creating cutting edge digital services'" | Co-funded by the European Union [ICT Policy Support Programme (ICT PSP) "Competitiveness and Innovation"] | Partners: ESADE, Fraunhofer FOKUS, FORUM VIRIUM HELSINKI, City of Amsterdam Economic Development Department, waag society, Provincia Di Roma, CASPUR, Universitat Pompeu Fabra Barcelona, Manchester Digital Development Agency, dotopen, LYNX, guifi.net, Nesta, Ajuntament de Barcelona | http://commonsforeurope.net/ |
| Cityserve | LIV, PEO | Broadband, Internet acces, PC access, E-skills | "Cityserve, one of Manchester City Council's flagship projects in the New Deal for Communities was set up to challenge this view and to underpin regeneration of one of the UK's most deprived urban areas" | Local government sponsored | Manchester City Council | http://www.city-serve.com/ |
| TellUS Pilot: The Green Home Watch | ENV, GOV | Eco heating, renewable energy, buildings, internet, data, citizen as a sensor | "A map-based crowd sourcing website that allows citizens to share their experiences of eco heating services and products" | Additional funding from the University of Manchester Social Responsibility Flagship Support | Manchester City Council; University of Manchester; EU | http://www.tellus-toolkit.com/ |
| Go ON Manchester | PEO, LIV | Social inclusion, Internet, e-skills | "Go ON is a national campaign to promote digital inclusion. The key focus is to bring the benefits of the Internet to every individual, organisation and community in the UK" | Manchester city council, Manchester Digital Development Agency, EU CIP | Manchester City Council, Manchester College, the Chamber of Commerce, the Manchester Digital trade association, social housing organisations, local digital and creative networks, voluntary and community organisations. | http://go-on-manchester.com/ |
| CitySDK | MOB, ECO | data, service delivery, Ebusiness | "Helping cities to open their data and giving developers the tools they need, the CitySDK aims for a step change in how to deliver services in urban environments. The Project focuses on three Pilot domains: Smart Participation, Smart Mobility and Smart Tourism" | CitySDK is a 3.4 million Euro project, part funded by the European Commission | 23 partners across 9 countries including private companies, development and expert organisations, network organisations, universities and research institutes | http://www.citysdk.eu/ |
| IREEN | ENV | ICT, Innovation, Strategy, Roadmap, energy efficiency | "To deliver a comprehensive strategy & roadmap for European-scale innovation and take-up in ICT for energy-efficiency in neighbourhoods" | Coordination Action by DG Connect (Directorate General for Communications Networks, Content and Technology) | Manchester City Council (MCC), Centre Scientifique et Technique du Bâtiment (CSTB), VTT Technical Research Centre of Finland, Atos Spain s.a.e (ATOS), Acciona Infraestructuras (Acc), GreenIT Amsterdam (GITA), D'Appolonia S.p.a (DAPP), Austrian Institute of Technology (AIT) | http://www.ireenproject.eu/ |
| SMARTiP Project | PEO, LIV | ICT - Apps, eskills, citizens | "The project aims to act as a catalyst to stimulate citizen engagement in becoming active generators of content and applications development" | Co-funded by the European Union [ICT Policy Support Programme (ICT PSP) "Competitiveness and Innovation"] | 14 partners (private/public/universities) across 5 cities (Manchester, Oulu, Ghent, Bologna, Cologne) | http://www.smart-ip.eu/ |
| NICE (Networking Intelligent Cities for Energy Efficiency) | ENV, PEO | Measurement, Learning sessions with experts, Networks of people, Data, Framework | "The project aims to create a partnership of cities on ICT and energy efficiency" | The project is funded under the ICT strand of the 7th Research Framework Programme (FP7) | 97 Eurocities members, Clicks and Links, Manchester City Council, Leibniz Institute of Ecological Urban and Regional Development | http://www.eurocities.eu/eurocities/activities/projects/NiCE-Networking-intelligent-Cities-for-Energy-Efficiency |

**Potential Impacts on EU2020**

Manchester has 10 smart city initiatives which between them directly address all EU 2020 target areas. At present the UK is significantly underachieving EU 2020 targets for renewable energy use, expenditure on R&D and to a lesser extent early leavers from education/training. Moreover, the UK has not set national targets in many of these areas.

Three initiatives specifically seek to increase energy efficiency and reduce CO2 emissions. The Networking Intelligent Cities for Energy Efficiency is decreasing ICT's direct carbon footprint per city by 30%. The TellUS Pilot crowdsources information from citizens to share experiences of eco heating services - this will feed into climate change and carbon reduction policy at city and state level. IREEN also aims to increase uptake of ICT to increase energy efficiency.

Cityserve challenged the link between deprivation and social exclusion through e-skills, internet and PC access. Broadband access grew from 2% in 2001 to 25% in 2005 and overall 75% of residents have internet access. PC ownership increased from 19% in 2001 to 52% in 2005. 57% of residents identified access to online services through Cityserve as beneficial, highlighting improved communication with family and their community.

Six initiatives focus on citizen connectivity, including e-Government services, open access to data and digital inclusion. In fostering R&D through open data and reducing social exclusion, poverty may be reduced. Moreover, businesses which can access high speed broadband are more competitive and can grow. Go ON Manchester enabled households to save up to £560 per year shopping and paying bills online.

| Alignment to Europe2020 objectives | | | |
|---|---|---|---|
| | EU | National | |
| Employment rate | 75% | No target in NRP | |
| R&D in % of GDP | 3% | No target in NRP | |
| CO2 emission reduction | -20% | -16% | x |
| Renewable energy | 20% | 15% | x |
| Energy efficiency | 20% | n.a. | x |
| Early school leaving | less than 10% | No target in NRP | |
| Tertiary education | at least 40% | No target in NRP | |
| Reduction of population at risk of poverty | at least 20 million | Existing numerical targets of the 2010 Child Poverty Act | x |

| Copenhagen | |
|---|---|
| Country | Denmark |
| Population | 541989 |

| National EU2020 progress | National | EU |
|---|---|---|
| Employment rate (2011) | 75.8% | 68.6% |
| Expenditure on R&D (2010) | 3.1% | 2.0% |
| Greenhouse Gas Emissions (1990-2010) | 89 | 85 |
| Renewable Energy (2010) | 22% | 12.1% |
| Early Leavers from education/training (2011) | 9.6% | 13.5% |
| Tertiary educational attainment (2011) | 41.2% | 34.6% |
| People at risk of poverty/social exclusion (2010) | 18.3% | 23.6% |

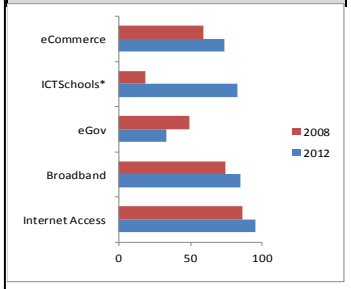
**City profile - Innovation Strategy**

•To turn Copenhagen into a leading testbed for new green solutions. The purpose is to use the city as living lab for new green solutions in partnership private partners and research institutions.

•To expand the visibility of the solutions that are tested and demonstrated in Copenhagen by promoting the city as an international showcase for smart green solutions. We do this by establishing showcase platforms, bidding for large energy and climate congresses and other means that showcase the solutions to a wider global audience.

Source: http://subsite.kk.dk/sitecore/content/Subsites/CityOfCopenhagen/SubsiteFrontpage/Business/Growth_and_partnerships/Strategy.aspx

**Country ICT baseline**




GOV ECO ENV MOB PEO LIV

| Smart City Initiatives | Characteristics | Components | Objectives | Funding | Stakeholders | Source |
|---|---|---|---|---|---|---|
| Transportation integration | MOB, ENV, GOV, ECO | ICT Mobile Access, Multimodality, Monitoring and sensors, Data | "On-line and physical integration of bus, train and metro. Integration of bicycles in public transport system. ICT based journey planner, easy transfer modes, one ticket for train, bus and metro" | Public | The municipality of Copenhagen | http://www.cphcleantech.com/media/2113602/integrated%20transport.pdf |
| Cycling lanes | ENV, MOB | Intelligent Traffic System, LEDs, monitoring and sensors to allow the road to adapt to the users | "Implementing an intelligent traffic System to transform cycling lanes" | Public | The municipality, Copenhagen Harbour, the citizens and the real estate owners | https://subsite.kk.dk/sitecore/content/Subsites/CityOfCopenhagen/SubsiteFrontpage/LivinginCopenhagen/~/media/A6581E08C2EF4275BD3CA1DB951215C3.ashx |
| The Harbour Bath | ENV,LIV | Monitoring and sensors, Data, ICT, Utilities - Water | "Modernising the sewage system, adopting a cleaning programme. Commissioning a strong urban design to create a recreational space" | Public | The municipality, the citizens and the real estate owners | http://www.dac.dk/en/dac-cities/sustainable-cities-2/all-cases/water/copenhagen-from-sewer-to-harbour-bath/?bbredirect=true |
| Water Management | ENV, LIV | Monitoring and sensors, ICT, Utilities - Water, Data | "Clean tap water (sustainable solution as Copenhagen is growing) so the citizens can drink high quality water directly from the tap" | Public | Municipality of Copenhagen and the citizens | http://www.ecoinnovation.dk/NR/rdonlyres/9FEEE910-27A4-4BE7-8A01-DD17BE0C072E/0/KBH_havn_baggrundsartikel_1.pdf |
| Wind Power in Middelgrunden | ENV | Renewable energy, traditional energy sources e.g. fossil fuels, ICT management through smart grid and smart meters to ensure continuous power irrespective of the weather. Data and monitoring | "Electricity production from wind power increase from 22% in 2012 to 50% in 2020" | Partnership based on local ownership, supported by the Danish Energy Agency (nearly 45 million Euro) | Citizens (local ownership), electricity provider and Municipality | http://www.dac.dk/en/dac-cities/sustainable-cities-2/all-cases/energy/copenhagen-cities-can-run-on-wind-energy/?bbredirect=true |
| Nordhavn | ENV, LIV, MOB | Geothermal, seasonal thermal storage, wind, & marine biomass, Transportation: metro system, bicycles. New buildings, interconnection with existing systems, utilities infrastructure | "The development of Nordhavn will focus on sustainable energy and new types of energy" | Public | Municipality of Copenhagen and the citizens | http://www.stateofgreen.com/en/Profiles/E-ON-Nordic/Solutions/Nordhavn-%E2%80%93-a-New-Sustainable-Neighbourhood-in-Cope |
| NICE (Networking Intelligent Cities for Energy Efficiency) | ENV, PEO | Measurement, Learning sessions with experts, Networks of people, Data, Framework | "The project aims to create a partnership of cities on ICT and energy efficiency" | The project is funded under the ICT strand of the 7th Research Framework Programme (FP7). | 97 Eurocities members, Clicks and Links, Manchester City Council, Leibniz Institute of Ecological Urban and Regional Development | http://www.eurocities.eu/eurocities/activities/projects/NiCE-Networking-intelligent-Cities-for-Energy-Efficiency |

**Potential Impacts on EU2020**

All of Copenhagen's initiatives that we researched had a focus on energy. From the data gathered initiatives in Copenhagen are only addressing the use of energy - 4 of which are directly related to either reducing CO2 emissions or increasing energy efficiency.

At present Denmark's greenhouse gas emissions are slightly above the EU 27 average (89 units vs. 85 units). However, it is performing highly in regard to renewable energy, and currently sources 22% of all energy from renewable sources - exceeding EU 2020 targets. Denmark's national target for renewable energy is 30%, meaning that in national terms it still have some way to go before it meets its target.

