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Abstract:

The SmartCities Information Paper is a dissemination tool to explain the main concepts of the Smart City vision and goals. There are many stakeholders who are yet reluctant to changes coming from this "buzzword". Especially in the municipal administration where silos resist to innovation if that means less power in the decision process. The aim of this deliverable is to find a useful guide to explain main concepts about Smart City and understand its importance for a more efficient management of everyday life in cities. This is not only about high tech, big data, embedded systems, electric vehicles and renewables energies. This is about how the Smart City can trigger a sustainable development for our cities and can help the delivery of better services to their citizens.

Keyword list: Smart City, Sustainable Development, Efficient systems, ICT, Embedded systems.

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1   Executive Summary

More than two thirds of the European population lives in urban areas. Cities are places where both problems emerge and solutions can be implemented. They are incubators for science and technology development, for creativity and innovation and for tackling the impact of climate change. However, cities are also places where many problems are concentrated (social differences, unemployment, poverty, etc.).

But the main feature of the city is that to some extent has kept a close relationship with its citizens. Politicians at city level are people that remain having a good knowledge of everyday problems. The more "micro" level problems are taken into account and solutions are provided considering minorities as well. Of course there are many barriers that municipalities face but the reward of getting citizen involvement in the decision processes is also high. And the transformations processes require more and more the support and lead from citizen.

European institutions, National Governments and Cities themselves are aware of this and are trying to find the best way to activate this transformation. Sustainability is a must and cities have to play their role as key players.

However cities are taking the lead of something that yet they are not prepared for. Lack of resources (human, technical and financial) as well as lack of stability (changes in regulatory framework, short term view due to elections, etc.) make difficult for them to get results quick. Complex systems like cities require holistic approaches that must consider not only direct impacts of decisions but also indirect and induced ones. Acting over a single brick without taking into the effect that has on the wall might lead to a breach that can demolish it.

The Smart City strategy comes to accelerate this process and to keep the holistic approach. This is how integrated planning can be delivered with the participation of citizen and tackling everyday problems as well as sustainability.

All started as a market opportunity for big ICT companies that though that they could use their products tor integrating municipal information and services. And new opportunities opened for local SMEs and companies. A study from the UK government[1] in 2013 estimated in USD 408 bn the potential of the global market for smart city solutions and the additional services required to deploy them by 2020. Benefits of smart city solutions are related to optimize resources, better information for better monitoring and management with lower consumption and reduction of operating costs.

In the heart of smart solutions we have embedded systems providing data. This is where the importance of CLINES project comes in. Addressing how regional clusters can help accelerating this process fostering the economic sustainability of partner companies and cities.

Many cities are yet reluctant to using these new systems. Talking to them about Internet of Things (IoT), embedded systems or even just about Smart Cities is like speaking a different language.

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[1] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/249423/bis-13-1217-smart-city-market-opportunties-uk.pdf

Sometimes because the concept can be seen as something negative and in some other cases because they represent changes that are felt as threads.

The purpose of this deliverable is to explain in an easy way what Smart City concept means and how can be understood. What is the general European framework about it and what kind of opportunities bring to cities. We will explain what the key drivers for the Smart City strategy are and what the link with CLINES project is. So this is a document that can be used as a reference guide for public officers that do not have a clear idea about the Smart City.

2   Introduction

CLINES project studies how to improve regional framework conditions to encourage a dynamic innovation based on research driven development around embedded systems technologies for smart cities. With the increasing incorporation of the IoT in cities machine-to-machine networks and embedded devices will multiply. Huge amount of data will be available and protocols will need to enhance their operation and management. Some have already started pointing out that RF community may run out of wireless spectrum due to the high number of devices.

Developing a regional framework to encourage innovation around embedded systems will help their cities in implementing their strategies at the right pace with the right solutions. Encompassing the deployment regional clusters can help municipal authorities in finding the best solutions in each moment. This chapter is about the different aspects that CLINES project addresses from the Smart City perspective.

2.1   Smart City strategy from CLINES project

As we explained in the introduction embedded systems are and have been part of our cities. For instance traffic lights with embedded systems have been running for a long time allowing their control. But the level of deployment that will be required in a few years will be huge and city authorities and their technology partners could squander USD341bn by 2025[2] if they adopt a fragmented versus standardized approach to IoT solutions. Benefits associated with a standards based approach to IoT are not purely financial. Interoperability, freedom from vendor lock-in and reduced systems integration problems must also be considered. For these reasons open standards are imperative in this rapidly evolving market.

The Smart City approach in the CLINES project foresees trans-regional innovation, public & private funding, cooperation of stakeholders, common innovation activities, etc. with the aim of ensuring an efficient development, exploitation and dissemination of ICT in the embedded systems domain. Working together and in cooperation allows the development of more standardized devices, communication systems, etc. This is of interest for municipalities in their Smart City approach to avoid later problems.

A second point of interest is related to the development of the regional innovation in this field. Cities are engines that will be requesting a number of supplies. More and more they are becoming big consumers of technology and as big players they will be driving changes in the industry. This is many times a proof-result process that cities can't afford. Services must be provided to citizens anyway. For instance a smart lightning system must avoid leaving a street without any light. If the smartness of the system doesn't work citizens won't be worried but if the light goes all night off there will be many citizens complaining. Some experiments at city level can be difficult and companies only understand this when they are part of the development. Fostering the regional

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[2] https://machinaresearch.com/news/smart-cities-could-waste-usd341-billion-by-2025-on-non-standardized-iot-deployments/

innovation and involving local companies in this process is the way to solve these types of problems.

Another aspect of the Smart City strategy is related to developing a smart economy. Sustainability should not only be thought as something environmental. A region also needs a smart specialization that will help setting a smart economy. Jobs and companies will be part of the attractiveness of a city/region. And, hence, in many cities are trying to bring talent, partnership with companies and foster clusterization of sectors to make their economies stronger and more competitive. The role of local and regional clusters is essential.

As we said ICT sector is one of the main pillars in the Smart City strategy. Most of the initiatives are related to the reduction of emissions, energy efficiency or smart mobility. But at the bottom line there are infrastructures (devices and connectivity networks), processing of information, development of specific service layers, smart platforms, etc. Somehow ICT remains as main tool to lead the Smart City strategy and therefor the connection with the CLINES project and the goals set up are very much aligned.

3   Smart City strategy triggering the sustainable development

Cities are more and more the focal point of sustainable transformation in Europe. Almost 80% of European citizens live in cities and they account for over 80% of the primary energy consumption in Europe. Moreover they are the main hub for economy activities reaching 85%[3] of the GDP that is generated in Europe. Figures demonstrate that cities are a main player with an important advantage: closeness to citizens and to day-to-day problems. For these reasons the increasing importance of the urban scale in setting sustainable policies has been recognized by multilateral and national government bodies.

Knowledge-intensive economies are requiring a fast response in technology terms that cities are demanded to comply with. At the same time not very efficient energy and mobility models require an energy transition that should be supported in changes at city level. So in last decade the pressure to adopt new strategies has reached cities to think and implement a more sustainable development while improving their citizen's quality of life.

How to do that is the question. There are a number of barriers that they face with a direct impact in their capability to be successful in this goal. Among others:

- Many times cities lack human resources prepared and updated to current technologies.

- Cities are complex systems of systems where interactions are hard to measure.

- It is difficult to determine the impact of the decisions that are taken (direct, indirect and induced effects are hardly evaluated)

- Budget cuts are constraining the investment possibilities and the implementation of policies supported by municipal funding.

- Breaking silos for an integrated planning and implementation.

- Upper regulatory framework that limits the operation capability of the municipality.

- The city is the heart of the metropolitan area but many times the decisions are taken as single player because multi-level governance is difficult.

Nevertheless cities have stepped forward and are trying to lead this process. For instance there are 6.858 signatories of the Covenant of Mayors[4] (most of them being cities) representing 212 million inhabitants in Europe. The compromise level of these cities goes beyond the mere fact of reducing by 20% their emissions. Many are active members in different networks building exchanges based on good practices that can help a wider and faster spread of the process. This can also be seen at National levels where many cities are acting as reference for other cities.

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[3] https://eu-smartcities.eu/sites/all/files/BROCHURE_SMART_CITIES_forWEB.pdf
[4] http://www.covenantofmayors.eu/index_en.html

This chapter will try to demonstrate that cities need to think about their strategy for fostering a sustainable development through activating a Smart City vision. If they want to overcome the barriers and be effective in their decision processes they need to implement a Smart City strategy that can lead them hand by hand with their citizens.

