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Delegations will find attached Commission document C(2012) 4701 final.

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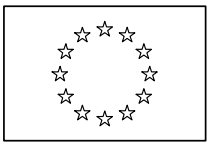

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COMMUNICATION FROM THE COMMISSION

SMART CITIES AND COMMUNITIES -
EUROPEAN INNOVATION PARTNERSHIP

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1. INTRODUCTION

With Europe 2020, a comprehensive strategy has been put forward to foster smart, inclusive and sustainable growth in Europe and to provide a framework for the European Union to emerge strengthened from the current financial and economic crisis. Innovation has been placed at the heart of the 2020 strategy as Europe's competitiveness and capacity to create new jobs depends on driving innovation in products and services. It is also the best means of successfully tackling major societal challenges, such as climate change and energy efficiency.

The Innovation Union announced European Innovation Partnerships (EIPs) which are designed to mobilise actors across the innovation cycle and across sectors around an overarching target in order to speed up innovative solutions to societal challenges, including major energy and transport challenges in cities and communities.

Smart urban technologies can provide an important contribution to the sustainable development of European cities. 68% of the EU population lives in urban areas, a proportion that is growing as the urbanisation trend continues in Europe[1] and worldwide[2].

The Smart Cities and Communities EIP (SCC) is a partnership across the areas of **energy, transport and information and communication** with the objective to catalyse progress in areas where energy production, distribution and use; mobility and transport; and information and communication technologies (ICT) are intimately linked and offer new interdisciplinary opportunities to improve services while reducing energy and resource consumption and greenhouse gas (GHG) and other polluting emissions (Figure 1). It is the logical next step 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[3]. SCC focuses on industry led innovation as a key driver to achieve economic and social change in urban areas and promotes actions across the innovation cycle and across different sectors. It will support existing and future EU initiatives for urban areas in the field of environment (i.e. resource efficiency, water, waste, pollution, green infrastructures) and climate policies.

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1 Eurostat (2011) Regional yearbook 2011: European cities. Urban areas are those of over 10 000 inhabitants.

2 UN Habitat (2011) State of the World's Cities 2010/2011: Bridging the urban divide

3 SET Plan Smart Cities and Communities Initiative

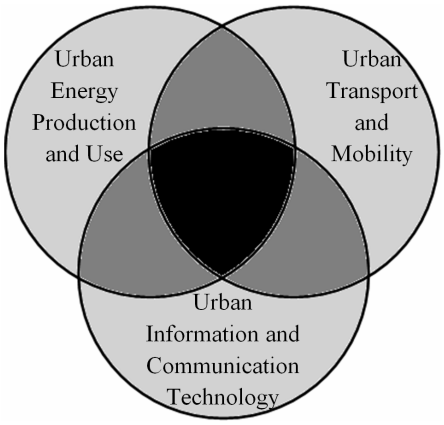

Figure 1. The SCC focusses on the intersection between energy, transport and ICT

The EU has developed a shared European vision of sustainable urban and territorial development. European cities should be places of advanced social progress and environmental regeneration, as well as places of attraction and engines of economic growth based on a holistic integrated approach in which all aspects of sustainability are taken into account.[4] The SCC should make a key contribution to this broader European policy agenda.

2. CONVERGENCE OF ENERGY, TRANSPORT AND ICT IN THE URBAN CONTEXT

Cities across Europe are forerunners in the transition towards a low carbon and resource efficient economy. They are already planning and acting for a more sustainable future characterised by investments in innovative, integrated technologies and services such as buildings, heating/cooling, mobility, lighting, broadband communications and other utilities. Several European cities have established programmes integrating the energy, transport and ICT sectors in order to deliver more efficient services for their inhabitants.