Two of Copenhagen's initiatives are specifically concerned with reducing CO2 emissions. These are transportation integration and using ICT to improve cycling lanes, designed to discourage individual car use. A further two initiatives aim to improve energy efficiency. Nordhavn is a development of energy-efficient buildings which will be based on district heating and in a few decades will be carbon neutral. Buildings will be designed for low energy demand with efficient installations for low temperature heating and high temperature cooling. High speed bicycle lanes to the development will also be provided. The second of these is the NICE project which aims to increase energy efficiency through partnership.

| Alignment to Europe2020 objectives | EU | National | |
|---|---|---|---|
| Employment rate | 75% | 80% | |
| R&D in % of GDP | 3% | 3% | |
| CO2 emission reduction | -20% | -20% | x |
| Renewable energy | 20% | 30% | x |
| Energy efficiency | 20% | 0.83 | x |
| Early school leaving | less than 10% | less than 10% | |
| Tertiary education | at least 40% | at least 40% | |
| Reduction of population at risk of poverty | at least 20 million | 22,000 (household with low work intensity) | |

| Helsinki | |
|---|---|
| Country | Finland |
| Population | 588,549 |

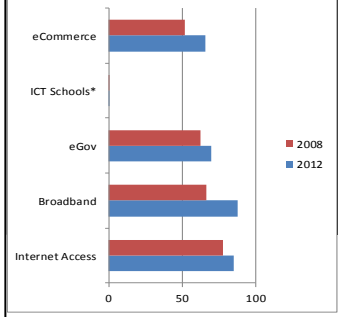
| National EU2020 | National | EU |
|---|---|---|
| Employment rate (2011) | 73.8% | 68.6% |
| Expenditure on R&D (2010) | 3.9% | 2.0% |
| Greenhouse Gas Emissions (1990-2010) | 106 | 85 |
| Renewable Energy (2010) | 31.0% | 12.1% |
| Early Leavers from education/training (2011) | 9.8% | 13.5% |
| Tertiary educational attainment (2011) | 46.0% | 34.6% |
| People at risk of poverty/social exclusion (2010) | 16.9% | 23.6% |

**City profile - Innovation Strategy**

The Helsinki Metropolitan Area is a dynamic world-class centre for business and innovation. Its high-quality services, arts and science, creativity and adaptability promote the prosperity of its citizens and bring benefit ts to all of Finland. The Metropolitan Area is being developed as a unified region close to nature where it is good to live, learn, work and do business.

Source: http://www.hel.fi/hel2/Helsinginseutu/Pks/PKS_InnovationStrategy_011009.pdf

**ICT baseline**




GOV ECO ENV MOB PEO LIV

| Smart City Initiatives | Characteristics | Components | Objectives | Funding | Stakeholders | Source |
|---|---|---|---|---|---|---|
| Digital urban services for easier living and travelling | MOB, LIV, PEO | ICT Access, Public & Open data, Real time traffic info, citizen as a sensor, ubiquitous technology, sensors, transportation, mobile devices | "This Project Area focuses especially on ubiquitous technology - technologies that are thoroughly integrated into everyday objects and activities. These services involve real-time traffic information for citizens, among others. Another area within the Smart City Projects is opening of public data" | Forum Virium Helsinki's Smart City Project | The City of Helsinki, Nokia, Elisa, TeliaSonera, tieto, IBM, logica, YLE, Siemens, SOK, Finnvera, Sitra, Tekes, VTT | http://www.forumvirium.fi/en/project-areas/smart-city |
| Developer portal / Apps4Finland / Open Helsinki – hack at home | GOV, ECO | Hackathons, open democracy, citizen input, apps, services | "The City of Helsinki is looking for new ways to support the developers to utilize open data in order to create digital services for the citizens. Open Helsinki. It encourages developers to create useful applications" | Forum Virium Helsinki's Smart City Project | Hack at Home program is produced in collaboration with the City of Helsinki, Apps4Finland and Forum Virium Helsinki. | http://www.forumvirium.fi/en/project-areas/smart-city/open-helsinki-hack-at-home |
| Forum Virium Helsinki Smart City Project | ECO, LIV, MOB | Transportation, ICT access, mobile devices, real time data | "Forum Virium Helsinki's Smart City Project Area is involved in the development of digital urban services that make travelling and living in the city easier. The services are used with mobile devices and they are an integral part of their urban environment" | Forum Virium Helsinki's Smart City Project | The City of Helsinki Health Centre, Helsinki City Tourism & Convention Bureau, City of Helsinki Economic and Planning Centre, Helsinki City Library and Helsinki Regional Transport Authority | http://www.forumvirium.fi/en/ |
| Common4U | GOV, ECO, MOB, LIV | Mobile node, FreeEurope Wi-Fi pilot, Innovative Internet technologies, Fiber from the "X" approach (FFTX), Open sensors networks, Open data portal | "Smart city initiative to 'close the gap' between cities and its citizens by 'fostering innovation' and 'creating cutting edge digital services'" | Co-funded by the European Union [ICT Policy Support Programme (ICT PSP) "Competitiveness and Innovation"] | Partners: ESADE, Fraunhofer FOKUS, FORUM VIRIUM HELSINKI, City of Amsterdam Economic Development Department, waag society, Provincia Di Roma, CASPUR, Universitat Pompeu Fabra Barcelona, Manchester Digital Development Agency, dotopen, LYNX, guifi.net, Nesta, Ajuntament de Barcelona | http://commonsforeurope.net/ |
| Citadel | GOV, ECO | Open data, Apps, eSkills, | "Citadel on the Move aims to make it easier for citizens and application developers alike from across Europe to use Open Data to create the type of innovative mobile applications that they want and need" | This project is co-funded by the EC under the CIP Programme. | 14 partners (mix of public/private) | http://www.citadelonthemove.eu/ |
| CitySDK | MOB, ECO | Data, service delivery, Ebusiness | "Helping cities to open their data and giving developers the tools they need, the CitySDK aims for a step change in how to deliver services in urban environments. The Project focuses on three Pilot domains: Smart Participation, Smart Mobility and Smart Tourism" | CitySDK is a 3.4 million Euro project, part funded by the European Commission | 23 partners across 9 countries including private companies, development and expert organisations, network organisations, universities and research institutes | http://www.citysdk.eu/ |
| NICE (Networking Intelligent Cities for Energy Efficiency) | ENV, PEO | Measurement, Learning sessions with experts, Networks of people, Data, Framework | "The project aims to create a partnership of cities on ICT and energy efficiency" | The project is funded under the ICT strand of the 7th Research Framework Programme (FP7). | 97 Eurocities members, Clicks and Links, Manchester City Council, Leibniz Institute of Ecological Urban and Regional Development | http://www.eurocities.eu/eurocities/activities/projects/NiCE-Networking-intelligent-Cities-for-Energy-Efficiency |
| Open Cities | PEO, LIV, ECO | Crowdsourcing, Open Data, FTTH networks and Open Sensor Networks | "Aims to validate how to approach Open & User Driven Innovation methodologies to the Public Sector in a scenario of Future Internet Services for Smart Cities" | Project co-funded by the European Commission within the ICT Policy Support Programme | 7 major European cities: Helsinki, Berlin, Amsterdam, Paris, Rome, Barcelona and Bologna | http://www.opencities.net/ |

**Potential Impacts on EU2020**

Helsinki has eight smart city initiatives. However, only one of these initiatives will have a direct impact on Europe 2020 targets. This is the EU wide initiative of Networking Intelligent Cities for Energy Efficiency which directly aims to increase energy efficiency. In terms of indirect impacts, a number of projects may impact on quality of life, and by extension poverty.

The lack of initiatives addressing EU 2020 targets directly may be because Finland is already performing relatively well against its objectives. It already sources 31% of its energy from renewable sources, it is exceeding the EU 2020 target for expenditure on R&D (and very nearly reaching its national target), early school leaving and the attainment of tertiary education. It is also significantly below the EU average for people at risk of poverty and social exclusion.

Greenhouse gas emissions are high compared to the rest of the EU. The Networking Intelligent Cities for Energy Efficiency may go some way toward addressing this.

Six of Helsinki's initiatives are concerned with improving quality of life through integrating ICTs into the urban environment and opening access to data in order to stimulate innovation. This may increase investment in R&D although the link between these initiatives and poverty is tentative.

| Alignment to Europe2020 objectives | EU | National | |
|---|---|---|---|
| Employment rate | 75% | 78% | |
| R&D in % of GDP | 3% | 4% | x |
| CO2 emission reduction | -20% | -16% | x |
| Renewable energy | 20% | 38% | |
| Energy efficiency | 20% | 4.21 | x |
| Early school leaving | less than 10% | 8% | |
| Tertiary education | at least 40% | 42% | |
| Reduction of population at risk of poverty | at least 20 million | 150,000 | x |

| Glasgow | |
|---|---|
| Country | United Kingdom |
| Population | 598,470 |

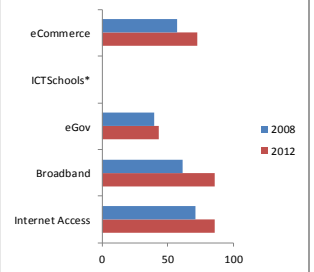
| National EU2020 | National | EU |
|---|---|---|
| Employment rate (2011) | 73.6% | 68.6% |
| Expenditure on R&D (2010) | 1.8% | 2.0% |
| Greenhouse Gas Emissions (1990-2010) | 77 | 85 |
| Renewable Energy (2010) | 3.3% | 12.1% |
| Early Leavers from education/training (2011) | 15% | 13.5% |
| Tertiary educational attainment (2011) | 45.8% | 34.6% |
| People at risk of poverty/social exclusion (2010) | 23.1% | 23.6% |

**City profile - Innovation Strategy**

Metropolitan Glasgow
Our principal subsidiary targets are to:
- stabilise our population at 2003 levels;
- secure an annual average GDP growth of 2% per annum –representing £6 bn by 2013;
- raise our employment rate to 75% – bringing 70,000 people of working age back into work by 2013;
- raise GDP per head to the Scottish average;
- increase the rate at which brownfield land is developed and/or treated from 300 Ha to 400 Ha per annum;
- generate a 10% increase in visitor expenditure – representing some £80m of increased tourist income.

Source:http://www.glasgow.gov.uk/CHttpHandler.ashx?id=2296&p=0

**ICT baseline**




GOV ECO ENV MOB PEO LIV

| Smart City Initiatives | Characteristics | Components | Objectives | Funding | Stakeholders | Source |
|---|---|---|---|---|---|---|
| Smart street lighting | MOB, ENV, LIV | Platform, Lighting system used as CCTV, integration, data | "Glasgow is developing an integrated operations centre; looking at social transport, street lighting, energy efficiency and active travel. e.g. we can harness the physical infrastructure of street lighting to be able to do more things than just light up streets, using this network as a digital platform for the city" | Public/Private | The Glasgow project, for example, is a partnership between the local authority and Cisco, Siemens, IBM and the Green Investment Bank among several others. | http://sustainablefutures.info/2013/05/02/smart-cities-glasgow-barcelona/ |
| Future City Glasgow | LIV, ENV, MOB | Public spaces, CCTV, TRAFFCOM road management, Sustainable energy solutions, Transport integration, Mobile access, Real time data | "Sustainable Glasgow - addressing issues such as energy conservation and generation, greater use of green technology such as white street lighting, air pollution and the integration of active transport (walking and cycling) routes with public transport networks" | £24 million funded by UK Technology Strategy Board (TSB) - the Government's innovation agency | Partners in the project include: Glasgow City Council, Glasgow Community & Safety Services, Sustainable Glasgow, health providers, energy suppliers and universities. | http://futurecity.glasgow.gov.uk/ |
| NICE (Networking Intelligent Cities for Energy Efficiency) | ENV, PEO | Measurement, Learning sessions with experts, Networks of people, Data, Framework | "The project aims to create a partnership of cities on ICT and energy efficiency" | The project is funded under the ICT strand of the 7th Research Framework Programme (FP7). | 97 Eurocities members, Clicks and Links, Manchester City Council, Leibniz Institute of Ecological Urban and Regional Development | http://www.eurocities.eu/eurocities/activities/projects/NiCE-Networking-intelligent-Cities-for-Energy-Efficiency |

**Potential Impacts on EU2020**

Three initiatives were sourced for Glasgow - all of which are relevant for addressing Europe 2020 targets related to energy. At present the UK is significantly underachieving EU 2020 targets for renewable energy use, expenditure on R&D and to a lesser extent early leavers from education/training. Moreover, the UK has not set national targets in many of these areas, as outlined in the box below.