3.1   Do we know what a Smart City is?

For last year's Smart City has become a sort of a buzzword with, in some cases, negative connotations. Sometimes considered as another fuzzy concept. But this is not only a word. This is a new vision that expands an idea and can trigger a strategy for cities. ***This vision is based in the fact that cities need to provide better services to their citizens in a sustainable manner (in economy, environmental and social terms).***

We do not intend to review the concept from its origins or give a final definition to it. Academics are struggling to find the more suitable definition. Our aim is to share some reflections that can help to understand the scope.

The origins of the Smart City concept go back to the 1990s when the focus was on the significance of new ICT with regards to modern infrastructures within cities. Different authors such as Anthony Townsend[5], research director at the Palo Alto-based Institute for the Future consider that the rise of the "Smart City" concept is both the result of global economic forces and the culmination of decades of technological progress. However, the financial crisis in 2008 played an essential role towards becoming this as a new "market trend". Big technology players realized that their customers freaked out and that had stopped spending money on new technology. Therefore new markets were sought and the idea of grafting smart technology used for multinational corporations to local governments took relevance. But this market didn't coalesce as quickly as expected because municipalities don't operate like enterprises in their buying processes.

The concept evolved into something not only related to ICT in few years. The urban agenda with the challenges that cities were facing varied the initial idea into a more extensive strategy The European Commission defined that in Smart Cities, digital technologies translate into better public services for citizens, better use of resources and less impact on the environment. The exploitation of the ICT as a tool to achieve better services more efficient is the new paradigm. There has been a clear shift on the focus for cities.

The question is whether we know what a smart city means. The answer is that it means something different to different people. No single definition has been provided that would satisfy all stakeholders. But in most of cases this term provides some aspirations for the urban transformation that can be represented in four basic aspects: institutional, urban scape, social and economic infrastructure that should be implemented in a sustainable manner.

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[5] A. Townsend 2013, "Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia"

3.2   What is first the Smart City or the Sustainable Development?

We all agree that sustainability is a goal for not only our cities but also for our regions and countries. The scarcity of resources represents a challenge for this society and although new resources are being designed and found it is true that the economic model is exhausted. For instance in the case of the energy sector a transition process is a need that governments, companies and rest of stakeholders are assuming.

In the case of the urban level the challenge is also clear. In this case we can determine that a sustainable development for a city should consider three basic pillars::

- Economic sustainability: Defined as the ability of a city to support a certain level of economic production. Economic activity is basic to keep citizens and avoid migrations.

- Social sustainability: Defined as the ability of a city to function at a social well-being and harmony. This would include problems derived from poverty, low educations rates, integration of immigrants or unsustainable social systems among others.

- Environmental sustainability: Defined as the ability to keep environmental quality and natural resource extraction rate within certain rates.

All three are important and to a high extend linked. Poverty may appear out of a weak welfare system for elderly people but at the same time will appear if young people are unable to find a job or if their salaries are too low. Another example could be if the city fosters the installation of PVs or supports retrofitting actions that can be deployed and implemented by local businesses. This will have a direct effect in the economy of the city.

Therefore sustainability in the broad sense can be seen as the vision and goals of the city. It will represent what to achieve and specific objectives can be set up for each of the pillars.

The Smart City strategy is the way we can achieve these goals. Becoming a Smart City aims to accelerate the transformation process towards their fulfilment. But this is not an objective by itself. Sometimes it is misunderstood the strategy and the goals. The embracement of this concept as the strategy driver is what can make a leap difference in how to get to where the city wants to be at in few years' time. In chapter 5 we analyse how this strategy can be implemented and what are the main working areas that should be considered.

3.3   Becoming a Smart City

Something interesting that should be discussed is how we can measure whether a city gets to its "smartness" potential. There are many frontrunners in Europe that are being seen as a reference for other cities. The innovation of their projects and, why not, the success in their implementation make them a good reference as mentors for other urban transformations. However it should always be considered that cities can have a different smartness potential and therefore the achievement of their goals should be measured in a different way.

The uniqueness of European cities requests that urban solution must be adapted to each situation. This was one of the problems that general ICT solutions faced when working with municipalities. And this is also one of the main problems that all institutions face when trying to scale up solutions. Scalability without adaptation is worthless. Does not work. Solutions prove feasible technically and financially in one city may not be feasible in another. There are no general solutions, as there is not a single Smart City definition. Each city must find its strategy, set up their goals and integrate its stakeholders as part of the solution.

In chapter 5 we will argue the importance of holistic approach due to the complexity of the interactions between stakeholders, sectors, services, citizen, other governmental bodies, etc. We can consider this as a wicked problem[6] that only we can work with from a system thinking perspective. The whole value chain should be considered and not only specific links in that chain.

Another issue is the funding to operate the transformation. Municipalities are facing budget cuts and their financial resources are very limited. Support from European institutions is needed but the most successful solutions will be the ones that can be based on business models that show financial feasibility. Solutions that are attractive for investments either from the private or the public sectors. It is worth to mention that many cities have decided to bet for services delivered directly by public companies (in DH networks, smart grids, car sharing services, etc.).

However there will be other investments whose financial ROI would not be attractive but that the city needs to implement. We could say that the business model of the city considers in fact different aspects like social or environmental benefits in addition to the economic ones.

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[6] Developments from STEEP Project. http://www.smartsteep.eu/

4   Supporting the Smart City Strategy in the EU

Cities in Europe represent both the source of and solution to today's economic, environmental and social challenges. Urban policies therefore have a wider cross-border significance, which is the reason why urban development is central to the EU's Regional Policy. We will explain in this chapter how, from the urban dimension of the cohesion policy the EU has established a specific Smart City strategy to accelerate the transition process of European cities.

4.1   General framework in Europe

The 2014-2020 period has determined the importance of the urban dimension by distributing, at least 50% of the ERDF resources in projects related to urban areas. Around 10 billion euros from the ERDF will be directly allocated to integrated strategies for sustainable urban development. And about 750 cities will be empowered to implement these integrated strategies.

This strategy is not new. The Commission has been a supportive tool for developing more sustainable cities in Europe. Since the approval of the ground-breaking Aalborg Charter in 1994 during the 1st European Sustainable Cities & Towns Conference the Commission has supported the development of the Local Agenda 21 processes. Later in 2008 with the launch of the Covenant of Mayors connecting the local and EU political levels. Finally, 2016 is the year of the launch of an EU Urban Agenda[7] with the aim of achieving a better integration of urban policies in the EU and establishing new forms of cooperation between local governments and the EU. This framework is supported by the Pact of Amsterdam launched at the end of May 2016. But 2016 is also the year of the Basque Declaration[8] where European cities acknowledge that there is a need for transformation and that they will compromise with it.

In the case of SmartCities and as part of these strategies a specific European Initiative on Smart Cities was established. This Initiative is part of The European Strategic Energy Technology (SET) Plan that aims to transform the energy production and use in the EU. Its goal is "to demonstrate the feasibility of rapidly progressing towards our energy and climate objectives at a local level while proving to citizens that their quality of life and local economies can be improved through investments in energy efficiency and reduction of carbon emissions[9]".

More specific objectives are:

- To trigger a sufficient take-up (reaching 5% of the EU population) of energy efficient and low carbon technologies to unlock the market.
- To reduce by 40% the GHE (reference year 1990) by 2020, that will demonstrate not only environmental and energy security benefits but also to provide socio-economic advantages in terms of quality of life, local employment and businesses and citizen empowerment.

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[7] http://ec.europa.eu/regional_policy/en/policy/themes/urban-development/agenda/
[8] http://conferences.sustainablecities.eu/fileadmin/user_upload/_imported/uploads/DOCUMENTS/Basque-Declaration-ENGLISH-WWW.pdf
[9] Quotation of the strategic objective. https://setis.ec.europa.eu/set-plan-implementation/technology-roadmaps/european-initiative-smart-cities

- To effectively spread across Europe best practices of sustainable energy concepts at local level, for instance through the Covenant of Mayors.