However these developments will not take place over night. For instance, in Europe new buildings represent only about 1% of the housing stock annually and less than 10% of road vehicle stock is newly registered each year[5], which means that introducing new technologies in existing cities will take time. Europe has scarce resources for experimentation and is therefore compelled to find and share the most cost-effective, low carbon and sustainable paths to realise smarter cities. This means that existing infrastructures must be refreshed and deliver multiple uses whenever possible. At the same time, technologies that are available today could find themselves surpassed and displaced in the next ten years. They should evolve to cope with new market demand. Furthermore, solutions need to be shown to be resilient, but also adaptable enough to capitalise on new breakthroughs and innovations and not introduce new barriers to market entry such as vendor lock-in or non-interoperable protocols and rules[6].

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4 Cities of Tomorrow – Challenges, visions, ways forward", European Commission (2011)

5 Eurostat (2011) Transport data

6 New market entrants could be organisations that have not traditionally participated in the provision of energy and transport services, such as telecommunications or ICT companies, or small and innovative players in existing markets.

Interoperability is a clear prerequisite for smart technologies. Further, relevant data has to be made widely available to facilitate the development and uptake of novel applications that have the potential to connect and respond in real-time to citizen's needs and preferences.

European suppliers of components, systems and services for smart urban applications must be positioned to address these challenges. Consequently their role will be increasingly important. Many of the component technologies that can deliver intelligent and resource-efficient mobility and energy production and use have already been developed. Now industry players from different sectors need to jointly develop and apply solutions that meet, for example, the demand for energy efficiency, alternative fuels and ICT in urban energy efficient applications.

At the same time, risks related to the scale-up and integration of these solutions remain. They originate from and are related to regulatory uncertainties, risk averseness of public procurement concerning innovative solutions, the current absence of standards and the immature market for truly integrated energy, transport and ICT solutions, among other things. Lead times for the commercialisation of these solutions need to be substantially shortened and synergies with existing infrastructures must be fully utilised whenever possible to minimise up-front investments and to facilitate procurement of innovations. The responses to the European Commission's public consultation on Smart Cities and Communities Initiative of the SET Plan confirmed the importance of these issues[7].

SCC will help to mitigate these risks through actions that demonstrate and propagate cost-effective technological and innovative non-technological solutions that are on the verge of commercialisation.

Some businesses are restructuring their operations, moving away from a single-sector approach by offering comprehensive and integrated system solutions, covering a range of public services such as energy, transport, digital communication.

At the European level, the SCC will nurture this formative process and as such will help de-risk investments and provide opportunities for cities and businesses that are not yet on this path. This will be assisted by the development of successfully demonstrated ‘template’ solutions for wider take-up across the EU. At present, however, investment in innovative solutions is associated with first-mover risks for both cities and businesses. The SCC also aims to maintain and even strengthen the technological leadership of EU industry. For this reason, the SCC will bring together the demand and the supply of innovative solutions.

Cities are concerned about potential technology and supplier lock-ins, the extra costs of non-standardised solutions, difficulties in promoting innovation in public procurement and uncertain returns on investment. Businesses, on the other hand, often cannot readily deploy innovative technologies and systems that are unfamiliar or costly for users, despite their potential for cost and pollution savings in the longer term; this can be a particular concern in regulated markets. Acceptability of these new solutions, and therefore the early involvement of citizens and stakeholders in shaping them, as well as the integration of non-technological elements in the final "package", are key to their rapid and wide uptake.

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[7] See http://ec.europa.eu/energy/technology/consultations/20110513_smart_cities_en.htm

These types of market failures can be tackled by coordinated and corrective action at the EU level and, along with other EU initiatives, should be addressed by the SCC, which will help to create initial markets for these solutions and ensure the sharing of best practices. The initiative will benefit from the Commission's proposal to rebalance its financing support towards product demonstration activities, prototyping and products validation in pilot lines as part of Horizon 2020.

Particular attention will be also paid to the potential for scale-up and replication so that projects under the SCC framework can serve as stepping stones towards realising full-scale deployment in Europe. It is vital that this integration is underpinned by fully exploiting potentials for synergies between relevant policy areas. Furthermore, it will be essential for the SCC to empower citizens and cities to make the right investment decisions as informed procurers of innovative technology and solutions to tackle their energy and transport challenges.