Glasgow's smart street lighting initiative aims to enhance energy efficiency by using the street lighting system for other functions - such as CCTV surveillance. The 'Future City Glasgow' initiative simultaneously aims to increase energy efficiency and reduce carbon emissions - directly addressing two EU 2020 targets. It focuses on energy conservation, the greater use of green energy and the promotion of walking and cycling to reduce CO2. Glasgow is also part of the Networking Intelligent Cities for Energy Efficiency.

| Alignment to Europe2020 objectives | EU | National | |
|---|---|---|---|
| Employment rate | 75% | No target in NRP | |
| R&D in % of GDP | 3% | No target in NRP | |
| CO2 emission reduction | -20% | -16% | x |
| Renewable energy | 20% | 15% | x |
| Energy efficiency | 20% | n.a. | x |
| Early school leavng | less than 10% | No target in NRP | |
| Tertiary education | at least 40% | No target in NRP | |
| Reduction of population at risk of poverty | at least 20 million | Existing numerical targets of the 2010 Child Poverty Act | |

GOV ECO ENV MOB PEO LIV

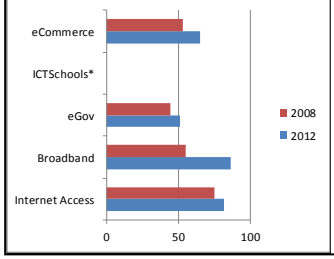
| Hamburg | |
|---|---|
| Country | Germany |
| Population | 1,786,448 |

| National EU2020 | National | EU |
|---|---|---|
| Employment rate (2011) | 76.3% | 68.6% |
| Expenditure on R&D (2010) | 2.8% | 2.0% |
| Greenhouse Gas Emissions (1990-2010) | 75 | 85 |
| Renewable Energy (2010) | 10.7% | 12.1% |
| Early Leavers from education/training (2011) | 11.7% | 13.5% |
| Tertiary educational attainment (2011) | 30.7% | 34.6% |
| People at risk of poverty/social exclusion (2010) | 19.7% | 23.6% |

**City profile - Innovation Strategy**

Insufficient data on specific city-level strategies for innovation in Hamburg

**ICT baseline**




| Smart City Initiatives | Characteristics | Components | Objectives | Funding | Stakeholders | Source |
|---|---|---|---|---|---|---|
| HafenCity | LIV, MOB, ENV | Renewable energy sources, Transportation, electric cars/buses, fuelling stations, green buildings, data | "The IBA project looks at innovative ways of remodelling existing urban infrastructure. Certifying and funding some 50 smaller projects, the IBA is part living laboratory, part city-size exhibition — meant to make Hamburg an example for other cities, regardless of their means and the level of their ambitions" | The city's investment in HafenCity will run to some €2.2 billion, though €1.5 billion of that is expected to make its way back to city coffers through the sale of properties in the project. | IBA Hamburg., HafenCity Hamburg GmbH and local sponsors | http://www.dac.dk/en/dac-cities/sustainable-cities-2/all-cases/master-plan/hamburg-hafencity---bringing-the-city-to-the-water/?bbredirect=true |
| Smart Power Hamburg | ENV, ECO, LIV | Energy generator, Energy Load, Storage, Network interaction, Data, Smart Grids, | "The main focus of Smart Power Hamburg is on intelligently linking energy generators, loads and storage systems" | The project is being funded by HAMBURG ENERGIE and the German Federal Ministry of Economics and Technology. | Hamburg University of Applied Sciences and RWTH Aachen University | http://www.eneff-stadt.info/en/heatingcooling-networks/project/details/intelligent-network-of-urban-infrastructures-smart-power-hamburg/ |
| NICE (Networking Intelligent Cities for Energy Efficiency) | ENV, PEO | Measurement, Learning sessions with experts, Networks of people, Data, Framework | "The project aims to create a partnership of cities on ICT and energy efficiency" | The project is funded under the ICT strand of the 7th Research Framework Programme (FP7). | 97 Eurocities members, Clicks and Links, Manchester City Council, Leibniz Institute of Ecological Urban and Regional Development | http://www.eurocities.eu/eurocities/activities/projects/NiCE-Networking-intelligent-Cities-for-Energy-Efficiency |

**Potential Impacts on EU2020**

Hamburg has two smart city initiatives - both of which are focused on energy efficiency.
Germany is already below the EU average in its volume of greenhouse gas emissions (75 vs. 85 units). Nevertheless, its national target is significantly lower than the EU 2020 target.
Germany also falls short of EU 2020 renewable energy targets given that 10.7% of its energy is currently derived from renewable sources compared to the 20% European target.
Moreover, Germany's national target is only 18% - revealing that is it not wholly aligned with EU objectives.
Smart Power Hamburg aims to develop innovative energy efficiency services - including the intelligent harmonisation of generators and loads in the linked system itself as well as the development of system services that are becoming increasingly important for electricity generators, the grid and electricity providers. A smart grid (intelligent energy network) is being created based on the existing urban infrastructure along with a platform for exchanging services. Future urban development projects will be able to purchase energy services to increase their efficiency or offer others their skills. The aim is to achieve energy-intelligent cooperation in the various urban districts, i.e. "smart" solutions. It is also intended to develop new business models to generate economic advantages. This may address energy efficiency as well as increase the use of renewable energy.

| Alignment to Europe2020 objectives | EU | National | |
|---|---|---|---|
| Employment rate | 75% | 77% | |
| R&D in % of GDP | 3% | 3% | |
| CO2 emission reduction | -20% | -14% | x |
| Renewable energy | 20% | 18% | x |
| Energy efficiency | 20% | 38.3 | x |
| Early school leaving | less than 10% | <10% | |
| Tertiary education | at least 40% | 42% | |
| Reduction of population at risk of poverty | at least 20 million | 330,000 (long-term unemployed) | |

| Oulu | |
|---|---|
| Country | Finland |
| Population | 141,671 |

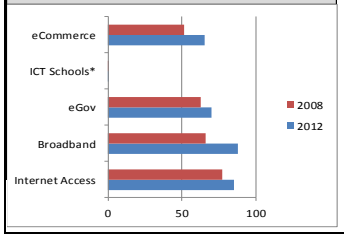
| National EU2020 | National | EU |
|---|---|---|
| Employment rate (2011) | 73.8% | 68.6% |
| Expenditure on R&D (2010) | 3.9% | 2.0% |
| Greenhouse Gas Emissions (1990-2010) | 106 | 85 |
| Renewable Energy (2010) | 31.0% | 12.1% |
| Early Leavers from education/training (2011) | 9.8% | 13.5% |
| Tertiary educational attainment (2011) | 46.0% | 34.6% |
| People at risk of poverty/social exclusion (2010) | 16.9% | 23.6% |

**City profile - Innovation Strategy**

The goal of the Oulu Inspires – Innovation Strategy 2007-2013 is to create a common vision on long-term, strategic development needs in our operating environment encompassing businesses, research and education institutes as well as the public sector, and to target joint efforts on the selected focus areas.

Source: http://www.ouluinspires.fi/strategy/inno_oulu.htm

**ICT baseline**




GOV ECO ENV MOB PEO LIV

| Smart City Initiatives | Characteristics | Components | Objectives | Funding | Stakeholders | Source |
|---|---|---|---|---|---|---|
| SMARTiP Project | PEO, LIV | ICT - Apps, eskills, citizens | "The project aims to act as a catalyst to stimulate citizen engagement in becoming active generators of content and applications development" | Co-funded by the European Union [ICT Policy Support Programme (ICT PSP) "Competitiveness and Innovation"] | 14 partners (private/public/universities ) across 5 cities (Manchester, Oulu, Ghent, Bologna, Cologne) | http://www.smart-ip.eu/ |
| OULLabs (Oulu Urban Living Labs) | ECO, LIV | high speed Internet, access, integration, NFC/RFID reader, cameras, wireless access points | "The project aims to intensify the economy for companies and communities by enabling user driven planning. To create new markets for service providers in its partner net" | Public/Private | 20 partners (including city council, private companies, European institutions and academia) | http://www.openlivinglabs.eu/livinglab/oullabs-oulu-urban-living-labs |
| Smart Urban Spaces | PEO, LIV, ECO, GOV | Network, Service standards, interoperability, frameworks, differentiation: unique image/local identity, Communication, Advance in infrastructure, technological advances | "The project aims to provide SW technology bricks and design frameworks that can be used for designing & adopting context based services (e.g. lbs, presence, instant messaging, local and interoperable services in cities/urban spaces)" | Public/Private | 25 partners (public private mix) | http://www.smarturbanspaces.org/partners/i/921/47/city-of-oulu |
| Arctic City | ENV, LIV | Smart grid, renewable energy, waste management, Infrastructure-buildings, eco-water system, services, interoperability between utilities | "The project aims to implement sustainable initiatives for its residents. The urban design will feature a smart grid, alternative and renewable energy sources, an eco-water system and centralised waste management" | Public | Public/Private | http://www.cleantechinvestor.com/portal/spotlight/11469-oulu-smart-city.html |
| NICE (Networking Intelligent Cities for Energy Efficiency) | ENV, PEO | Measurement, Learning sessions with experts, Networks of people, Data, Framework | "The project aims to create a partnership of cities on ICT and energy efficiency" | The project is funded under the ICT strand of the 7th Research Framework Programme (FP7). | 97 Eurocities members, Clicks and Links, Manchester City Council, Leibniz Institute of Ecological Urban and Regional Development | http://www.eurocities.eu/eurocities/activities/projects/NiCE-Networking-intelligent-Cities-for-Energy-Efficiency |

**Potential Impacts on EU2020**

For a relatively small city, Oulu has embarked on several Smart city initiatives aimed at a variety of sustainable solutions and covering the majority of smart city characteristics. Finland's relatively high expenditure on R&D may account for the high proliferation of initiatives in a smaller city. However, across the five initiatives examined there is little alignment between their objectives and the wider objectives of Europe2020.

The lack of initiatives addressing EU 2020 targets directly may be because Finland is already performing relatively well against its objectives. It already sources 31% of its energy from renewable sources, it is exceeding the EU 2020 target for expenditure on R&D (and very nearly reaching its national target), early school leaving and the attainment of tertiary education. It is also significantly below the EU average for people at risk of poverty and social exclusion.

Nevertheless, the Smart City initiatives in Oulu may have an indirect impact on EU2020 targets. SMARTiP, OULLabs and Smart Urban Spaces are all focussed on up-skilling citizens and creating open data/knowledge, which could have an impact on both employment rates, education and poverty levels in the city. In addition, Oulu's participation in the Networking Intelligent Cities for Energy Efficiency project and the Arctic City initiative may have further impacts on EU2020 targets for energy efficiency.

| Alignment to Europe2020 objectives | EU | National | |
|---|---|---|---|
| Employment rate | 75% | 78% | x |
| R&D in % of GDP | 3% | 4% | |
| CO2 emission reduction | -20% | -16% | x |
| Renewable energy | 20% | 38% | x |
| Energy efficiency | 20% | 4.21 | x |
| Early school leaving | less than 10% | 8% | |
| Tertiary education | at least 40% | 42% | |
| Reduction of population at risk of poverty | at least 20 million | 150,000 | x |

| Barcelona | |
|---|---|
| Country | Spain |
| Population | 1,620,437 |

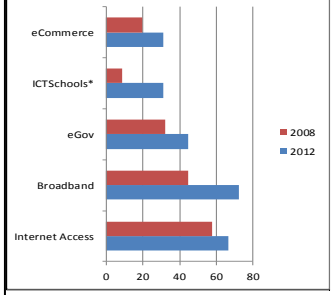
| National EU2020 | National | EU |
|---|---|---|
| Employment rate (2011) | 61.6% | 68.6% |
| Expenditure on R&D (2010) | 1.4% | 2.0% |
| Greenhouse Gas Emissions (1990-2010) | 126 | 85 |
| Renewable Energy (2010) | 13.8% | 12.1% |
| Early Leavers from education/training (2011) | 26.5% | 13.5% |
| Tertiary educational attainment (2011) | 40.6% | 34.6% |
| People at risk of poverty/social exclusion (2010) | 25.5% | 23.6% |

**City profile - Innovation Strategy**

Productive districts at human speed inside a hyper-connected and zero emissions city
Key Points
• A new organization targeted to Smart City principles and objectives
• Legal framework for ppp to flourish
• Urban area for ppp to settle and grow
• Feed the urban innovation ecosystem
• Living lab, development of a community of citizens, developers
• Facilities for SME experimentation
• Opening new opportunities for citizens to be more active and participative
• Strong international linkages