In the following graphic the main sectors to be considered as well as the progress of delivery to achieve the goals are shown:
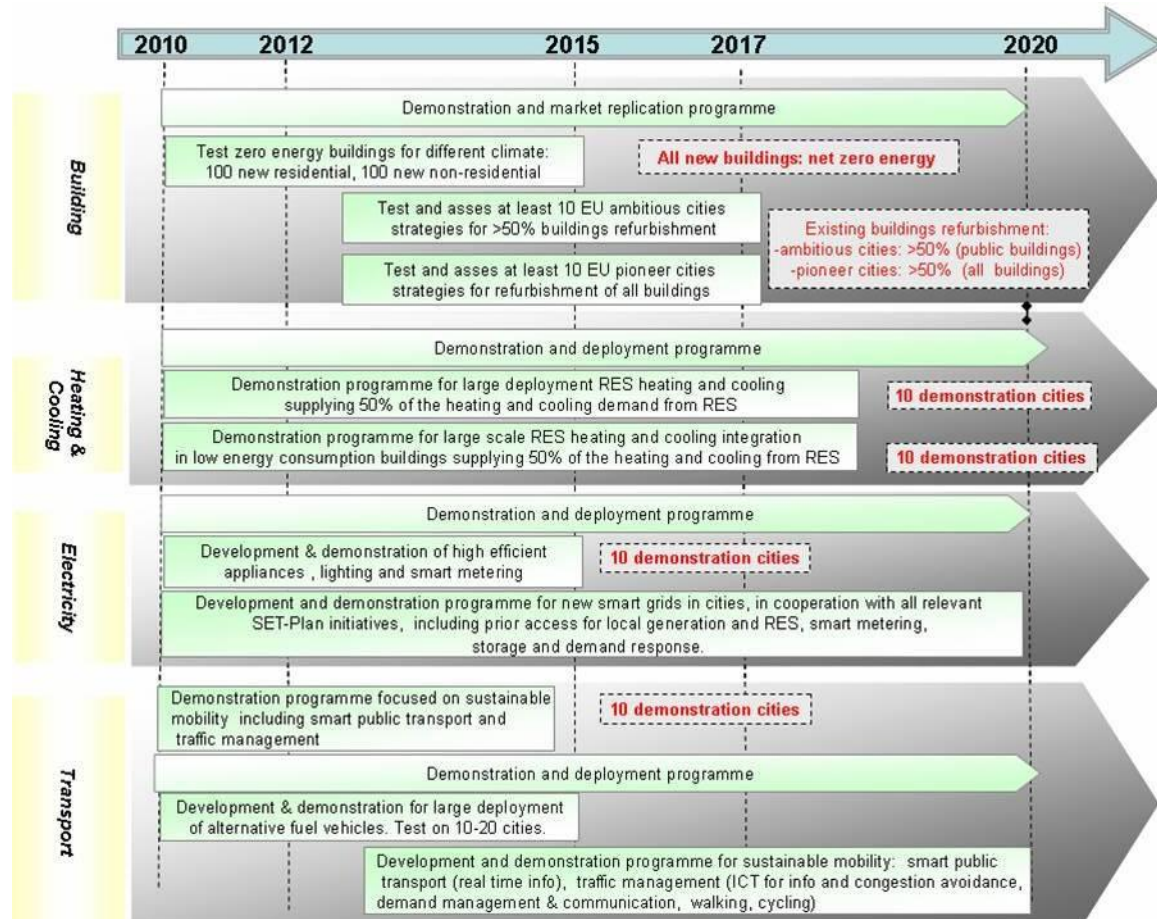

Figure 1: Indicative Roadmap for the Smart Cities Initiative

As can be seen there is an obvious turn into energy related matters with a focus in buildings (new and retrofitted), energy networks (thermal and electrical) and transportation. These have been considered as the main challenges and therefore the solutions that EU is looking for under the Smart City concept are mostly related to these sectors.

Several more specific programmes have been established so that this strategy can be implemented while supporting cities in their developments. In the following points we will explain in more detail these programmes. But generally speaking there are two big axes:

- One related to establishing linkages between cities, industry, academic and R&D world. The goal is to foster cooperation, exchanges in solutions, etc. There are several programmes and/or initiatives fostering this axis.

- The other one is by providing funding to cities to implement their interventions in the said sectors.

In the first group the most important initiatives are related to the European Innovation Partnership in SmartCities (EIP) and the EERA SmartCities Joint Programme. In the second group the most interesting programmes are H2020 with specific calls under SmartCities topic and the investment facilities that can help cities with some projects.

4.2   EERA SmartCities

Solutions involved in transforming cities into SmartCities are very complex. Only through interdisciplinary and multilevel system thinking can be solved. The European Energy Research Alliance (EERA[10]) provides an interesting framework for a joint effort of energy research expertise and infrastructure across Europe. It is part of the European Strategic Energy Technology Plan (SET-Plan[11]) that aims to accelerate the development and deployment of low-carbon technologies. It is expected that this will help to bring down costs and improve new technologies.

Within the EERA there are a number of Joint Programmes that aim to link academic and research expertise with industry. Due to its interest the EERA Joint Programme Smart Cities[12] which focuses on energy efficiency, large scale integration of renewables energies and smart energy management at city level was established. Over 75 institutions are participating in this JP, either as full members or as associated, including industry partners as well. Based on voluntary work from participants the JP is working on the following themes:

- Energy in cities
- Urban energy networks
- Energy-efficient interactive buildings
- Urban City related supply technologies

Ideas and learning are shared so that common proposals can be developed and prepared. But the main goal is to exchange knowledge that can support European cities in their transformation process towards a more sustainable path.

4.3   European Innovation Partnership in SmartCities (EIP Market Place)

The European Innovation Partnership on Smart Cities & Communities (EIP- SCC) was launched in July 2012[13]. Its main goal is to accelerate the industrial-scale roll-out of smart city solutions integrating technologies from Energy, Transport and Information and Communication Technologies (ICT). According to its Strategic Implementation Plan, "*this partnership strives at a triple bottom*

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[10] http://www.eera-set.eu/
[11] https://ec.europa.eu/energy/en/topics/technology-and-innovation/strategic-energy-technology-plan
[12] http://www.eera-set.eu/eera-joint-programmes-jps/smart-cities/
[13] http://ec.europa.eu/transparency/regdoc/rep/3/2012/ES/3-2012-4701-ES-F1-1.PDF

line gain for Europe: a significant improvement of citizens' quality of life, an increased competitiveness of Europe's industry and innovative SMEs together with a strong contribution to sustainability and the EU's 20/20/20 energy and climate targets".

The EIP-SCC consists of the High Level Group (supported by its Sherpa Group) who is responsible for the Strategic Implementation Plan and the Market Place[14] supported by the European Commission. Proposals of interest considered for this initiative total 370. They come in the form of Commitments from over 4.000 partners that have been engaged through 6 Action Clusters that meet regularly. These Action Clusters are:

- Business models, finance and procurement

- Citizen focus

- Integrated infrastructures & processes (including Open Data)

- Policy & Regulations/Integrated Planning

- Sustainable Districts and Built Environment

- Sustainable Urban Mobility

Benefits from being part of an Action Cluster come from having opportunities for learning, partnering, efficiency gains and new business insights and possibilities. These groups facilitate operational exchange between supply and demand side which is very interesting for detecting joint work possibilities.

Commitments are on a voluntary basis and therefore it must be clear that there is not any funding for developments or activities related this initiative.

4.4   SmartCities &Communities – SCC calls

Within its Horizon 2020 Work Programme for 2016-2017[15] the EC considered as one cross-cutting activity (focus area) the topic of smart and sustainable cities. It aims at bringing together cities, industry and citizens to demonstrate solutions and business models that can be scaled up and replicated, and that lead to measurable benefits in energy and resource efficiency, new markets and new jobs. The primary focus is creating the right enabling frameworks for large-scale innovation at urban level, including their business and governance models to allow a quick replication at scale.

The call comprises two distinct but mutually reinforcing parts:

- SCC1 that focuses on demonstrating sustainable, cost-effective and replicable district-scale solutions at the intersection of energy, transport enabled by ICT.

- SCC2-4 that focuses on providing evidence that re-naturing of cities through the deployment of innovative, locally adapted, systemic solutions – that are inspired and supported by nature

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[14] https://eu-smartcities.eu/
[15] http://ec.europa.eu/research/participants/data/ref/h2020/wp/2016_2017/main/h2020-wp1617-focus_en.pdf

– can be a cost-effective and economically viable way to make cities more sustainable, resilient, greener and healthier.

There is an overall indicative budget of 120 million of euros for 2016 and 111,5 million of euros for 2017.

At the same time and under the same Work Programme there are other calls that would fund Smart City projects or interventions as well. For instance under circular economy or Internet of Things in the case of cross cutting activities, and/or under other Work Programmes (Secure and Clean Energy, Mobility, etc.) as well.