The SCC will go beyond coordinating research and innovation projects and will tackle demand side measures such as enhancing new business models for energy, transport and ICT services, public procurement favouring initiatives that also provide benefits in resource efficiency and energy saving. . It will also inform future reviews of regulations and standards, for example those that will guide the installation and operation of smart electricity metering.

The objectives of the SCC will be by 2020 to demonstrate and scale up at least 20 major innovative solutions that combine energy, transport and ICT technologies and enable pioneering cities to outperform in terms of achieving the EU targets for reducing carbon emissions, use of renewable energy sources, and for increasing energy efficiency. Such performance indicators should be developed as part of the implementation.

3. IMPLEMENTATION OF THE SMART CITIES AND COMMUNITIES

The initiative is dedicated to demonstrating commercial-scale solutions in a small number of locations, thus supporting European cities and communities to meet their commitments in, for example, the fields of energy, transport, air quality or climate change mitigation. The first phase is the orientation of the 2013 Work Programme of the Seventh Framework Programme (FP7) to reflect the integrated nature of the urban energy, transport and ICT topics. In this Work Programme, topics related to SCC have been united in a call that maximises the impact of projects at the interface of the three sectors. Examples of cross-cutting themes are presented in Annex I.

Whilst these types of projects will raise the level of ambition and integration, they need to be complemented by demand side measures such as developing new business models, fostering procurements of innovative solutions, setting new standards or improving regulatory frameworks. Under the next Multiannual Financial Framework funding opportunities, including Horizon 2020 will be used. This later phase will be focused on larger EU lighthouse projects linkages with other national and municipal programmes and the development of demand side measures..

3.1. Lighthouse projects

Lighthouse projects will tackle issues at the intersection of the transport, energy and ICT sectors. The projects should trigger strategic partnerships of innovation-driven companies

from the three sectors acting across geographical borders. They should forge strong partnerships with local leaders and municipal authorities to gain the vital support and visibility necessary to engage and empower citizens and local stakeholders to reduce greenhouse gas emissions and energy consumption and more widely to improve the urban environment. Throughout the SCC, cities will be given the opportunity to highlight to potential consortia their project plans, key areas of interest and longer-term ambitions. Preliminary expectations for these projects are elaborated in Annex II.

Lighthouse projects should offer solutions to the broad range of geographical, spatial and demographic characteristics of European cities. They should encompass a project design phase where different building blocks would be selected; an integration phase where these would be combined, and in many cases also integrated with legacy infrastructure and systems, for demonstration and validation at a scale that is sufficient to enable systemic change in applications which are not yet commercial. This should be followed by a review phase to assess performance and transferability. Industry led consortia are expected to be strongly committed to the use of open standards to facilitate interoperability across systems and to making all relevant data accessible and as widely available as possible.

Lighthouse projects could be funded from a number of sources including EU funding, national and regional funding, and private investments. The Commission's proposals for Horizon 2020 include the range of funding instruments that could be used which include for example grants for research and innovation actions, technical assistance(e.g. following the ELENA model); innovative financial instruments such as the Risk-Sharing Financial Facility; the European Energy Efficiency Fund; as well as the European Regional Development Fund (ERDF) and Cohesion Fund and other EU funds as appropriate.

EU Cohesion Policy can provide support for research and innovation in these areas. In particular, the development of research and innovation strategies for smart specialisation proposed by the Commission as an essential condition for the use of ERDF in the next programming period will contribute to deliver more targeted ERDF support and a strategic and integrated approach to harnessing the potential for smart growth in all regions and cities[8].

Market introduction of innovative services and new-technologies could also be stimulated by pre-commercial procurement which can trigger additional public and private funds.

3.2. Horizontal Actions for collaboration on key challenges

The Commission will support selected horizontal activities to address specific challenges, foster cross-project collaboration and promote common approaches (see figure 2). This will include Working Groups within the Stakeholder Platform (see chapter 4.2) and also specific actions to disseminate results to stakeholders. Moreover options for EU policy initiatives, future regulation and standardisation facilitating commercial roll-out will be collected. . This will necessitate the use of performance data and other information from the lighthouse projects including use of common standards and metrics to measure environmental and other relevant impacts, common practices for data collection and integration, financing and citizen empowerment and engagement.