Source: http://www.majorcities.eu/workshops/2012-

**ICT baseline**




GOV ECO ENV MOB PEO LIV

| Smart City Initiatives | Characteristics | Components | Objectives | Funding | Stakeholders | Source |
|---|---|---|---|---|---|---|
| Smart Streets of Barcelona suburb Sant Cugat | MOB, ENV, ECO | ICT - Technical resource, Skills, data | "Sant Cugat has built the first Smart Street in Catalonia to try different ICT solutions for urban, the environment and for the management of mobility services" | Public/Private | The city has provided the technical and manpower resources, and companies have provided supplies and installation of all technical solutions. | http://smartcity.santcugat.cat/?lang=en |
| Smartgrids and smart metering | ENV | Smart meters, smart grid, energy technologies, renewable energy, Data, LED lighting, Green buildings, Storage, Microgrids | "The project aims to upgrade its power supply system in Barcelona where it will roll out a cutting-edge smart grid offering greater savings and more efficient and sustainable management" | Public/Private | The scheme, which is backed by the Barcelona City Council's and involves various energy technology companies. | http://www.endesa.com/en/aboutEndesa/businessLines/principalesproyectos/Barcelona_Smartcity |
| City Protocol | GOV, ENV, MOB, LIV | Enegry consumption measurement/monitoring, ICT, Parking space sensors, Transportation, Common Service Delivery Platform, Real time data | "The City Protocol will include white papers, standards, service descriptions and other Smart City models. Cisco will focus on developing a technology reference architecture known as the City Cases Methodology that will define the ICT aspects of the Smart City Protocol and will be embedded into the overall City Protocol model" | Public/Private | Cisco, City of Barcelona | http://newsroom.cisco.com/press-release-content?articleId=680179 |
| Solar hot water ordinance/ Solar energy | ENV, GOV, PEO | Renewable energy - solar panels | "Barcelona is the first European city to have a Solar Thermal Ordinance making it compulsory to use solar energy to supply 60% of running hot water in all new buildings, renovated buildings, or buildings changing their use. It applies to both private and public buildings" | Public/Private | The Ordinance is managed by the newly established Barcelona Energy Agency (BEA)— the agency funds two full time staff, provides training, information and media | http://www.c40cities.org/c40cities/barcelona/city_case_studies/barcelonas-solar-hot-water-ordinance |
| Citadel | GOV, ECO | Open data, Apps, eSkills, | "Citadel on the Move aims to make it easier for citizens and application developers alike from across Europe to use Open Data to create the type of innovative mobile applications that they want and need" | This project is co-funded by the EC under the CIP Programme. | 14 partners (mix of public/private) | http://www.citadelonthemove.eu/ |
| NICE (Networking Intelligent Cities for Energy Efficiency) | ENV, PEO | Measurement, Learning sessions with experts, Networks of people, Data, Framework | "The project aims to create a partnership of cities on ICT and energy efficiency" | The project is funded under the ICT strand of the 7th Research Framework Programme (FP7). | 97 Eurocities members, Clicks and Links, Manchester City Council, Leibniz Institute of Ecological Urban and Regional Development | http://www.eurocities.eu/eurocities/activities/projects/NiCE-Networking-intelligent-Cities-for-Energy-Efficiency |
| iCity | ECO | ICT networks, platforms | "The iCity project aims at making a step forward in the co-creation of services of public interest by third parties (developers, small and medium enterprises) that are pushing for their space as service providers in the urban spaces of Smart Cities" | Project co-funded by the European Commission within the ICT Policy Support Programme | 9 partners (public/private mix) | http://icityproject.eu/ |
| CitySDK | MOB, ECO | data, service delivery, Ebusiness | "Helping cities to open their data and giving developers the tools they need, the CitySDK aims for a step change in how to deliver services in urban environments. The Project focuses on three Pilot domains: Smart Participation, Smart Mobility and Smart Tourism" | CitySDK is a 3.4 million Euro project, part funded by the European Commission | 23 partners across 9 countries including private companies, development and expert organisations, network organisations, universities and research institutes | http://www.citysdk.eu/ |
| Common4U | GOV, ECO, MOB, LIV | Mobile node, FreeEurope Wi-Fi pilot, Innovative Internet technologies, Fiber from the "X" approach (FFTX) , Open sensors networks, Open data portal | "Smart city initiative to 'close the gap' between cities and its citizens by 'fostering innovation' and 'creating cutting edge digital services'" | Co-funded by the European Union [ICT Policy Support Programme (ICT PSP) "Competitiveness and Innovation"] | Partners: ESADE, Fraunhofer FOKUS, FORUM VIRIUM HELSINKI, City of Amsterdam Economic Development Department, waag society, Provincia Di Roma, CASPUR, Universitat Pompeu Fabra Barcelona, Manchester Digital Development Agency, dotopen, LYNX, guifi.net, Nesta, Ajuntament de Barcelona | http://commonsforeurope.net/ |
| Open Cities | PEO, LIV, ECO | Crowdsourcing, Open Data, FTTH networks and Open Sensor Networks | "Aims to validate how to approach Open & User Driven Innovation methodologies to the Public Sector in a scenario of Future Internet Services for Smart Cities" | Project co-funded by the European Commission within the ICT Policy Support Programme | 7 major European cities: Helsinki, Berlin, Amsterdam, Paris, Rome, Barcelona and Bologna | http://www.opencities.net/ |

**Potential Impacts on EU2020**

Barcelona has a large number of Smart City initiatives compared to most other European cities, which cover all smart city characteristics. There is also strong alignment between the objectives of Europe2020 and the objectives of several initiatives, especially in the areas of energy and social exclusion.

Several initiatives, such as Commons4u and Citadel, focus on citizen connectivity, including e-Government services, open access to data and digital inclusion. The impact of the current economic crisis means that Spain is far below EU averages on several indicators and achieving their national targets on employment, expenditure on R&D, education and poverty looks increasingly difficult. In fostering R&D through open data and reducing social exclusion, poverty may be reduced.

| Alignment to Europe2020 objectives | EU | National | |
|---|---|---|---|
| Employment rate | 75% | 74% | |
| R&D in % of GDP | 3% | 3% | |
| CO2 emission | -20% | -10% | x |
| Renewable energy | 20% | 20% | x |
| Energy efficiency | 20% | 25.2 | x |
| Early school leaving | less than 10% | 15% | |
| Tertiary education | at least 40% | 44% | |
| Reduction of population at risk of poverty | at least 20 million | 1,400,000-1,500,000 | x |

GOV ECO ENV MOB PEO LIV

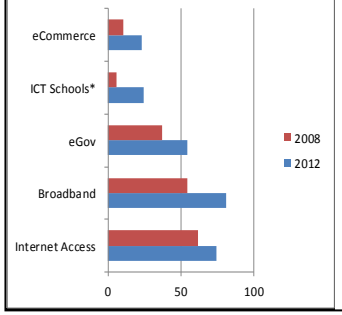
| Tallinn | |
|---|---|
| Country | Estonia |
| Population | 399,816 |

| National EU2020 | National | EU |
|---|---|---|
| Employment rate (2011) | 70.4% | 68.6% |
| Expenditure on R&D (2010) | 1.6% | 2.0% |
| Greenhouse Gas Emissions (1990-2010) | 50 | 85 |
| Renewable Energy (2010) | 24.6% | 12.1% |
| Early Leavers from education/training (2011) | 10.9% | 13.5% |
| Tertiary educational attainment (2011) | 40.3% | 34.6% |
| People at risk of poverty/social exclusion (2010) | 21.7% | 23.6% |

**City profile - Innovation Strategy**

1) Human resources - that proportionally more people are involved in, working on or earning income from the development and implementation of new ideas and solutions.
2) Cooperation - that new skills and knowledge generated through partnerships and improved capabilities (both literally and in the material sense) are contributing to growth in the competitive ability, market force, export base and internationalisation of companies.
3) Internationalisation - that companies and educational institutions are capable of positioning themselves internationally, of obtaining information from a broader base and of being competitive.
4) Physical and intellectual city space - that an inspirational city space which fosters innovation and breaks down barriers is contributing to the development and implementation of new knowledge.
Source:http://www.tallinn.ee/eng/Tallinn-Innovation-Strategy-2009-2013

**ICT baseline**




| Smart City Initiatives | Characteristics | Components | Objectives | Funding | Stakeholders | Source |
|---|---|---|---|---|---|---|
| Smart Card system (Free Public Transport) | ENV, MOB, ECO | Transportation, Infrastructure, Buses and Trams, Bus lanes, Data, Monitoring | "The information gathered from the smart card could potentially be used in traffic management. Also. there's a potential of building up a completely new ICT infrastructure (NFC technology) based on the smart card" | Public | The city council of Tallinn | http://www.eurocities.eu/eurocities/news/Residents-enjoy-free-public-transport-in-Tallinn-WSPO-952EDX |
| NICE (Networking Intelligent Cities for Energy Efficiency) | ENV, PEO | Measurement, Learning sessions with experts, Networks of people, Data, Framework | "The project aims to create a partnership of cities on ICT and energy efficiency" | The project is funded under the ICT strand of the 7th Research Framework Programme (FP7). | 97 Eurocities members, Clicks and Links, Manchester City Council, Leibniz Institute of Ecological Urban and Regional Development | http://www.eurocities.eu/eurocities/activities/projects/NiCE-Networking-intelligent-Cities-for-Energy-Efficiency |

**Potential Impacts on EU2020**

The major focus of smart city initiatives in Tallinn appears to be in the energy sector through the provision of efficient public transport and participation in the Networking Intelligent Cities for Energy Efficiency project.

Although this aligns with Europe2020 targets to increase energy efficiency, Estonia is already higher than the EU average in this sector and there appears to be an absence of smart city initiatives aimed at improving social exclusion, education and employment.

In achieving their Europe2020 targets, there is a need for an increased emphasis on employment and poverty in future smart city initiatives

| Alignment to Europe2020 objectives | EU | National | |
|---|---|---|---|
| Employment rate | 75% | 76% | |
| R&D in % of GDP | 3% | 3% | |
| CO2 emission reduction | -20% | 11% | x |
| Renewable energy | 20% | 25% | x |
| Energy efficiency | 20% | 0.71 | |
| Early school leaving | less than 10% | 10% | |
| Tertiary education | at least 40% | 40% | |
| Reduction of population at risk of poverty | at least 20 million | Reduce the at risk of poverty rate (after social transfers) to 15% (from 17.5% in 2010) | |

| Athens | |
|---|---|
| Country | Greece |
| Population | 789,166 |

| National EU2020 | National | EU |
|---|---|---|
| Employment rate (2011) | 59.9% | 68.6% |
| Expenditure on R&D (2010) | n/a | 2.0% |
| Greenhouse Gas Emissions (1990-2010) | 113 | 85 |
| Renewable Energy (2010) | 9.2% | 12.1% |
| Early Leavers from education/training (2011) | 13.1% | 13.5% |
| Tertiary educational attainment (2011) | 28.9% | 34.6% |
| People at risk of poverty/social exclusion (2010) | 27.7% | 23.6% |

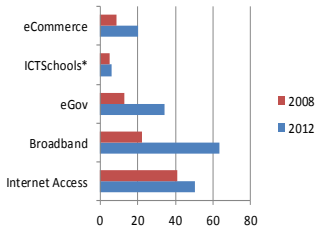
**City profile - Innovation Strategy**

With this new mission, ADDMA has designed a comprehensive 10-year Development Program with specific goals and measures. The key priorities and objectives of its strategic planning are:

- Helping the city's businesses to improve competitiveness
- Improving citizens' quality of life
- Regenerating the urban area
- Sustaining the improvement effort

Source: http://www.developathens.gr/en/company/company-profile#the-ten-year-development-program-of-athens-and-its-goals

**ICT baseline**




GOV ECO ENV MOB PEO LIV

| Smart City Initiatives | Characteristics | Components | Objectives | Funding | Stakeholders | Source |
|---|---|---|---|---|---|---|
| Peripheria | GOV | Mobile Apps, Citizens as a sensor | "Periphèria applies creativity and Future Internet Technologies to address the sustainability issues of your city" | This project is partially funded by the European Union CIP PSP Grant Agreement no. 271015 | PERIPHÈRIA is carried out by a project consortium led by Alfamicro (PT) and made up of 12 partners from 5 EU Member States | http://www.peripheria.eu/ |
| Livecity | PEO, GOV | Wireline, 4g wireless network, virtual path slice, Video-to-video (v2v), xDSL | "LiveCity addresses a number of communities where the citizen of a city have specific challenges which can derive benefits from the use of live interactive high definition video-to-video. These communities include emergency ambulances; hospitals, doctors, museum curators, city administrations and schools" | Public/Private | Public service providers, network infrastructure operators, SMEs, Subject matter experts, project across 5 Cities (Dublin, Luxembourg, Athens, Valladolid, Griefswald) | http://www.livecity-psp.eu/ |
| Digital Cities | GOV, LIV, PEO | public available Wi-Fi, Training, Promotion, Mobile technology, Citizen as a sensor | "The project focuses on the problem of the low ICT adoption by European local authorities in non-metropolitan areas, geographically isolated areas and other areas of social exclusion" | European Union Interreg IVC | Manchester Digital Development Agency, Almere Knowledge City Foundation, City of Jesenik, University Transilvania of Brasov, Municipality of Brasov, Municipality of Xanthi, e-Trikala, Institute of Communication and Computer Systems (Athens), Malta Government Technology Investments Ltd, Paralimni Municipality | http://www.digital-cities.eu/ |

**Potential Impacts on EU2020**

Greece remains far behind the EU average in most of the Europe2020 targets. This is reflected in the lower national targets for Greece. There is also no direct alignment between its smart city initiatives and Europe2020.