Other options come from ERDF that has a special focus on sustainable urban development. At least 5% of the ERDF resources are set aside for this field through integrated actions managed by cities. For some countries and depending on their development this can represent an important funding opportunity.

The Urban Agenda agreed with the Pact of Amsterdam16 will also open a number of possibilities for cities. Twelve priority themes have been selected and partnerships are being established so that interventions can be thought more adequately.

4.5   European Fund for Strategic Investments (EFSI[17])

Rapid changes are requesting availability of financing for many projects. The European Fund for Strategic Investments (EFSI) is an initiative launched jointly by the EIB Group and the EC to help overcome the current investment gap by mobilising private financing for strategic investments. The goal is to unlock additional investment of at least EUR 315bn over a three year period.

The focus of this initiative is related to project related to strategic infrastructure (including digital, transport and energy), renewable energies, education & research and support of small businesses. According to last figures with EUR 20,4 bn approved by the EIB Group almost EUR 116 bn have been leveraged.

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[16] http://ec.europa.eu/regional_policy/sources/policy/themes/urban-development/agenda/pact-of-amsterdam.pdf
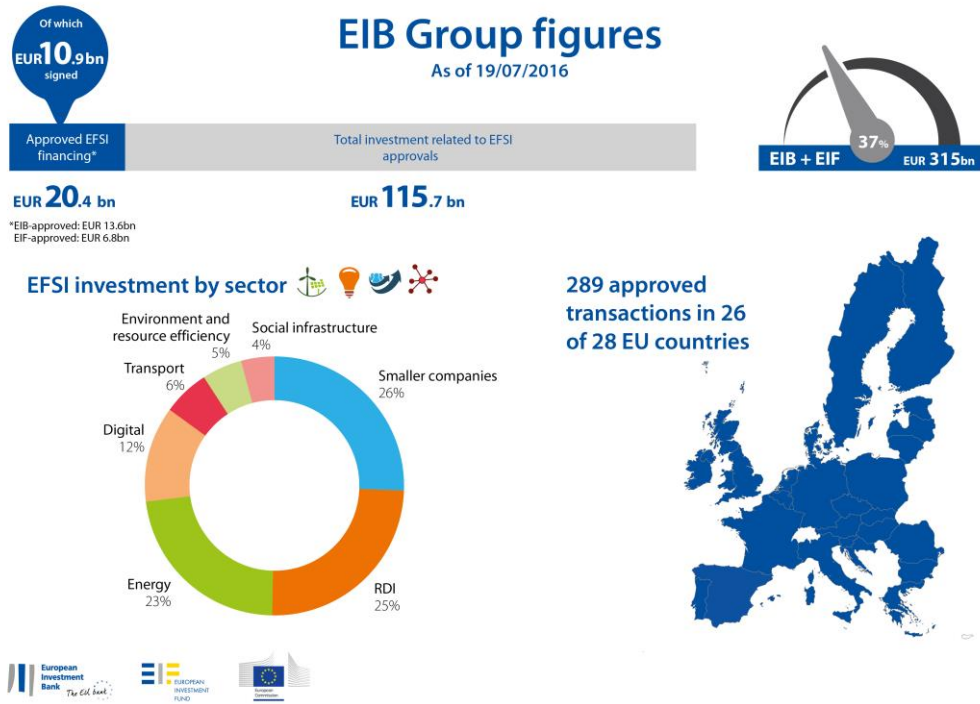[17] http://www.eib.org/efsi/index.htm

Figure 2: EIB Group figures[18] from their website.

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[18] Please see disclaimer related to this graph in http://www.eib.org/efsi/index.htm

5   Key factors for designing the Smart City

5.1   From Integrated planning to implementation

There are many guidelines and strategies that have been developed over the last few years aiming to support cities on developing integrated "smart city" plans. For example, FP7 projects STEEP[19] and STEP UP[20] worked on developing integrated strategies for energy planning in the context of smart cities. In any integrated planning strategy, it has to be stressed the need to consider the city as a complex system of processes, where the different elements of the city are connected and one intervention in one process of the city influences the rest of the processes. The collaboration of all stakeholders across the value chain (public administrations, technology experts, companies, end users, etc.), should also be well managed and coordinated, particularly considering that smart city concept includes a variety of areas such as energy, mobility and ICTs.

 The long-term temporal perspective, which requires strong political commitment, and the need for specific financial planning and economic instruments are also key factor for successful implementation of integrated planning.

In this section, and following the proposal from Espiga & Azkarate (2014), five keys for a successful planning and implementation of smart city projects are described, covering smart innovation & technology, smart structure, smart projects, smart financing architecture, and smart economy.
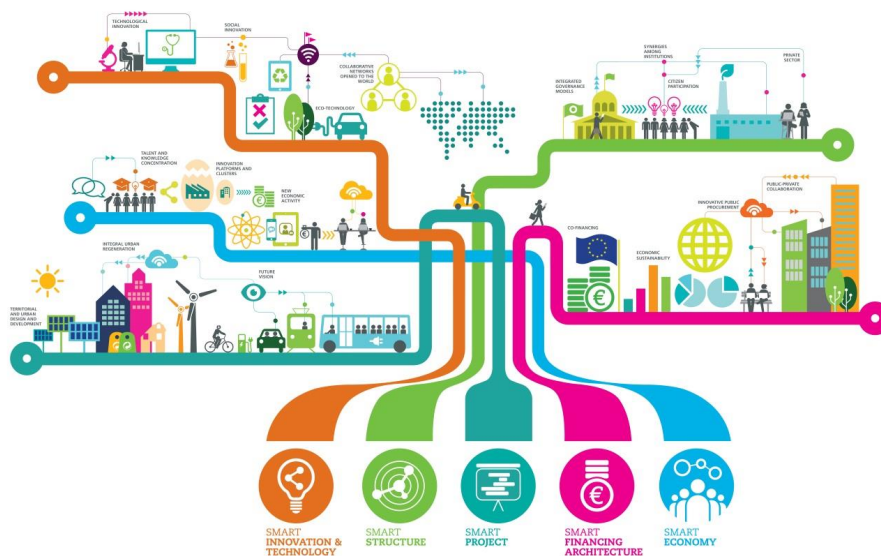

Figure 3: 5 keys to design smart cities [Espiga & Azkarate, 2014]

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[19] http://www.smartsteep.eu/
[20] http://www.stepupsmartcities.eu/

5.2   Smart Project

The Smart City proposes a wide, integrated focus where technology improves the efficiency of city operations, the quality of life of its citizens and the growth of the local economy. The final aim of is to achieve the "sustainable city", a city where economic, social and ecological components are harmoniously connected - the Smart City - considered the first stage in a necessary transition towards higher concepts. In response to the complexity and diversity of issues such as climate change, quality of life, inclusive economic growth, social cohesion, etc. impacting on all aspects related to life in the city (city planning and order, means of transport, safety, health, services, housing, etc.).

Commitment to the smart city makes sense as much as it serves a future project which will be turned into an opportunity for:

- Citizens, providing access to new services and solutions to facilitate and make our life in the city more comfortable, to move faster, to communicate and give us more safety.

- Companies, providing a platform to unfold a wide variety of products and services in fields such as: electric mobility, waste recovery, energy efficiency and smart energy management, data collection and treatment, mobile interactivity, etc. New business opportunities will be created in the fields of transport, industry, energy, new technologies, construction, new materials, etc.

- Public administration can render services more efficiently and at a lower cost, offering citizens new services together with communication options and social participation.

The city level is ideal to promote a sector of eco-technological city solutions converging private and public initiative, promoting territory development and urban rehabilitation pilot projects, and combining a smart city design with the sensible application of clean technologies.

5.3   Smart Innovation & Technology

Innovation is the only strategy ensuring long-term sustainability, responding to the challenges of socio-economic development at territory level and promoting a greener and more sustainable economy. This smart scenario is characterised by the need for innovation and technology. There is an opportunity space open to new ways of understanding the city and the territory and to influence them promoting real-scale pilot projects, demonstrating technologies oriented to achieve low carbon urban environments.

Technology is not only a problem solving tool, but also plays a leading role as a lever to create new businesses, facilitating the generation of a renovated industry based on knowledge and innovation. However, this business creation role requires hybridism of technology with other knowledge and innovation classes, making collaboration among multiple players, essential.