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8 http://ipts.jrc.ec.europa.eu/activities/research-and-innovation/s3platform.cfm

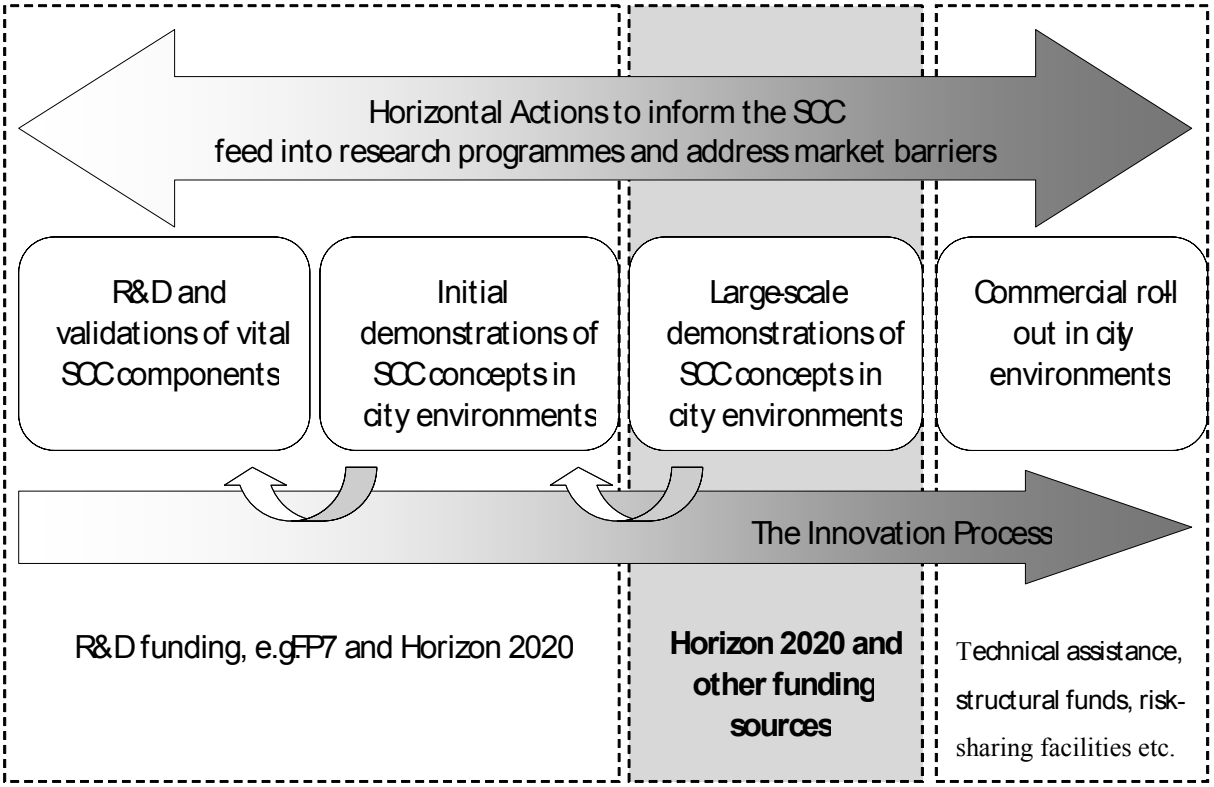

Figure 2. Stages in the Smart Cities and Communities innovation process

An important objective of SCC is to identify successful business models that can be adapted to local circumstances, can stimulate innovation, can create local jobs and can mobilise entrepreneurship. With high and presumably further-increasing prices of energy and other resources, reduction of consumption can pay off quickly and provide substantial economic and environmental benefits. However, there are currently a number of market failures that limit the extent to which these benefits can be realised[9]. Amongst others, new business models could involve multiple uses for existing infrastructure, service-oriented companies such as Energy Service Companies (ESCOs) and better and standardised availability and management of data, particularly data from public authorities. The need to anticipate the changing nature of infrastructure as management of information becomes as important as ownership of physical assets and natural monopoly. Where relevant, cities can integrate these experiences into their sustainable urban development strategies, with support from ERDF.