The smart city initiatives in Athens are unique from other cities examined in that all initiatives deal with Smart Governance. For example, the "MySquare" app, developed in the Peripheria project, is a mobile application which gives citizens the opportunity to become proactive in improving their City and as a consequence, their everyday life.

Athens is also unique in that it is the only city out of the sample that is not pursuing an initiative aimed at improving environmental issues.

| Alignment to Europe2020 objectives | EU | National | |
|---|---|---|---|
| Employment rate | 75% | 70% | x |
| R&D in % of GDP | 3% | to be revised | |
| CO2 emission reduction | -20% | -4% | |
| Renewable energy | 20% | 18% | |
| Energy efficiency | 20% | 2.7 | |
| Early school leaving | less than 10% | 10% | |
| Tertiary education | at least 40% | 32% | |
| Reduction of population at risk of poverty | at least 20 million | 450,000 | x |

GOV ECO ENV MOB PEO LIV

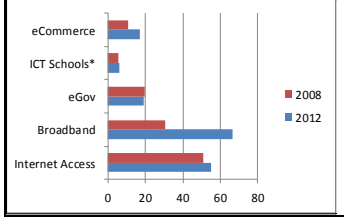
| Milan | |
|---|---|
| Country | Italy |
| Population | 1,315,803 |

| National EU2020 | National | EU |
|---|---|---|
| Employment rate (2011) | 61.2% | 68.6% |
| Expenditure on R&D (2010) | 1.3% | 2.0% |
| Greenhouse Gas Emissions (1990-2010) | 97 | 85 |
| Renewable Energy (2010) | 9.8% | 12.1% |
| Early Leavers from education/training (2011) | 18.2% | 13.5% |
| Tertiary educational attainment (2011) | 20.3% | 34.6% |
| People at risk of poverty/social exclusion (2010) | 24.5% | 23.6% |

**City profile - Innovation Strategy**

Insufficient data on specific city-level strategies for innovation in Milan

**ICT baseline**




| Smart City Initiatives | Characteristics | Components | Objectives | Funding | Stakeholders | Source |
|---|---|---|---|---|---|---|
| Smart Light | ENV, LIV | LED Street lights, Public Wi-Fi, electric car recharging, multimedia touch-screen info columns, SOS call boxes | "From the low-consumption, innovative LED street lights to the free ultra-broadband Wi-Fi, from the recharging points for electric cars to the SOS call-boxes and multimedia touch-screen info columns, the elegant street in the heart of the city's fashion zone has become a test-bed for innovative solutions" | Public/Private | The project was organised by the local tradesmen's association with the patronage of the city administration, and the support of companies like Renault Italia, Fastweb, the Cariboni Group, Samsung, Umpi, the IMQ Institute of Quality Marques and Blachere Italia. | http://www.wantedinmilan.com/news/2002221/milan-s-smart-street-lit-up.html |
| Global Optimisation of traffic for a better air quality Levels (GOAL) | GOV, MOB, ENV | Integrated mobility system, Citizens, Decision support system, Citizen as a sensor | "Project's objective is to demonstrate the effectiveness of policies, strategies, models and innovative technologies to reduce air pollution caused by congestion and vehicular traffic emissions in cities, testing an integrating system applicable at three functions of mobility intensely impacting the air quality in European cities" | Public/Private | Milan City Council intends to involve no-profit associations, institutes, authorities and private subjects, the researcher's world | http://www.cost.eu/download/Mori |
| Peripheria | PEO | Apps | "Periphèria applies creativity and Future Internet Technologies to address the sustainability issues of your city" | This project is partially funded by the European Union CIP PSP Grant Agreement no. 271015 | PERIPHÈRIA is carried out by a project consortium led by Alfamicro (PT) and made up of 12 partners from 5 EU Member States | http://www.peripheria.eu/ |
| TIDE | MOB, ENV | Network traffic management, Open Access Server, User friendly human machine interface | "The mission of the TIDE project is to enhance the broad transfer and take-up of 15 innovative urban transport and mobility measures throughout Europe and to make a visible contribution to establish them as mainstream measures" | EU FP7 funding | The TIDE consortium consists of 14 partners from 9 countries: Belgium, Germany, Hungary, Italy, the Netherlands, Poland, Spain, Sweden and the UK. Moreover, two partners - Polis and EUROCITIES – through their member cities and regions cover the whole European territory, including accession and neighbouring countries. | http://www.tide-innovation.eu/ |
| Smartspaces | LIV, ENV | real-time data from sensors, actuators and meters, and dynamic-pricing data | "The pilot site Milan (Italy) aims to fully comprehend energy consumption across the city by choosing representative buildings and representative areas of consumption inside the buildings chosen" | The project is co-funded by the European Commission within the CIP ICT Policy Support Programme. | BT, Cisco, Milan City Council | http://www.smartspaces.eu/ |
| NICE (Networking Intelligent Cities for Energy Efficiency) | ENV, PEO | Measurement, Learning sessions with experts, Networks of people, Data, Framework | "The project aims to create a partnership of cities on ICT and energy efficiency" | The project is funded under the ICT strand of the 7th Research Framework Programme (FP7). | 97 Euro cities members, Clicks and Links, Manchester City Council, Leibniz Institute of Ecological Urban and Regional Development | http://www.eurocities.eu/eurocities/activities/projects/NiCE-Networking-intelligent-Cities-for-Energy-Efficiency |

**Potential Impacts on EU2020**

Milan is pursuing a large variety of smart city initiatives, covering the majority of smart city characteristics. Several initiatives have an emphasis on improving energy efficiency through monitoring energy consumption levels, such as the Smart Light project which adjusts street lighting to the level of natural sunlight, therefore reducing both energy costs and CO2 emissions. The focus on energy is also reflected in mobility projects such as TIDE and GOAL.

Italy remains behind the EU average on many of the Europe2020 indicators, and future Smart City initiatives should expand their focus on addressing issues related to employment and education.

| Alignment to Europe2020 objectives | EU | National | |
|---|---|---|---|
| Employment rate | 75% | 67-69% | |
| R&D in % of GDP | 3% | 2% | |
| CO2 emission reduction | -20% | -13% | x |
| Renewable energy | 20% | 17% | |
| Energy efficiency | 20% | 27.9 | x |
| Early school leaving | less than 10% | 15-16% | |
| Tertiary education | at least 40% | 26-27% | |
| Reduction of population at risk of poverty | at least 20 million | 2,200,000 | |

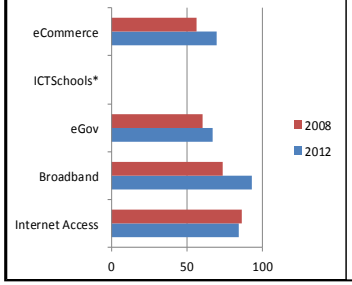
| Eindhoven | |
|---|---|
| Country | the Netherlands |
| Population | 216,036 |

| National EU2020 | National | EU |
|---|---|---|
| Employment rate (2011) | 77.0% | 68.6% |
| Expenditure on R&D (2010) | 1.9% | 2.0% |
| Greenhouse Gas Emissions (1990-2010) | 99 | 85 |
| Renewable Energy (2010) | 3.3% | 12.1% |
| Early Leavers from education/training (2011) | 9.1% | 13.5% |
| Tertiary educational attainment (2011) | 41.1% | 34.6% |
| People at risk of poverty/social exclusion (2010) | 15.1% | 23.6% |

**City profile - Innovation Strategy**

Brainport 2020
In the 2020-strategy, specific ambitions are formulated:
The annual contribution to the gross national product will have risen in 2020 by 40 billion to 136 billion euros.
The economic growth in Southeast Netherlands of around 3% is double our country's average.
The three field labs will be world renowned in 2020 as an incubator of innovative solutions for home care, mobility and sustainable buildings.
In 2020 Southeast Netherlands will be heading for near full employment. The job market needs everyone, both the knowledge workers and highly educated technicians and manual skilled workers and craftsmen.
Source:http://www.brainport.nl/en/brainport-2020/brainport-2020

**ICT baseline**




GOV ECO ENV MOB PEO LIV

| Smart City Initiatives | Characteristics | Components | Objectives | Funding | Stakeholders | Source |
|---|---|---|---|---|---|---|
| Traffic flow system | MOB | Transportation, sensors, cloud-enabled IBM, Smarter Traffic Center, Mobile devices to inform the public, Data from vehicles, NXP telematics chips | "The project aims to show that anonymous information from vehicles can be analysed by local traffic authorities to resolve road network issues faster, reduce congestion and improve traffic flow" | Public/private | IBM and NXP Semiconductors | http://www.nxp.com/news/press-releases/2013/02/dutch-city-region-of-eindhoven-works-with-ibm-and-nxp-to-improve-traffic-flow-and-road-safety.html |
| NICE (Networking Intelligent Cities for Energy Efficiency) | ENV, PEO | Measurement, Learning sessions with experts, Networks of people, Data, Framework | "The project aims to create a partnership of cities on ICT and energy efficiency" | The project is funded under the ICT strand of the 7th Research Framework Programme (FP7). | 97 Eurocities members, Clicks and Links, Manchester City Council, Leibniz Institute of Ecological Urban and Regional Development | http://www.eurocities.eu/eurocities/activities/projects/NiCE-Networking-intelligent-Cities-for-Energy-Efficiency |

**Potential Impacts on EU2020**

The Netherlands is far from its national target on renewable energy and remains higher than the EU average on Greenhouse Gas emissions.

Unlike other smart mobility initiatives observed in other cities, the 'Traffic flow system' project does not mention energy efficiency in its objectives and instead is focussed more on improving safety and responding to emergencies.

Only through Eindhoven's participation in the Networking Intelligent Cities for Energy Efficiency programme does the city address any of the Europe2020 targets.

| Alignment to Europe2020 objectives | EU | National | |
|---|---|---|---|
| Employment rate | 75% | 80% | |
| R&D in % of GDP | 3% | 2,5 % | |
| CO2 emission reduction | -20% | -16% | x |
| Renewable energy | 20% | 14% | |
| Energy efficiency | 20% | n.a. | x |
| Early school leaving | less than 10% | <8 % | |
| Tertiary education | at least 40% | >40% 45% expected in 2020 | |
| Reduction of population at risk of poverty | at least 20 million | 100,000 | |

GOV ECO ENV MOB PEO COM

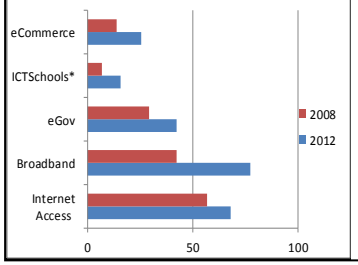
| Budapest | |
|---|---|
| Country | Hungary |
| Population | 1,727,621 |

| National EU2020 | National | EU-average |
|---|---|---|
| Employment rate (2011) | 60.7% | 68.6% |
| Expenditure on R&D (2010) | 1.2% | 2.0% |
| Greenhouse Gas Emissions (1990-2010) | 70 | 85 |
| Renewable Energy (2010) | 7.6% | 12.1% |
| Early Leavers from education/training (2011) | 11.2% | 13.5% |
| Tertiary educational attainment (2011) | 28.1% | 34.6% |
| People at risk of poverty/social exclusion (2010) | 29.9% | 23.6% |

**City profile - Innovation Strategy**

Insufficient data on specific city-level strategies for innovation in Budapest

**ICT baseline**




| Smart City Initiatives | Characteristics | Components | Objectives | Funding | Stakeholders | Source |
|---|---|---|---|---|---|---|
| TIDE | MOB, ENV | Network traffic management, Open Access Server, User friendly human machine interface | "The mission of the TIDE project is to enhance the broad transfer and take-up of 15 innovative urban transport and mobility measures throughout Europe and to make a visible contribution to establish them as mainstream measures" | EU FP7 funding | The TIDE consortium consists of 14 partners from 9 countries: Belgium, Germany, Hungary, Italy, the Netherlands, Poland, Spain, Sweden and the UK. Moreover, two partners - Polis and EUROCITIES – through their member cities and regions cover the whole European territory, including accession and neighbouring countries. | http://www.tide-innovation.eu/ |
| NICE (Networking Intelligent Cities for Energy Efficiency) | ENV, PEO | Measurement, Learning sessions with experts, Networks of people, Data, Framework | "The project aims to create a partnership of cities on ICT and energy efficiency" | The project is funded under the ICT strand of the 7th Research Framework Programme (FP7). | 97 Eurocities members, Clicks and Links, Manchester City Council, Leibniz Institute of Ecological Urban and Regional Development | http://www.eurocities.eu/eurocities/activities/projects/NiCE-Networking-intelligent-Cities-for-Energy-Efficiency |

**Potential Impacts on EU2020**

Budapest has relatively few smart city initiatives, with the Networking Intelligent Cities for Energy Efficiency being the only initiative that aligns with Europe2020 objectives.