Smart cities need co-operation between industry, government agencies and citizens to achieve specific local objectives, to generate the necessary relational density and interaction, which allow

the creation of new creative economies and spaces where technology innovation is also social innovation.

Once the minimum knowledge and technological infrastructure is in place, the city and its territory should also be able to use its own domestic market as experimental laboratory to test different business models, supporting the development of new advanced solutions, products and services by industry. The existence of a domestic market with an innovative nature regarding procurement habits is a key factor to developing a local innovative industry, starting from the administration itself as public purchaser. Thus the importance of promoting and articulating innovative public procurement processes in strategic territorial and urban development projects.

5.4   Smart Structure (Management & Governance)

Managing this transformation requires a governance scheme to replace the one-way policy-making - from top to bottom - by methods of governance which are inclusive and open to the co-operation of different players. The involvement of citizens and interested parties (companies, universities, R&D centres, institutions and public bodies…) is critical for the success of the Smart City and, in this context, governance could be interpreted as a responsibility shared by public administration, the private sector and citizens in dealing with city problems.

To pursue a city project with the scope and approach proposed in this document requires a smart structure of leadership, promotion and management. Leadership at local level is increasingly relevant for the growth of open, collaborative territorial innovation ecosystems which facilitate, promote and boost physical and knowledge infrastructure which make the territory smart, effective and attractive and differentiate the city as the best scenario for investment and performance of innovative economic activities.

Compartmental structures which are commonplace in traditional local administrations encounter serious difficulties to address strategies involving integral, participative intervention in different management scopes (city planning, transport, the environment, economic promotion, etc.) and/or implying the synchronisation of activities among administrations at different levels such as alignment between urban development and regional specialisation plans promoted by Europe. A smart focus develops integrated governance models facilitating co-ordination at interdepartmental and inter-institutional level (multi-governance).

Different structures to promote and manage strategic smart city projects can be proposed. In some cases, this role can be delegated to development agencies which are separate from the municipal structure, with more or less capacity to act and provide resources. In any event, a smooth relationship and co-ordinated action with municipal departments is crucial for good performance. In other cases, local public leadership has created clusters and innovation platforms to boost the local project, while promoting the development of new solutions and products by companies. A tool which is growing on importance is incubators and accelerators, as means to facilitate initiative and new business creation.

5.5   *Smart Financing Architecture*

The transformation of a city into a Smart City requires significant financing. Although part of the project can be financed through traditional procurement mechanisms, budget restrictions and the level of investment required force cities to look for new supplementary means of financing.

Europe is a positive context. In 2012, the European Commission (EC) launched a new initiative, the European Innovation Partnerships on Smart City and Communities. Its main purpose is to share European resources for the development of Smart Cities with the aim of supporting urban demo projects related to energy, transport and ICTs. Europe will promote large-scale lighthouse demo projects with integrated urban solutions (energy, transport, ICTs...) as a lever to progress towards the 20/20/20 sustainability targets. Nevertheless, this is a limited mechanism and cities will be required to find partnerships and co-financing structures adapted to the complexity of projects.

Procurement through the Private-Public Collaboration (PPC) formula is particularly interesting for Smart City projects as it enables risk and benefit sharing. PPC is a concept covering different types of co-operation between the Public and the Private Sectors in relation to infrastructure and service hiring to maintain activity and promote innovation in technology companies, while improving and developing public services to guarantee budget sustainability. The application scope of PPC agreements is very wide as they are a tool for ensuring performance and exploitation of projects and ensures a competitive economic return for the private sector involved. However, the advantages of a PPC procurement formula go beyond the budget scope, as they favour innovation and enable accelerating the development of new higher quality services, generating greater social impact. In most cases, PPC contracts require very high resources implying in turn the need for outsourced financing sources, other than funding from the project promoters. Among the different sources of public financing, the European Union (EU) -as main booster of Smart City projects- offers major opportunities to cities. Examples are the European Regional Development Fund (ERDF), which requires at least 5% of the funds are allocated to integrated activities related to sustainable city development (16,000 million Euro), to be potentially allocated through the . Integrated Territorial Investment (ITI) tool. Integrated Territorial Investment (ITI) is a tool which enables Member States to implement operative Programmes transversally and seek financing from several priority axes of one or more operational Programmes, to guarantee the implementation of an integrated strategy in a territory. ITI is a tool encouraging integrated use of EU funds (ERDF, ESF, CF) to achieve better results with the same amount of public investment while ensuring the involvement of local players and offering greater safety in relation to financing for promoters.

As well as receiving funding for the abovementioned city developments, Smart City projects may also benefit from other funds from the EU such as the Framework Programme for Research and Innovation H2020, the Business Competitiveness Programme COSME, Rural Development funds EAFRD or the LIFE programme for the environment and climate change.

On the other hand, there are financial instruments acting as catalysts for public and private resources to achieve a multiplying effect of investment in high socio-economic value projects, which are sustainable from a financial point of view, but not attractive to private funds given their risk profile or maturity term. It is worth highlighting the importance of the European Commission initiative, jointly developed with the European Investment Bank and the Council of Europe

Development Bank (CEB), JESSICA (Joint European Support for Sustainable Investment in City Areas) which finances integrated and sustainable projects for urban development. Other relevant instruments are: RSFF (Risk Sharing Finance Facility) or ELENA (European Local ENergy Assistance).

5.6   *Smart Economy*

Cities are poles of talent and knowledge concentration where the future of economic growth will take place. The dynamics of wealth creation cannot be separated from innovation and talent concentration and takes place first and foremost in the metropolis which plays a crucial role in the transition towards knowledge economy, as they host an increasingly larger part of the better qualified, more creative and entrepreneurial population.

Creative economy tends to become territorial, to select suitable spaces for networking and exchange. In particular, the relational density that characterizes the urban environment makes it an ideal place for the development of this new creativity and knowledge economy.

Metropolitan expansion questions the traditional city concept removing its limits and absorbing areas around the city to expand into large city areas, cross-linking multiple functional areas (housing, activities, commerce, leisure, etc.) and with activities branching out in territories. The economic impacts of technological changes on a city and its territory have to be carefully studied and planned, to prevent transitions to smart cities that do not translate into resource and energy efficiency.

As an example, on the use of ICTs for efficient mobility will have positive economic activity and direct job creation on the ICT solution development and implementation. There will be also indirect impacts, for example socioeconomic effects one step behind in the supply chain, such as job creation (or destruction) on service suppliers, contractors, etc. The induced impacts that smart city implementations would have on the overall city socioeconomic performance, for example on citizens health or wellbeing (which could also translate on socioeconomic benefits), or stimulating economic growth are also important to take into account, although more difficult to measure and calculate (combination of input-output modelling with supply chain analysis would be needed for this).

6   Monitoring Smart City Actions

Monitoring the progress and performance of city actions, and their impact on the targeted environmental and socioeconomic issues, is a key factor to allow proper evaluation with an impartial perspective.

The city monitoring has to select a series of selected indicators, which should be regularly and should serve for communication of results to the different stakeholders and aiding on decision making, and for general dissemination to citizens encouraging their participation on the smart city processes.

Several initiatives have provided monitoring frameworks over the years, both for specific projects, for sectorial initiatives, or for whole cities.   For example, CIVITAS21 initiative has developed an indicator framework for sustainable urban mobility), CONCERTO22 Initiative developed detailed indicators for energy monitoring, and the Green Digital Charter23 have developed specific indicators for ICTs.

The following sections describe international frameworks and initiatives for smart city monitoring and benchmarking, and two of the most relevant initiatives related to smart city monitoring at European level.

6.1   International monitoring and benchmarking initiatives

The CEN-CENELEC Smart Cities and Communities Coordination Group, compiles international initiatives in its final report '*SSCC-CG Final report Smart and Sustainable Cities and Communities Coordination Group'* (January 2015). This international work includes standardization efforts for defining indicators and monitoring, as well as other initiatives proposing indicators for monitoring and benchmarking, as well as certification schemes.