3.3. Indicators and assessment of impact

SCC indicators will provide understanding of the contribution of individual activities to the achievement of the broader objectives. They will help guide industrial partners by providing clarity on the expected performance of technologies and other innovative solutions, against which they will be validated. A limited number of indicators will be associated with the activities in each project and these will correspond to the EU-level priorities and key challenges for energy, transport and ICT such as: environmental performance, energy performance of districts and cities, share of RES in the energy use, shared use of

[9] See SEC(2011)277

infrastructure, reduced ICT foot print, availability of data in common formats, urban transport management, market uptake of proposed solutions. Monitoring of the interventions using the indicators will also entail assessment of the cost-effectiveness of any recorded or extrapolated improvements, taking into account life-cycle costing methodologies whenever possible, as well as induced employment effects of the action. The SET-Plan Information System (SETIS[10]) is well-placed to undertake this monitoring at EU level.

The monitoring system should promote the use of common methodologies and metrics for establishing baselines and capturing performance improvements, be consistent with or build on already existing methodologies used in the Covenant of Mayors, European Green Capital Award , Green Digital Charter and CIVITAS Forum.

The precise level of ambition of indicators would be defined by the cities in collaboration with the industry consortia, thus facilitating the engagement not only of cities that have taken a lot of measures on the path towards sustainability but also other cities that will be incentivised to advance and raise their longer-term level of ambition. The Commission intends, therefore, to foster improvements in all types of cities irrespective of their initial starting point.

3.4. International cooperation

The Commission encourages the sharing of experience and best practice solutions at global level, particularly with countries which have innovative, cost-effective and socially inclusive solutions to enhance quality of life in cities, while reducing their carbon footprint. At the current rate of growth the world's urban population would double every 40 years[11]. While urbanisation is slowing in many areas, including Europe, the scale of the global challenge has reached an unprecedented level. In many emerging economies cities are being established or rebuilt afresh. By 2030 the population of the world's cities will increase from 3.3 billion to almost five billion people[12]. The pace of these developments and the impact on the respective economies makes knowledge and best practice exchange with cities in emerging economies (eg. China) an area of particular emphasis[13]. Twinning of EU efforts with those in third countries could help set all regions on a more sustainable path and help establish sizeable global markets for European industry.

3.5. Relation to overall EU support to urban development and energy efficiency

Cohesion policy is supporting integrated sustainable urban development across the EU through the investments of the European Regional Development Fund (ERDF), the European Social Fund (ESF) and the Cohesion Fund (CF). Regional policy provides a broader integrated framework for sustainable urban development to which the SCC, with its focus on industry-led urban technology applications in energy, transport and ICT can make a key contribution. The projects addressing technology and innovation challenges under the present initiative will at EU level mainly be co-financed through FP7 and later through Horizon 2020, but they could become inspirational and adapted to respond to the needs of other cities and

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10 http://setis.ec.europa.eu

11 UN (2010) World Urbanization Prospects The 2009 Revision

12 UNFPA (2007) State of the World Population 2007. Unleashing the potential of urban growth.

13 In 2011, for example, the EU and China agreed to launch the EU-China Urbanisation Partnership based on the Covenant of Mayors.

communities applying for regional policy funding. Regional policy can thus support the roll out of successful demonstration projects from the Smart Cities and Communities to a larger number of urban areas in the framework of integrated strategies for sustainable urban development.