Although the TIDE project may also have an indirect impact on some of the energy targets for Hungary, the primary focus is on more transparent and cost effective urban transport management and the creation of an urban transport knowledge centre.

Considering Hungary's position below the EU average on several Europe2020 indicators, an alignment of their objectives with Europe2020 could be considered in the future.

| Alignment to Europe2020 objectives | EU | National | |
|---|---|---|---|
| Employment rate | 75% | 75% | |
| R&D in % of GDP | 3% | 2% | |
| CO2 emission reduction | -20% | 10% | X |
| Renewable energy | 20% | 15% | |
| Energy efficiency | 20% | 2.96 | X |
| Early school leaving | less than 10% | 10% | |
| Tertiary education | at least 40% | 30% | |
| Reduction of population at risk of poverty | at least 20 million | 450,000 | |

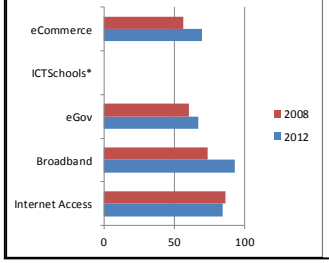
| Amsterdam | |
|---|---|
| Country | the Netherlands |
| Population | 779,808 |

| National EU2020 | National | EU |
|---|---|---|
| Employment rate (2011) | 77.0% | 68.6% |
| Expenditure on R&D (2010) | 1.9% | 2.0% |
| Greenhouse Gas Emissions (1990-2010) | 99 | 85 |
| Renewable Energy (2010) | 3.3% | 12.1% |
| Early Leavers from education/training (2011) | 9.1% | 13.5% |
| Tertiary educational attainment (2011) | 41.1% | 34.6% |
| People at risk of poverty/social exclusion (2010) | 15.1% | 23.6% |

**City profile - Innovation Strategy**

5 themes:
**Living:** To determine which technologies and methods are the most effective, various projects will be initialized, ranging from renovating old canal-side buildings to installing smart meters.
**Working:** To determine which technologies and methods are the most effective to enable Smart Working, various projects will be initialized, focusing on sustainable real estate, processes of companies and to convince people to work in a smarter manner for instance using a smart work center instead of spending time in a traffic jam.
**Mobility:** In order to determine which technologies, concepts, approaches and forms of cooperation are most successful, various Mobility projects will be initialized. All focusing on sustainable ways of transport and the infrastructure required to realise them. For example implementing new logistic concepts, dynamic traffic management concept and a network of recharging points for electric scooters throughout the city.
**Public Facilities**: In order to determine which technologies, concepts, approaches and forms of cooperation are most successful to make the public facilities more sustainable on a large scale and organised in a smarter manner.The projects in the Public Services theme focus on smart solutions and approaches in schools, hospitals, sport areas, libraries, streets, etc.
**Open Data:** Publicly-available data that can be used and combined to provide Amsterdammers with new insights and the chance to make decisions based upon actual facts and figures.
Source:http://www.ey.com/Publication/vwLUAssets/03_Amsterdam_Smart_City/$FILE/03_20121024 RIGA.pdf

**ICT baseline**




GOV ECO ENV MOB PEO LIV

| Smart City Initiatives | Characteristics | Components | Objectives | Funding | Stakeholders | Source |
|---|---|---|---|---|---|---|
| Amsterdam Smart City Platform | LIV, MOB, ENV, GOV, PEO, ECO | ICT, Apps, Fall detection sensors, Gamathon, Crowdsourcing, Sustainable technologies | "Amsterdam Smart City (ASC) is a unique . Together, our goal is to develop the Amsterdam Metropolitan Area into a smart city" | EFRO, Dutch National Government, City government, private investments (Liander) | public-private partnership, with over 70 partners from businesses, authorities, research institutions and the people of Amsterdam | http://amsterdamsmartcity.com/projects |
| Citadel | GOV, ECO | Open data, Apps, eSkills, | "Citadel on the Move aims to make it easier for citizens and application developers alike from across Europe to use Open Data to create the type of innovative mobile applications that they want and need" | This project is co-funded by the EC under the CIP Programme. | 14 partners (mix of public/private) | http://www.citadelonthemove.eu/ |
| NICE (Networking Intelligent Cities for Energy Efficiency) | ENV, PEO | Measurement, Learning sessions with experts, Networks of people, Data, Framework | "The project aims to create a partnership of cities on ICT and energy efficiency" | The project is funded under the ICT strand of the 7th Research Framework Programme (FP7). | 97 Eurocities members, Clicks and Links, Manchester City Council, Leibniz Institute of Ecological Urban and Regional Development | http://www.eurocities.eu/eurocities/activities/projects/NiCE-Networking-intelligent-Cities-for-Energy-Efficiency |
| Common4U | GOV, ECO, MOB, LIV | Mobile node, FreeEurope WiFi pilot, Innovative Internet technologies, Fiber from the "X" approach (FFTX) , Open sensors networks, Open data portal | "Smart city initiative to 'close the gap' between cities and its citizens by 'fostering innovation' and 'creating cutting edge digital services'" | Co-funded by the European Union [ICT Policy Support Programme (ICT PSP) "Competitiveness and Innovation"] | Partners: ESADE, Fraunhofer FOKUS, FORUM VIRIUM HELSINKI, City of Amsterdam Economic Development Department, waag society, Provincia Di Roma, CASPUR, Universitat Pompeu Fabra Barcelona, Manchester Digital Development Agency, dotopen, LYNX, guifi.net, Nesta, Ajuntament de Barcelona | http://commonsforeurope.net/ |
| Digital Cities | GOV, LIV, PEO | public available Wi-Fi, Training, Promotion, Mobile technology, Citizen as a sensor | "The project focuses on the problem of the low ICT adoption by European local authorities in non-metropolitan areas, geographically isolated areas and other areas of social exclusion" | European Union Interreg IVC | Manchester Digital Development Agency, Almere Knowledge City Foundation, City of Jesenik, University Transilvania of Brasov, Municipality of Brasov, Municipality of Xanthi, e-Trikala, Institute of Communication and Computer Systems (Athens), Malta Government Technology Investments Ltd, Paralimni Municipality | www.digital-cities.eu |
| Open Cities | PEO, LIV, ECO | Crowdsourcing, Open Data, FTTH networks and Open Sensor Networks | "Aims to validate how to approach Open & User Driven Innovation methodologies to the Public Sector in a scenario of Future Internet Services for Smart Cities" | Project co-funded by the European Commission within the ICT Policy Support Programme | 7 major European cities: Helsinki, Berlin, Amsterdam, Paris, Rome, Barcelona and Bologna. | http://www.opencities.net/ |

**Potential Impacts on EU2020**

Amsterdam has many smart city initiatives, covering all characteristics of smart cities. The Amsterdam Smart City Platform is unique in that it is the only initiative within the sample that covers all characteristics. The initiative covers 38 projects across five different themes, including living, working, mobility, public facilities and open data.

There are 2 initiatives which contain an environmental focus. The NICE PROJECT - which spans many cities aims to decrease ICT's direct carbon footprint by 30% per city. It should be noted that the Netherlands is far from its national target on renewable energy and remains higher than the EU average on Greenhouse Gas emissions.

The Citadel project aims to enable the public to create apps from open data, therefore capitalising on talent and contributing to R&D.

In line with an inclusive society, Amsterdam's involvement in the Digital city initiative aims to ensure 100% access to fast broadband, thereby connecting citizens to the ICT related resources available, thus making their lives 'smarter'. This, alongside the Common4U project, aims to create digital services for citizens to access.

| Alignment to Europe2020 objectives | EU | National | |
|---|---|---|---|
| Employment rate | 75% | 80% | x |
| R&D in % of GDP | 3% | 2.5% | x |
| CO2 emission reduction | -20% | -16% | x |
| Renewable energy | 20% | 14% | |
| Energy efficiency | 20% | n.a. | x |
| Early school leaving | less than 10% | <8 % | |
| Tertiary education | at least 40% | >40%<br>45%<br>expected in 2020 | |
| Reduction of population at risk of poverty | at least 20 million | 100000 | x |

| Malmo | |
|---|---|
| Country | Sweden |
| Population | 278,523 |

| National EU2020 | National | EU |
|---|---|---|
| Employment rate (2011) | 79.4% | 68.6% |
| Expenditure on R&D (2010) | 3.4% | 2.0% |
| Greenhouse Gas Emissions (1990-2010) | 91 | 85 |
| Renewable Energy (2010) | 47.9% | 12.1% |
| Early Leavers from education/training (2011) | 6.6% | 13.5% |
| Tertiary educational attainment (2011) | 46.8% | 34.6% |
| People at risk of poverty/social exclusion (2010) | 15.0% | 23.6% |

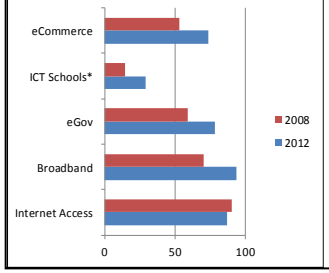
**City profile - Innovation Strategy**

More efficient energy consumption. Energy consumption in Malmö will decrease by at least 20% per person by 2020*, and by a further 20% by 2030. More renewable energy. Solar, wind, water and biogas will be phased in and fossil fuels phased out. The proportion of renewable energy will be 100% in the City of Malmö by 2020. The ambition is for as large a proportion of this energy as possible to be produced locally. Reduction of emissions. Greenhouse gas emissions will decrease by at least 40%, calculated from 1990.

Transition in transport and travel. The significant development of rail traffic and other electrically (green electricity) driven public transport, as well as an extended network of cycle lanes, will create new possibilities for local and regional travel. The capacity for transporting goods by ferry and train will be improved.

Source: http://www.malmo.se/download/18.6301369612700a2db9180006235/Environmental-Programme-for-the-City-of-Malmo-2009-2020.pdf

**ICT baseline**




GOV ECO ENV MOB PEO LIV

| Smart City Initiatives | Characteristics | Components | Objectives | Funding | Stakeholders | Source |
|---|---|---|---|---|---|---|
| Peripheria | LIV, PEO, ENV | Virtual forums, smart meters, measuring, social media | "The 'Neighbourhood' lab works in the contentious multi-ethnic suburbs of Rosengård and Fosie and focuses on urban development, collaborative services and social media, exploring the potential of new media for co-creation and social innovation" | This project is partially funded by the European Union CIP PSP Grant Agreement no. 271015 | PERIPHÈRIA is carried out by a project consortium led by Alfamicro (PT) and made up of 12 partners from 5 EU Member States | http://www.peripheria.eu/ |
| Citadel | GOV, ECO | Open data, Apps, eSkills, | "Citadel on the Move aims to make it easier for citizens and application developers alike from across Europe to use Open Data to create the type of innovative mobile applications that they want and need" | This project is co-funded by the EC under the CIP Programme. | 14 partners (mix of public/private) | http://www.citadelonthemove.eu/ |
| NICE (Networking Intelligent Cities for Energy Efficiency) | ENV, PEO | Measurement, Learning sessions with experts, Networks of people, Data, Framework | "The project aims to create a partnership of cities on ICT and energy efficiency" | The project is funded under the ICT strand of the 7th Research Framework Programme (FP7). | 97 Eurocities members, Clicks and Links, Manchester City Council, Leibniz Institute of Ecological Urban and Regional Development | http://www.eurocities.eu/eurocities/activities/projects/NiCE-Networking-intelligent-Cities-for-Energy-Efficiency |

**Potential Impacts on EU2020**

Like other Scandinavian countries, Sweden is higher than the EU-average on almost all of the Europe2020 indicators. For example, their renewable energy target is 49%, compared to the EU target of 20%.

The initiatives cover a range of Smart City components, with the exception of initiatives linked to mobility.