Regarding international standards, the International Standard ISO 37120 *"Sustainable development of communities -- Indicators for city services and quality of life"* is of particular interest as it suggests a variety of indicators, subdivided within 17 areas (economy, education, Energy, Environment, Finance, Fire and emergency response, Governance, Health, Recreation, Safety, Shelter, Solid waste, Telecommunications and innovation, Transportation, Urban planning, Wastewater, Water and sanitation), aiming for allowing city monitoring and benchmarking in relation to other cities. Data is available at the portal http://open.dataforcities.org/

Other remarkable initiatives include the European Energy Award (EEA), created more than 20 years ago and implemented in more than 1200 cities in Europe, as well as adopted by the Covenant

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[21] www.civitas.eu

[22] http://www.concertoplus.eu/

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

of mayors as a "preferred tool" to implement and follow their Strategy Energy Action Plans (SEAP). EEA covers 6 areas, mobility, regional planning and development, communal buildings and facilities, supply and disposal, external communication and cooperation, internal organization, and regularly publishes a benchmark of cities according to its evaluation method. http://www.european-energy-award.org/

Existing schemes for neighbourhood certification, such as BREEAM Communities[24] or LEED for Neighbourhoods[25] , can also be of interest particularly regarding environmental evaluation.

6.2   *Smart Cities Information System (SCIS)*

The Smart Cities Information System (SCIS), http://smartcities-infosystem.eu/ , launched with support from the European Commission, encompasses data collected from ongoing and future projects under the CONCERTO initiative and Smart Cities calls in Horizon 2020.

SCIS brings together project developers, cities, institutions, industry and experts from across Europe to exchange data, experience and know-how and to collaborate on the creation of smart cities and an energy-efficient urban environment.

With a focus on smart cities, energy efficiency, transport and mobility, and ICT, SCIS showcases solutions in the fields of sustainable building and district development, renewable energy sources for cities, energy efficiency and low-carbon technology applications.

The Smart Cities Information System:

- Collects valuable data and expertise from smart cities demonstration projects and sites and channels them into a comprehensive database to promote replication of projects;
- Presents a thematic overview of projects with a focus on technologies and expertise in fields such as energy-efficient buildings, districts and cities, sustainable energy, geothermal communities, sustainable urban planning, low-carbon cities and zero-energy neighbourhoods;
- Offers an outline of renewable energy sources and low-carbon technologies and examples of their use;
- Establishes best practice by analysing and visualising project results, enabling project developers and cities to learn and replicate;
- Identifies barriers and points out lessons learnt, with the aim of finding better solutions for technology implementation and replication, and policy development;
- Provides recommendations to policy makers on support and policy actions needed to address market gaps.

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[24] http://www.breeam.com/communitiesmanual/
[25] http://www.usgbc.org/articles/gettingknow-leed-neighborhood-development

6.3   *CityKeys Project*

The CITYkeys project is funded by EU H2020 programme, with the aim to develop and validate, with the aid of cities, key performance indicators and data collection procedures for the common and transparent monitoring as well as the comparability of smart city solutions across European cities.

The CITYkeys evaluation framework evaluates the impact of a smart city project comparing before and after situations or comparing expected impact with a reference situation. CITYKeys framework includes indicator at city level, which encompasses 73 city indicators, divided in the following areas:

People
1. Encouraging a healthy lifestyle
2. Cybersecurity
3. Data privacy
4. Digital literacy
5. Ground floor usage

Planet
1. Domestic material consumption
2. Brownfield use
3. Local food production
4. Urban heat island

Prosperity
1. Share of certified companies
2. Innovation hubs in the city
3. Open data

Governance
1. Smart city policy

The idea of CITYKeys is that cities monitor the implementation of projects and their impact on the city level through the indicator framework.

6.4   *From monitoring to impact evaluation*

The monitoring activities through a set of indicators should allow cities to calculate the real impact of smart city implementation, in environmental and socioeconomic terms. While is expected that smart technologies will help cities to increase efficiency and reduce resource use and labour in various sectors, there will inevitability be some sectors of the economy that will experience a de-growth , and some professions that are set to disappear. Monitoring and understanding these effects would provide opportunities to focus on investing these liberated resources and efforts on making the transition towards more resilient, less resource intensive and zero energy cities.

As an example, the use of ICT to improve mobility within the city, to increase energy efficiency in buildings or in public lighting, and many other city activities and services has a clear direct impact in relation to economic activity and direct job creation for the implementation of the ICT services and its management. This good practices of ICT implementation will also have associated direct energy savings and reduction of environmental impact on those processes. The direct resources used by the ICT implementation itself, should be consistently lower than the associated energy savings.

There will be also indirect impacts associated to these ICT implementations, for example socioeconomic effects one step behind in the supply chain, such as job creation (or destruction) on service suppliers, contractors, etc. Other indirect effects associated to better services can be for example the impact on citizen's health or wellbeing, which should also be possible to evaluate and measure. A combination of input-output modelling with supply chain analysis will allow calculation of some of these indirect impacts. For example in an input-output analysis , focused on indirect energy use for the city of Beijing (Zhang et al, 2014), it is shown how shifts on patterns of consumption between one to other economic sector, could result in increasing overall resource use even if direct resource use reduction has taken place.

A last factor to be studied is the impacts that the ICT implementations could have on the overall city performance, not directly or indirectly related to the ICT actions but as the result of the overall improvement of the city socioeconomic performance. This is indeed much more difficult to measure and to predict, as it will depend on multitude of factors that relate the city to its regional, national and international context, and how we predict economic progress and development.

Performing this overall analysis, and taking it as a basis to select and prioritize not only ICT deployment strategies and investments, but also focusing on the energy and resource efficiency sectors, should be an aspect to consider by cities. Efforts by the research community should be put in this area of methodological analysis and development of tools to facilitate decision making, taking into account all social actors in the process.

7   CLINES supporting the Smart City

Embedded systems are systems based on information and communication technologies that reside in and control a device, product or system, i.e., it is embedded in a larger system. These are key technological building blocks for numerous innovative products and solutions in the area of smart cities. Mobile sensors, regulation and control services will be the basis for innovative applications in all areas of our lives [Thiel et al, 2014]. Modern traffic control in a city could be an example of this where cars and trucks are monitored either by mobile sensors in the vehicles or on stationary locations, the sensor data communicated, analysed, and used in controlling traffic lights and information to drivers.

Various regions around the world are already developing action plans to push economic development by enabling innovative technology partnerships within the collaborative area of embedded systems for smart cities. (De Colvenaer et al, 2016).While there is no doubt ICT will be a key factor on the development of a new economy based on innovation, creativity and personal development, how this translate throughout the economy and the city activity in terms of productivity, efficiency and resource use is still to be studied.

While ICTs and embedded systems will definitely help cities to become resource efficient and improve quality of life, both cities and citizens have to assume that most current jobs are likely to adapt, change, or disappear, and give a way to new knowledge and creativity based jobs. For example, retail and wholesale, which makes more than 15% of jobs in some large cities (PwC, 2013), could be a vulnerable sector for unemployment in cities with increasingly more self-service cashiers & online shopping. Ensuring that nobody is leaving aside this transition because of lack of capacity to adequate or innovate is a real challenge for cities and citizens. Companies should be also at the centre of this transition towards the Smart, Digitized Cities of tomorrow, based on Embedded Systems Technology, and cooperation and interaction between companies and other stakeholders through cluster networks is a key element for success on this goal.

CLINES project has developed a Joint Action Plan, detailing a strategy and actions necessary to promote the development of the involved regions and clusters. It pinpoints what it will take for the involved partners to push economic development by enabling innovative technology partnerships within the collaborative area of embedded systems for smart cities.

The Joint Action Plan was defined among all the stakeholders to ensure that it meets with the expectations of the different stakeholders, that it is relevant to them, founded in their strongholds, and created commitments of the stakeholders leading to the expected economic development in the involved regions.

The project through this deliverable intends to leave an easy guide to understand better the concept. Small and medium cities are not running so fast as big cities in the implementation of this strategy. And a little help for understanding the basics has been seen as something of interest. A presentation in ppt addressing key facts will also complement this deliverable to give a quick view on this topic to city officials.

At the same time the project has also considered the preparation and presentation of a paper to the Smart City Expo of Barcelona where the developments of the project and the idea of Smart City could be presented. We are including as annex in this deliverable the paper that was presented as a working document so that can be used by other partners to present it to other possible events.

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8   Annex 1:

WORKING PAPER[26] - TECNALIA , JULY 2016
ICTs, EMBEDDED SYSTEMS AND THE FUTURE OF CITIES
Patxi Hernandez, Eneko Arrizabalaga

ABSTRACT:

The global "smart" trend seeks increasing connectivity, data availability and processing as a basis to improve all kinds of products or services, and it is expected this will increase global efficiency and life quality while using less resources. The application of the "smart" concept to cities needs however to deal with the additional immense technical and socioeconomic complexity of the social, environmental, and economic changes that will occur and will have unpredicted impacts on jobs or resource use. This working paper presents a conceptual discussion on issues that arise from the implementation of ICTs into smart cities, and suggests the need for supply chain analysis including direct, indirect and induced effects of measures, which would allow predicting or estimating the impacts on the labour market and on resource efficiency. This analysis could serve as an input for decision making particularly in the field of energy planning, as we try to move to less resource intensive, zero energy cities.