There are also series of more focused sectoral initiatives which complement the broader approach to urban development supported by EU regional policy. These include, but are not limited to: the Covenant of Mayors; Concerto; CIVITAS; the Green Digital Charter; the Urban Europe Joint Programming Initiative; the Green Capital Award; the Energy Efficient Buildings Public Private Partnership, the European Green Building Programme, the European Green Cars Initiative and the European Energy Research Alliance (EERA) Joint Programme on Smart Cities and the EIT Knowledge and Innovation Communities. Successive calls under the EU's Framework Programmes for Research have specifically invested in research and innovation for urban transport, ICT, and energy since the 1980s. Recently, the launching of a European Innovation Partnership (EIP) on water has sought to further optimise the urban dimension of water services in Europe and offers opportunities for future collaboration with the SCC. Furthermore, there are also numerous smart city relevant initiatives at national and regional level.

These initiatives cover much common ground but have not so far been targeted at the intersection of the energy, transport and ICT sectors. The SCC will build on these initiatives by establishing a coherent, overarching and dedicated framework that will rationalise and consolidate efforts to exploit the considerable potential for innovation.

3.6. Rewarding success

To showcase good practice and stimulate cities to promote their successes a biennial prize is envisaged to be awarded starting with 2014, by the Commissioners for Energy, Transport and Digital Agenda. The prize will reward a SCC project partnership that has achieved a high impact (e.g. market uptake solutions). An independent expert committee will evaluate the proposals on the basis of the projects undertaken and the potential to inspire an intelligent and efficient transition to greater sustainability.

4. GUIDANCE AND GOVERNANCE

To guide the development of the SCC, a governance structure will be designed that will incorporate inputs from relevant stakeholders. The structure will be tailor-made to correspond to the intended intervention at the level of cities and to the complexity of action at the intersection of the three different sectors. The governance structure of the SCC will be composed of two entities: the High Level Group and the Stakeholder Platform. The Platform should liaise with the SET Plan Steering Group to ensure coherence between national and EU efforts. The operational support will be strengthened by activities under the next Multiannual Financial Framework and Horizon 2020. The governance structure will not supersede and replace other initiatives or instruments and will be one important contributor among others to the definition of research priorities in the annual work programmes for EU research and innovation funding. The governance framework will become operational in the second half of 2012.

4.1. High Level Group

The High Level Group is advisory to the Commission and will have senior representatives of industry, cities, civil society, relevant EU initiatives in this area and the Commission as members. The High Level Group will be led by the three Commissioners for Energy, Transport and Digital Agenda who will select the members of the High Level Group in a transparent way. Participation of representatives of regulators, standardisation bodies or associated sectors is also envisaged. The Group will advise on the strategic orientation of SCC and will steer the development of the Strategic Implementation Plan for the Smart Cities and Communities EIP by:

- Identifying bottlenecks that are blocking or slowing down the development and deployment of technologies and their market uptake in order to address pressing societal needs.

- Identifying the actions that need to be taken to overcome these bottlenecks. This could include more effective use of EU funds, as well as actions needed on public procurement, standard setting and regulatory frameworks.

The Group would also:

- assess the progress made by SCC and to bring to the attention any new developments that could have an impact on the achievement of the aims and objectives of the SCC;

- lead by example in the development and promotion of initiatives that will help to realise the aims and objectives of the SCC;

- promote the SCC in forums across Europe and internationally.

The Group would meet at least twice per year.

4.2. Stakeholder Platform

The Smart Cities and Communities Stakeholder Platform is being designed to accommodate the constituencies of the cities, communities and other public authorities, citizens, NGOs and relevant industrial sectors[14]. It is open to participation by all stakeholders and will report to the Commission.

Its tasks are:

- to support the development of the Strategic Implementation Plan by 2013 and monitor its implementation under the guidance of the High Level Group. As such it would make a proposal to the Commission on concrete types of activities and actions which would be prepared alongside the first calls for proposals for under Horizon 2020.

- to report on market requirements – such as business models, standardisation, public procurement and regulatory measures – for supporting the 'template' solutions and new

[14] http://eu-smartcities.eu

technologies and non-technological innovative solutions in their journey to commercial roll-out and sustainability[15].

- to ensure the exchange of knowledge and act as a catalyser for forming partnerships among the sectors and between industrial, research and local actors.