Two out of the three initiatives concentrate on the environment. The NICE PROJECT - which spans many cities aims to decrease ICT's direct carbon footprint by 30% per city. Peripheria uses ICT to encourage communication between in a bid to change behaviour towards energy consumption and incentivise people to use less.

The Citadel project aims to enable the public to create apps from open data, therefore capitalising on talent and contributing to R&D.

Social inclusion is generated in the Peripheria project using the MyOpinion app where photos and tweets are displayed, thereby giving people a voice and encouraging a sense of ownership and community within the local area.

| Alignment to Europe2020 objectives | EU | National | |
|---|---|---|---|
| Employment rate | 75% | Well over 80% | |
| R&D in % of GDP | 3% | 4% | x |
| CO2 emission reduction | -20% | -17% | x |
| Renewable energy | 20% | 49% | x |
| Energy efficiency | 20% | 12.8 | x |
| Early school leaving | less than 10% | <10% | |
| Tertiary education | at least 40% | 40-45% | |
| Reduction of population at risk of poverty | at least 20 million | Reduction of the % of women and men who are not in the labour force (except full-time students), the long-term unemployed or those on long-term sick leave to well under 14% by 2020 | x |

| Bremen | |
|---|---|
| Country | Germany |
| Population | 547,340 |

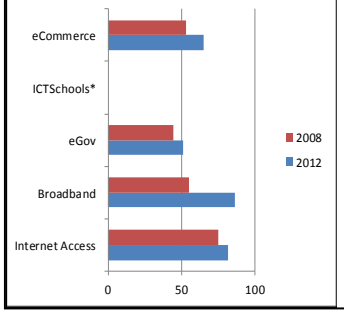
| National EU2020 | National | EU |
|---|---|---|
| Employment rate (2011) | 76.3% | 68.6% |
| Expenditure on R&D (2010) | 2.8% | 2.0% |
| Greenhouse Gas Emissions (1990-2010) | 75 | 85 |
| Renewable Energy (2010) | 10.7% | 12.1% |
| Early Leavers from education/training (2011) | 11.7% | 13.5% |
| Tertiary educational attainment (2011) | 30.7% | 34.6% |
| People at risk of poverty/social exclusion (2010) | 19.7% | 23.6% |

**City profile - Innovation Strategy**

Innovation Programme 2020
1. To enhance the competitiveness of the city; to further strengthen its strong position
2. Cooperation between industries (to enhance); expand science; include SMEs more frequently as a rule
3. to strengthen the cluster structures but also further expand areas of expertise
4. Foster technology and knowledge transfer within and between the clusters and to initiate cooperation
5. Promote innovative start-ups
6. Promoting innovation framework -conditions
7. Ensure supply of venture capital; tailored financing for businesses

Source: http://www.wirtschaft.bremen.de/sixcms/media.php/13/Innovationsprogramm_2020.pdf

**ICT baseline**




GOV ECO ENV MOB PEO LIV

| Smart City Initiatives | Characteristics | Components | Objectives | Funding | Stakeholders | Source |
|---|---|---|---|---|---|---|
| Environmental building management | LIV, ENV | Software, Centralised control, Efficiency of heating, real time data, sensors, green buildings | "Unify more than 1,200 municipal properties under a single, open building management system (BMS)" "Optimize the efficiency of heating systems in the buildings to cut energy consumption" | Public/Private | Invensys & The City of Bremen. Immobilien Bremen, Anstalt des öffentlichen Rechts," the city's property service company | http://smartcitiescouncil.com/resources/city-bremen-cuts-energy-consumption-and-consolidates-building-management-wonderware-solution |
| Peripheria | MOB | Traffic guidance system, real time data, mobile apps sensors for parking space monitoring. | "The approach is to find new (technology-based) service concepts that complement or improve existing offers. Brepark operates the ICT infrastructure for parking and related control technology, such as sensors for parking space monitoring" | This project is partially funded by the European Union CIP PSP Grant Agreement no. 271015 | PERIPHÈRIA is carried out by a project consortium led by Alfamicro (PT) and made up of 12 partners from 5 EU Member States | http://www.peripheria.eu/ |
| PEOPLE | PEO | Mobile Stud.IP Platform, Study Planner iOS, Location based services | "The objective of the Bremen pilot is to improve the quality of life at the Technology Park – especially the university's campus. A dedicated focus will be on social aspects like encouraging and improving grouping activities for students" | This project is partially funded under the ICT Policy Support Programme (ICT PSP) | 9 partners (public/private/university) Four pilots created, at four different European cities: | http://www.people-project.eu/portal/ |

**Potential Impacts on EU2020**

Germany is already below the EU average in its volume of greenhouse gas emissions (75 vs. 85 units). Nevertheless, its national target is significantly lower than the EU 2020 target. Germany also falls short of EU 2020 renewable energy targets given that 10.7% of its energy is currently derived from renewable sources compared to the 20% European target. Moreover, Germany's national target is only 18% - revealing that is it not wholly aligned with EU objectives.
The Wonderware project has reduced energy consumption down by 15% to 18%, by optimising heating efficiencies in municipal buildings across the city. A reduction in CO2 emissions and increased awareness of the environment is supported by the Peripheria project which aims to improve mobility by promoting car sharing and providing real time data on traffic and parking space availability.

The PEOPLE initiative aims to improve student's quality of life through facilitating group activities.

| Alignment to Europe2020 objectives | EU | National | |
|---|---|---|---|
| Employment rate | 75% | 77% | |
| R&D in % of GDP | 3% | 3% | |
| CO2 emission reduction | -20% | -14% | X |
| Renewable energy | 20% | 18% | |
| Energy efficiency | 20% | 38.3 | X |
| Early school leaving | less than 10% | <10% | |
| Tertiary education | at least 40% | 42% | X |
| Reduction of population at risk of poverty | at least 20 million | 330,000 (long-term unemployed) | |

## Dublin

| | |
|---|---|
| Country | Ireland |
| Population | 506,211 |

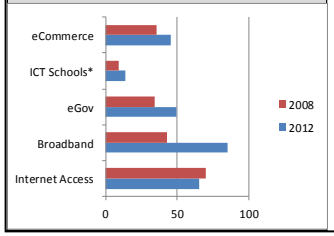
| National EU2020 | National | EU |
|---|---|---|
| Employment rate (2011) | 63.8% | 68.6% |
| Expenditure on R&D (2010) | 1.7% | 2.0% |
| Greenhouse Gas Emissions (1990-2010) | 111 | 85 |
| Renewable Energy (2010) | 5.6% | 12.1% |
| Early Leavers from education/training (2011) | 10.8% | 13.5% |
| Tertiary educational attainment (2011) | 49.7% | 34.6% |
| People at risk of poverty/social exclusion (2010) | 29.9% | 23.6% |

### City profile - Innovation Strategy

In 2012, Dublin will be a city where communities, agencies, businesses, citizens and decision-makers will have easy access to manageable information and have the means and ability to communicate with each other. Dublin will be a city that harnesses the power of communications technology to connect and inform people, create opportunities and tackle social exclusion.

Source:http://www.dublin.ie/uploadedFiles/City_Development_Board/chapter_03_connected.pdf

### ICT baseline




GOV ECO ENV MOB PEO LIV

| Smart City Initiatives | Characteristics | Components | Objectives | Funding | Stakeholders | Source |
|---|---|---|---|---|---|---|
| Road congestion system | MOB | Transportation, Real time data, Mobile devices, Road sensors, GPS, ICT access | "The work involves applying analytics to huge amounts of data to solve pressing problems. In Dublin, information comes from an array of sources including road sensors and GPS updates from the city's 1,000 buses. A digital map of the city is being built, overlaid with the real-time positions of the city's buses" | Public/Private | Dublin City Council and IBM | http://www.guardian.co.uk/local-government-network/2013/jun/05/dublin-city-smart-approach-data |
| SMART Dublin | ENV, ECO | Transportation, water and energy, City fabric, buildings, energy consumption | "Pilot projects a/o: Understanding and predicting energy consumption (resulting in -7% energy consumption government buildings); Merrion Water project (pressure reduction potential of -44%); Job creation" | Public/Private | entrepreneurs, researchers and the city authorities - Dublin City Council and IBM | http://www.ibm.com/smarterplanet/global/files/es__es_es__cities__madrid_tom_leahy.pdf |
| Dublinked | ENV,MOB | Open Data on planning, transport, environment, arts, culture and heritage | "This new regional data sharing initiative sees previously unreleased public operational data being made available online for others to research or reuse. There are over 140 datasets available, ranging from planning, transport, environment, arts, culture and heritage" | Public/Private | Dublin's Local Authorities and National University of Ireland Maynooth. Technology provided by IBM | http://dublinked.ie/ |
| Digital Dublin | GOV, LIV, PEO, ECO | Open Data, Open Innovation, Citizens | "The project aim is to facilitate further innovation in the region, long-term sustainability, enhanced citizen-focussed governance and job creation. In doing so, it will improve the functioning of the city, making it a better place to live, work, study and visit. It will improve the attractiveness of the city for home-grown and foreign tech companies and digital start-ups" | Public/Private | An alliance of Government, Business, Higher Education and Citizens, Intel Labs, Maynooth College, Imperial College London and City Council | http://digitaldublin.ie/ |
| Livecity | PEO, GOV | Wireline, 4g wireless network, virtual path slice, Video-to-video (v2v), xDSL | "LiveCity addresses a number of communities where the citizen of a city have specific challenges which can derive benefits from the use of live interactive high definition video-to-video. These communities include emergency ambulances; hospitals, doctors, museum curators, city administrations and schools" | Public/Private | Public service providers, network infrastructure operators, SMEs, Subject matter experts, project across 5 Cities (Dublin, Luxembourg, Athens, Valladolid, Griefswald) | http://www.livecity-psp.eu/ |
| NICE (Networking Intelligent Cities for Energy Efficiency) | ENV, PEO | Measurement, Learning sessions with experts, Networks of people, Data, Framework | "The project aims to create a partnership of cities on ICT and energy efficiency" | The project is funded under the ICT strand of the 7th Research Framework Programme (FP7). | 97 Eurocities members, Clicks and Links, Manchester City Council, Leibniz Institute of Ecological Urban and Regional Development | http://www.eurocities.eu/eurocities/activities/projects/NiCE-Networking-intelligent-Cities-for-Energy-Efficiency |

### Potential Impacts on EU2020

Dublin has a large number of Smart City initiatives compared to most other European cities, which cover all smart city characteristics. There is also strong alignment between the objectives of Europe2020 and the objectives of several initiatives, especially in the areas of energy and social exclusion.

50% ( 3 out of 6) of the initiatives identified address the environment. For example, SMART Dublin has reduced energy consumption in government buildings. Dublin, like other cities in our sample, is part of the NICE Initiatives which aims to decrease ICT's direct carbon footprint per city by 30%.
Dublinked aims to make available data on energy efficiencies - amongst other things available to the public to reuse, therefore creating new knowledge and applications. Data is also utilised in Digital Dublin which aims to ensure more efficiency management of the city.

In other areas, LiveCity aims to use video-to-video services to ensure safe and effective communication. And more efficient motoring is supported by the Road congestion system which uses monitoring sensors and ICT to provide live traffic information.

| Alignment to Europe2020 objectives | EU | National | |
|---|---|---|---|
| Employment rate | 75% | 69-71% | x |
| R&D in % of GDP | 3% | approx.2 % (2.5% GNP) | |
| CO2 emission reduction | -20% | -20% | x |
| Renewable energy | 20% | 16% | |
| Energy efficiency | 20% | 2.75 | x |
| Early school leaving | less than 10% | 8% | |
| Tertiary education | at least 40% | 60% | |
| Reduction of population at risk of poverty | at least 20 million | 186,000 by 2016 | x |

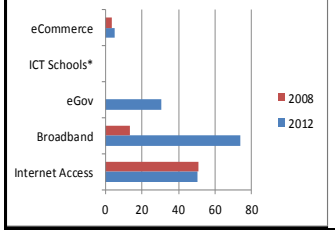
| Tirgu Mures | |
|---|---|
| Country | Romania |
| Population | 311,428 |

| National EU2020 | National | EU |
|---|---|---|
| Employment rate (2011) | 62.8% | 68.6% |
| Expenditure on R&D (2010) | 0.5% | 2.0% |
| Greenhouse Gas Emissions (1990-2010) | 48 | 85 |
| Renewable Energy (2010) | 22.9% | 12.1% |
| Early Leavers from education/training (2011) | 17.5% | 13.5% |
| Tertiary educational attainment (2011) | 20.4% | 34.6% |
| People at risk of poverty/social exclusion (2010) | 41.4% | 23.6% |

**City profile - Innovation Strategy**

Digital Mures strategy is made up of two main components: a modern infrastructure of private-public services and, second, the construction and the development of a medical IT technological park.
While the infrastructure of private-public services will generate money saving and will increase the comfort of the citizen and of the private business environment, "The Scientific City for Medical IT" will contribute to the development of industry and of research at global level, and will bring about thousands of working places in Tirgu-Mures.
Source:
http://www.tirgumures.ro/index.php?option=com_content&view=article&id=231%3Astrategia-digital-mures&catid=44&Itemid=280&lang=en

**ICT baseline**




GOV ECO ENV MOB PEO LIV

| Smart City Initiatives | Characteristics | Components | Objectives | Funding | Stakeholders | Source |
|---|---|---|---|---|---|---|
| EU Platform for Intelligent Cities (EPIC) | GOV, LIV, PEO | Cloud computing, Innovation, E-services, Service delivery | "Aims to wed state-of-the-art cloud computing technologies with fully researched and tested e-Government service applications to create the first truly scalable and flexible pan-European platform for innovative, user-driven public service delivery" | European Commission-funded project (CICT PSP) | 17 project partners including city-level institutions, private companies, universities - across 4 cities | http://www.epic-cities.eu/ |

**Potential Impacts on EU2020**

Poverty remains a major issue for Romania, with over 40% of the population at risk, which is almost double the EU average.