1 SMART CITIES CONCEPT

A vision for Smart Cities is that they should integrate very different aspects related to the environment, resources, infrastructures, services, social and policy behaviour, etc. to progress in social, economic and environmental sustainability using technology (ICTs) resources to improve efficiency of city operations, the quality of life of citizens and local economy growth.

As the European Society for Innovation in Cities and Smart Communities (2013) expresses in its strategic implementation plan, the implementation of this vision implies identifying, choosing and integrating the best solutions and technologies with sound and independent criteria, putting them at the service of a smart city project. This also requires a second relevance factor associated with the technology factor: the economic and business model. We are about to unfold a wide variety of products and services with a strong technological base. The speed and success of this unfolding will depend to a great extent on suitability and social acceptance of economic and business models for launching to market.

The three-fold technology-market-business model is the base activity core to unfold technology-based innovations. Technology is not only a problem solving tool, but also plays a leading role as a lever to create new businesses, facilitating the generation of a renovated industry based on knowledge and innovation. However, this business creation role requires hybridism of technology with other knowledge and innovation classes, making collaboration among multiple players, essential [Espiga & Azkarate, 2014].

The vision of smart city projects as catalysts for innovation & technology and integrating socio-economic and governance challenges is taking shape in various forms , an example of which is shown in Figure 1. In this approach the final aim is to achieve the "sustainable city", a city where economic, social and ecological components are harmoniously connected. In response to the complexity and diversity of issues such as climate change, quality of life, inclusive economic growth, social cohesion, etc. impacting on all aspects

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[26] You can use this working paper requiring previous permission to the authors.

related to life in the city (city planning and order, means of transport, safety, health, services, housing, etc.). The Smart City proposes a wide, integrated focus where technology improves the efficiency of the city operations, the quality of life of its citizens and the local economy growth.
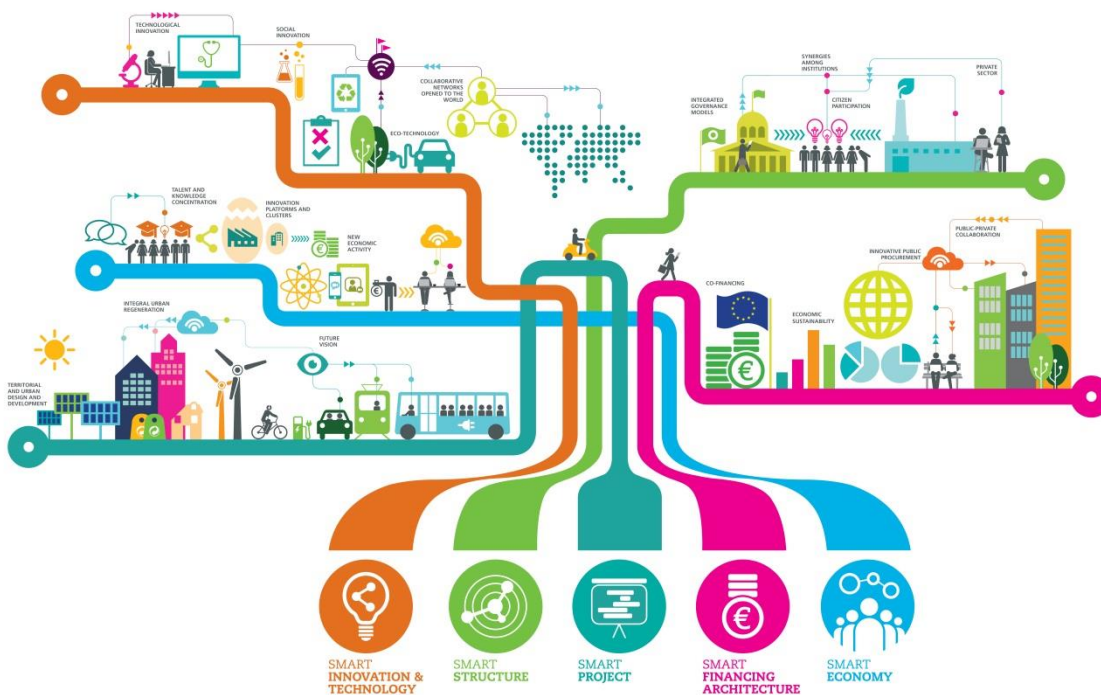

Figure 1: 5 keys to design smart cities [Espiga & Azkarate, 2014]

2. ICT & EMBEDDED SYSTEMS DRIVING EFFICIENCY IN CITIES

Embedded systems are systems based on information and communication technologies that reside in and control a device, product or system, i.e., it is embedded in a larger system. These are key technological building blocks for numerous innovative products and solutions in the area of smart cities. Mobile sensors, regulation and control services will be the basis for innovative applications in all areas of our lives [Thiel et al, 2014]. Modern traffic control in a city could be an example of this where cars and trucks are monitored either by mobile sensors in the vehicles or on stationary locations, the sensor data communicated, analyzed, and used in controlling traffic lights and information to drivers. Various regions around the world are already developing action plans to push economic development by enabling innovative technology partnerships within the collaborative area of embedded systems for smart cities. (De Colvenaer et al, 2016).While there is no doubt ICT will be a key factor on the development of a new economy based on innovation, creativity and personal development, how this translate throughout the economy and the city activity in terms of productivity, efficiency and resource use is still to be studied.

3. UNDERSTANDING CITY CHANGES

Technological shifts can result in large shifts in social structures (World Economic Forum,2015), and in how individuals both contribute to society and make a living within it. While these ICT driven changes can have egalitarian and emancipatory potential, this would only occur if these are managed correctly. A smart city

has to make sure that citizens are able to jump into the knowledge economy, that their own the transition processes and are the ones setting the pace of change.

While ICTs and embedded systems will definitely help cities to become resource efficient and improve quality of life, both cities and citizens have to assume that most current jobs are likely to adapt, change, or disappear, and give a way to new knowledge and creativity based jobs. For example , retail and wholesale, which makes more than 15% of jobs in some large cities (PwC, 2013), could be a vulnerable sector for unemployment in cities with increasingly more self-service cashiers & online shopping. Ensuring that nobody is leaving aside this transition because of lack of capacity to adequate or innovate is a real challenge for cities and citizens.

Following this observation about the future of jobs in smart cities, the next logical question can be in relation to resource use and efficiency. As discussed by Berkhout & Hertin (2004), in terms of resources and environment the efficiency triggered by ICTs should compensate impacts of the production and use of ICTs (resource use and pollution related to the production of infrastructure and devices, electricity consumption of hardware, electronic waste disposal) . But there is another level of structural, societal, and induced impacts which are related on how ICTs affect our lives, whose impact are not so well studied, and can refer to the actual embedded impact of services and products we used.

Few questions can be made in this regard:

Is the improved quality of life we expect in smart cities leading to additional product and services consumption, and will it produce a "rebound effect" in resource use?

Will the increased efficiency, and the collaborative and sharing economy triggered by ICTs be capable of reducing overall resource use in cities?

Should cities in a world with ever growing population and ever depleting resources start planning their actions so the efficiency triggered by ICT through the different processes really translates in a reduction of resource use?

This issue is worth exploring in a systematic way, by analyzing types of activities and sectors which are likely to change most, understanding the impact of those changes in terms of jobs, resource and energy use, and prioritizing technologies and measures in the field of resource and energy efficiency that will help cities in this transition.

Cities are likely to need less cashiers or drivers in the future, and it is certain that more ICT and knowledge based jobs will be created… but a bigger picture should also take into account how overall economic, social and environmental aspects should be affected. In terms of efficiency, the evaluation of the energy and resources, which is not frequently evaluated on the same level as ICT implementation, is of strategic importance.

4. ANALYSIS OF THE IMPACT OF THE TRANSITION TO SMART CITIES AS AN INPUT TO ENERGY PLANNING

While ICTs will help smart cities to increase efficiency and reduce resource use and labor in various sectors, there will inevitability be some sectors of the economy that will experience a de-growth , and some professions that are set to disappear. There is an opportunity to focus on investing these liberated resources and efforts on making the transition towards more resilient, less resource intensive and zero energy cities. But for this transition , there is a need to take informed decisions regarding resource an energy planning. This working paper claims for a need of a supply chain analysis and a study of the impacts that each technological change would have on a city, to prevent transitions to smart cities that do not translate into resource and energy efficiency.

As an example, the use of ICT to improve mobility within the city, to increase energy efficiency in buildings or in public lighting, and many other city activities and services has a **clear direct impact** in relation to economic activity and direct job creation for the implementation of the ICT services and its management.

This good practices of ICT implementation will also have associated direct energy savings and reduction of environmental impact on those processes. The direct resources used by the ICT implementation itself, should be consistently lower than the associated energy savings.

There will be also **indirect impacts** associated to these ICT implementations, for example socioeconomic effects one step behind in the supply chain, such as job creation (or destruction) on service suppliers, contractors, etc. Other indirect effects associated to better services can be for example the impact on citizens health or wellbeing, which should also be possible to evaluate and measure. A combination of input-output modelling with supply chain analysis will allow calculation of some of these indirect impacts. For example in an input-output analysis , focused on indirect energy use for the city of Beijing (Zhang et al, 2014), it is shown how shifts on patterns of consumption between one to other economic sector, could result in increasing overall resource use even if direct resource use reduction has taken place.

A last factor to be studied is the impacts that the ICT implementations could have on the overall city performance, not directly or indirectly related to the ICT actions but as the result of the overall improvement of the city socioeconomic performance. This is indeed much more difficult to measure and to predict, as it will depend on multitude of factors that relate the city to its regional, national and international context, and how we predict economic progress and development.

Performing this overall analysis, and taking it as a basis to select and prioritize not only ICT deployment strategies and investments, but also focusing on the energy and resource efficiency sectors, should be an aspect to consider by cities. Efforts by the research community should be put in this area of methodological analysis and development of tools to facilitate decision making, taking into account all social actors in the process.

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9   Annex 2: Smart Cities presentation

CLINES

SmartCities

More than a buzz word?
The strategy behind this approach

| 22-08-2016 | Cluster-based innovation through Embedded Systems technology | 1 |

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CLINES

Cities are
places where
problems
emerge

But also
where
solutions
can be
implemented

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| 22-08-2016 | Cluster-based innovation through Embedded Systems technology | 2 |

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CLINES

Population:
- 70% lives in cities.
- Demographic increase of urban areas in next years up to 80% of the population.
- Big changes in the demography piramid.

Economy:
- Around 75% of European GDP generated in cities.
- Engines of wealth.

Environment:
- 60-65% of GHG emissions are generated by cities.
- Almost 80% if all services around cities are taken into account.
- Consumption of 75-80% of primary energy

Importance of Cities in Europe

22-08-2016 | Cluster-based innovation through Embedded Systems technology | 3

CLINES

The Challenge: Climate Change Paris Agreement → **Energy transition is a need for a low carbon economy**

22-08-2016 | Cluster-based innovation through Embedded Systems technology | 4

CLINES

What do we need for a low carbon economy?
Shift towards:

- More renewable sources
- More efficient management
- Reduction of consumption

SUSTAINABILITY

Cities are key players of this process. Big part of the solution.

CLINES

However they are Complex systems that faced many barriers and problems:

- Lack of human resources "updated technologically"
- Systems of systems where interactions are difficult to measure
- What are the impacts and effects of the decisions?
- Budget cuts
- Breaking silos for an integrated planning
- Regulatory framework
- Multilevel governance
- Definition of cities' business models
- Boundaries of interventions. The city versus its metropolitan area
- Etc. ...

22-08-2016   Cluster-based innovation through Embedded Systems technology   7

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How can they work? Vision? SUSTAINABILITY

Environmental — Ability to keep environmental quality and natural resource extraction rate within certain rates

Economic — Ability to support certain level of economic production avoiding migrations

Social — Ability to function at a social well-being and harmony including eradication of proverty, education, etc.

22-08-2016   Cluster-based innovation through Embedded Systems technology   8

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What are the main pillars in the SmartCity strategy?

5 keys to design smart cities [Espiga & Azkarate, 2014]

22-08-2016   Cluster-based Innovation through Embedded Systems technology   11

Smart Project:

Commitment to the smart city makes sense as much as it serves a future project which will be turned into an opportunity for:

- Citizens with better access to more services at reasonable cost and increasing their quality of life

- Companies so that they can unfold a wide variety of products and services creating new business opportunities

- Public administration that will be able to render public services more efficiently (more services at lower cost)

22-08-2016   Cluster-based Innovation through Embedded Systems technology   12

CLINES

Smart Innovation & Technology:

Opportunity space open to new ways of understanding the city and its territory:

- Technology as problem solving tool but also as lever to create business opportunities

- Innovation to keep being sustainable.

- Cities are living labs to test innovations and technologies. But these can only be afford if benefits are clear.

22-08-2016   Cluster-based Innovation through Embedded Systems technology   13

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 320043

CLINES

Smart Structure (Management & Governance):

Replacement of top-down policy making by more inclusive and open schemes:

- Shared responsibility in the governance specially with citizens.

- However, not only citizen-centric, but also taking into account other agents (companies, universities, R&D centers, other institutions and public bodies …)

- Requires a strong leadership and internal coordination of municipal departments

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Smart financing architecture:

Funding through:

- Own resources, prioritization based on expected impacts.

- Building Public Private Partnerships. Attractiveness of business models and risk sharing schemes can lever additional private investment.

- Help private companies in their investments. The city can be a catalyst

- Use financial resources provided by EC, National Governments, etc. Many instruments.
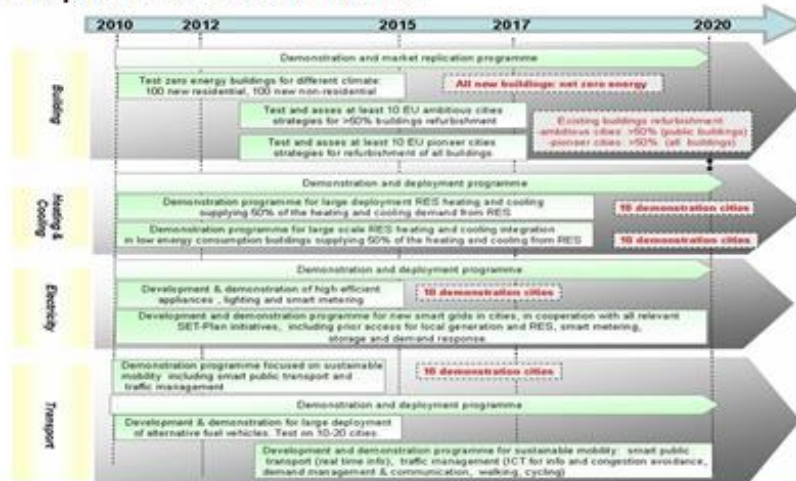
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Smart economy:

- Exploit cities as poles of talent and knowledge

- Generators of GDP but also generators of many intangible assets: collective intelligence, creativity, networking, etc.

- Not only direct and indirect effects in the economy, but also induced effects.

- Fostering economy development instruments such as clusters, incentives for investments and innovation, etc.

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CLINES

Find references – good practices:

But develop your own strategy as city

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CLINES

Contribution of CLINES Project to SmartCity Strategy:

- ICT is a transversal tool for achieving efficiency in the management of energy, mobility, etc. Embedded systems play and will play in the near future a mayor role in capturing data and providing control and monitoring over different devices and systems. Therefore the approach of CLINES project is focused in main elements.

- Showrooms in the project provide references and good practices that cities can use as reference.

- Innovation, hand by hand, cooperating between cities and local clusters, specially in the field of embedded systems will guarantee the development of systems that can be easily integrated and answer the evolving needs. This will lead to a technology development as well with direct impact in the local economy.

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CLINES

Contribution of CLINES Project to SmartCity Strategy:

- Urban and Regional clustering processes will help in networking to provide in a complementary way the whole value chain in the sector. This is an advantage for the costumer, the city, but it is also an advantage for suppliers that can work out joint strategies not only for the market but also for developing new products and services.

- This is an important element for achieving an economic sustainability in cities and therefore it should be integrated in the overall strategy.

- The project provides Joint Action Plans (JAP) as an action strategy outlining the future development of involved regions and cluster organizations. The focus being in enabling innovative research and technology partnerships in Embedded Systems for Smart Cities (ESSC).

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Thanks