This is reflected in the characteristics which are covered in their initiatives which address smart living and smart people and not the environment. EPIC, uses ICT to create user-driven public service delivery which aims to improve access and available services for the population.

| Alignment to Europe2020 objectives | EU | National | |
|---|---|---|---|
| Employment rate | 75% | 70% | |
| R&D in % of GDP | 3% | 2% | |
| CO2 emission reduction | -20% | 19% | |
| Renewable energy | 20% | 24% | |
| Energy efficiency | 20% | 10 | |
| Early school leaving | less than 10% | 11% | |
| Tertiary education | at least 40% | 27% | |
| Reduction of population at risk of poverty | at least 20 million | 580,000 | x |

| Ljubljana | |
|---|---|
| Country | Slovenia |
| Population | 272,220 |

| National EU2020 | National | EU |
|---|---|---|
| Employment rate (2011) | 68.4% | 68.6% |
| Expenditure on R&D (2010) | 2.1% | 2.0% |
| Greenhouse Gas Emissions (1990-2010) | 106 | 85 |
| Renewable Energy (2010) | 19.6% | 12.1% |
| Early Leavers from education/training (2011) | 4.2% | 13.5% |
| Tertiary educational attainment (2011) | 37.9% | 34.6% |
| People at risk of poverty/social exclusion (2010) | 18.3% | 23.6% |

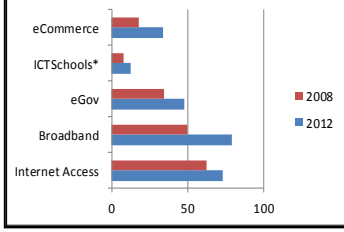
**City profile - Innovation Strategy**

The Vision of the City of Ljubljana by year 2025 outlines three principal development aims, including:

- Ideal city (i.e. the optimal city size – for living, working, recreation)
- Sustainable city (i.e. preserved natural and urban environment in the city and urban region)
- Slovenian metropolis (European competitive capital city)

Source: http://www.ljubljana.si/en/green-capital/vision-2025/

**ICT baseline**




GOV ECO ENV MOB PEO LIV

| Smart City Initiatives | Characteristics | Components | Objectives | Funding | Stakeholders | Source |
|---|---|---|---|---|---|---|
| Ljubljana smart city project | ENV, LIV | Renewable energy sources, Monitoring | The project aims to encourage direct communication with citizens on environmental protection, sustainable energy use, renewable energy sources | Public Private mix | Siemens and the City of Ljubljana | http://www.ljubljanapametnomesto.si |
| CIVITAS | MOB | Real time information, e-ticketing, electric vehicles | The project aims to support cities to introduce ambitious transport measures and policies towards sustainable urban mobility | Co-financed by the European Commission | Public-private mix | http://www.civitasljubljana.si/ |

**Potential Impacts on EU2020**

Both the Smart City initiatives which were identified for Ljubljana are aimed at improving sustainability. Civitas has a specific focus on mobility, whereas the city's Smart City project has an overview focus on sustainable energy use.
Slovenia does not have a national target for energy efficiency.

| Alignment to Europe2020 objectives | EU | National | |
|---|---|---|---|
| Employment rate | 75% | 75% | |
| R&D in % of GDP | 3% | 3% | |
| CO2 emission reduction | -20% | 4% | |
| Renewable energy | 20% | 25% | x |
| Energy efficiency | 20% | n.a | x |
| Early school leaving | less than 10% | 5% | |
| Tertiary education | at least 40% | 40% | |
| Reduction of population at risk of poverty | at least 20 million | 40,000 | |

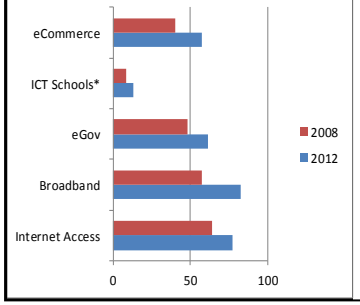
| Lyon | |
|---|---|
| Country | France |
| Population | 474,946 |

| National EU2020 | | |
|---|---|---|
| | National | EU |
| Employment rate (2011) | 69.2% | 68.6% |
| Expenditure on R&D (2010) | 2.2% | 2.0% |
| Greenhouse Gas Emissions (1990-2010) | 93 | 85 |
| Renewable Energy (2010) | 11.4% | 12.1% |
| Early Leavers from education/training (2011) | 12.0% | 13.5% |
| Tertiary educational attainment (2011) | 43.3% | 34.6% |
| People at risk of poverty/social exclusion (2010) | 19.2% | 23.6% |

**City profile - Innovation Strategy**

Lyon aims to improve:
•at an economic level:◦encouraging business creation and support the emergence of the jobs of the future in the digital economy and in the green economy,
•at sustainability level - new technologies and usages, promoting changes in energy use, offer new transport solutions
•at urban development level - finding new ways of thinking about the way the area is managed
Source: http://www.business.greaterlyon.com/lyon-smart-city-strategy-policy-france-europe.347.0.html?&L=1

**ICT baseline**




GOV ECO ENV MOB PEO LIV

| Smart City Initiatives | Characteristics | Components | Objectives | Funding | Stakeholders | Source |
|---|---|---|---|---|---|---|
| Lyon Smart Community | MOB, ENV, LIV | Data monitoring, renewable energy, smart metering for monitoring and providing additional information about service provision, Electric vehicles, Green buildings | "Achieve a positive-energy eco-district reduce congestion and achieve carbon free city travel help users control their energy use manage data collection" | NEDO will support 50 million EUROs to the project | NEDO, Toshiba and Toshiba Solutions, Bouygues Immobilier, Veolia Transdev and GRANDLYON HABITAT | http://www.economie.grandlyon.com/fileadmin/user_upload/fichiers/site_eco/20121121_gl_lyon_smart_community_dp_en.pdf |

**Potential Impacts on EU2020**

Despite pursuing less smart city initiatives than the other cities in the sample, the Lyon Smart Community project covers three of the six smart city characteristics.

France remains ahead of the EU average on most indicators related to Europe2020, with only renewable energy and Greenhouse Gas emissions lagging behind. This priority is emphasised in the objectives of Lyon Smart Community which aims at reducing the carbon footprint of the city's transport system and provide data to manage energy use.

The significance of the Japanese agency New Energy and Industrial Technology Development Organization (NEDO) as a stakeholder is unique in that there are few non-European stakeholders in the Smart City initaitives

| Alignment to Europe2020 objectives | | | |
|---|---|---|---|
| | EU | National | |
| Employment rate | 75% | 75% | |
| R&D in % of GDP | 3% | 3% | |
| CO2 emission reduction | -20% | -14% | |
| Renewable energy | 20% | 23% | X |
| Energy efficiency | 20% | 34 | |
| Early school leaving | less than 10% | 10% | |
| Tertiary education | at least 40% | 50% | |
| Reduction of population at risk of poverty | at least 20 million | 1,600 000 people | |

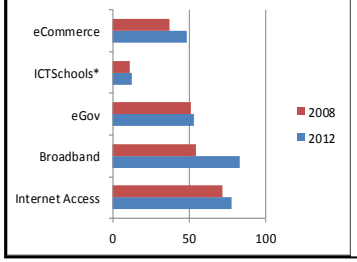
| Vienna | |
|---|---|
| Country | Austria |
| Population | 1,714,142 |

| National EU2020 | National | EU |
|---|---|---|
| Employment rate (2011) | 75.2% | 68.6% |
| Expenditure on R&D (2010) | 2.8% | 2.0% |
| Greenhouse Gas Emissions (1990-2010) | 108 | 85 |
| Renewable Energy (2010) | 30.4% | 12.1% |
| Early Leavers from education/training (2011) | 8.3% | 13.5% |
| Tertiary educational attainment (2011) | 23.8% | 34.6% |
| People at risk of poverty/social exclusion (2010) | 16.6% | 23.6% |

**City profile - Innovation Strategy**

Smart City Wien
The quality of life in the federal capital of Austria, Vienna, with its population of 1.8 million, is one of the highest among the big cities of the world. Vienna enjoys a strong international reputation in this field. The Smart City Vienna concept offers local citizens a credible perspective on the future of their city. Smart City policy is social welfare policy that treats all dimensions equally over the long term. The central goal is to safeguard and improve ecological, economic and social performance.
Source: https://smartcity.wien.at/site/en/das-projekt/

**ICT baseline**




GOV ECO ENV MOB PEO LIV

| Smart City Initiatives | Characteristics | Components | Objectives | Funding | Stakeholders | Source |
|---|---|---|---|---|---|---|
| Aspern | LIV | Renewable energy and traditional power supply, building systems, smart power grids, monitoring and detection, Data, storage and ICT | "The project aims to create 8.500 housing units will accommodate 20.000 people. Furthermore, 20.000 jobs will be created in the fields of service, trade and industry, science, research and education" | Public/Private | Wien 3420 AG, the City of Vienna, Siemens | http://www.siemens.com/innovation/en/news/2013/e_inno_1319_1.htm |
| NICE (Networking Intelligent Cities for Energy Efficiency) | ENV, PEO | Measurement, Learning sessions with experts, Networks of people, Data, Framework | "The project aims to create a partnership of cities on ICT and energy efficiency" | The project is funded under the ICT strand of the 7th Research Framework Programme (FP7). | 97 Eurocities members, Clicks and Links, Manchester City Council, Leibniz Institute of Ecological Urban and Regional Development | http://www.eurocities.eu/eurocities/activities/projects/NiCE-Networking-intelligent-Cities-for-Energy-Efficiency |
| iScope | LIV, MOB, PEO, ENV | Interoperable 3D Urban Information Models, citizens as a sensor, data smart meters, mobile devices | "i-SCOPE delivers an open platform on top of which it develops, three "smart city" services: Improved inclusion, Optimization of energy, Environmental monitoring" | Co-funded by the European Union [ICT Policy Support Programme (ICT PSP) "Competitiveness and Innovation"] | 21 partners (public, private mix) | http://www.iscopeproject.net/ |

**Potential Impacts on EU2020**

The objectives of the smart city initiatives appear to reflect wider Europe2020 targets, with job creation, social inclusion and energy efficiency all cited.

With the exception of tertiary education attainment, Austria is higher than the EU average on most Europe2020 indicators.

Vienna have a range of initaives, at a European and a city level. They participate in the NICE initiative which aims to decrease the carbon footprint of ICT by 30%. iScope links both environment and people though its use of peoeple as sensors to collect information on city wide noise levels through collecting this data on mobile phones.

Another initiative that addresses smart living is Aspern, which aims to create jobs and produce a susatinable living environment.

| Alignment to Europe2020 objectives | EU | National | |
|---|---|---|---|
| Employment rate | 75% | 77-78% | x |
| R&D in % of GDP | 3% | 4% | |
| CO2 emission reduction | -20% | -16% | x |
| Renewable energy | 20% | 34% | x |
| Energy efficiency | 20% | 7.16 | x |
| Early school leaving | less than 10% | 9.50% | |
| Tertiary education | at least 40% | 38% | |
| Reduction of population at risk of poverty | at least 20 million | 235,000 | x |

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DIRECTORATE-GENERAL FOR INTERNAL POLICIES

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