- to ensure European-wide appraisal, outreach and liaison activities facilitating the implementation of the SCC.

The platform will comprise working groups to discuss and analyse specific topics and will ensure coherence between SCC activities and other relevant EU and Member State actions. The Stakeholder Platform will benefit from the support and active participation of Member State representatives, and will integrate relevant elements of the Strategic Energy Technology Plan (SET-Plan).

5. CONCLUSION

The SCC aims at accelerating the deployment of innovative technologies, organisational and economic solutions to significantly increase resource and energy efficiency, improve the sustainability of urban transport and drastically reduce greenhouse gas emissions in urban areas. The SCC is an industry-led initiative that is tailor-made to correspond to the intended intervention at the level of cities and communities, and to the complexity of action at the interface of the three sectors by:

- catalysing the market entry of innovative and integrated energy and transport technologies and services, and enabling ICT for urban applications,.

- learning from tested 'template' solutions that help to bridge innovation gaps and stimulate the convergence of industrial value chains in the energy, transport and ICT sectors and allow replication in cities across Europe.

- taking horizontal actions and informing policies and market-oriented measures that can validate and accelerate commercial deployment,

- building on, strengthening, rationalising and consolidating the current portfolio of city initiatives, thus ensuring coherence between regulatory and standardisation policies, in addition to procurement of innovation and project funding.

The first step is the orientation of the relevant parts of the 2013 Work Programme of the Seventh Framework Programme to reflect the integrated nature of the urban energy, transport and ICT topics. Subsequent steps will include the development of a Strategic Implementation Plan by 2013 to raise the level of ambition and integration among the three sectors under the Horizon 2020, the timely formulation of common indicators for monitoring, evaluation and target-setting and a supportive framework for the subsequent full-scale roll-out of innovative systems and solutions in Europe's cities.

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[15] This will incorporate a Joint Industry Roadmap for Smart Cities as identified in the context of the Digital Agenda for Europe: http://ec.europa.eu/information_society/digital-agenda/index_en.htm

The achievement of the present partnership objectives will focus on innovative technologies and solutions at the intersection of energy, transport and ICT sectors thus contributing to other key areas of sustainable urban development (i.e. water and waste management, climate adaptation). The partnership will remain consistent with urban, environment and climate policies, and seek to exploit complementarities and mutual benefits with other EIPs.

The Commission calls on the Council and Parliament to:

- Support the SCC and its objectives with the full involvement of all stakeholders in a comprehensive and integrative approach;

- Invite Member States to:

  - share information on the outcomes of EU projects in the country and across Member States

  - avail of the experiences gained in SCC projects to facilitate the rollout of innovation to support the transformation of today's cities and communities into Smart Cities and Communities, by ensuring coherence and synergy between the SCC and support instruments such as the ERDF and Cohesion Fund

  - promote the use of common standards to capture and present energy and emissions data related to projects and cities, to improve reliability and utility at EU level;

  - maximise the uptake of innovation criteria in public procurement in order to be conducive to market uptake of innovative solutions.

Annex I – Expectations for SCC lighthouse projects

The Commission expects that consortia participating in the SCC will have the following characteristics:

- A compact, delivery-oriented consortium involving innovation-driven industrial technology partners and key service providers from the energy, transport and ICT sectors, working in partnerships with cities and other innovators.

- Active involvement in the consortium of cities and communities from at least two Member States or Associated States, to ensure that solutions are transferable and deliver EU added value.

- Strong commitment of the consortium-members to open standards that facilitate interoperability across systems, prevent vendor lock-in and foster competition

- Commitment to support scale-up, innovation procurement and replication within the city, in other cities and in other situations.

- Commitment to measure, collect and disclose data in common formats that are necessary for further replication and development of applications, in particular information about costs and impact (energy savings, CO2 reductions, financials savings, jobs created, environmental impacts, etc).

- Prepare and implement a business case for wide deployment to underpin leverage of significant public and/or private co-financing to deliver an ambitious roll-out and maximum impact of EU funds.

- Capacity to involve citizens and end-users at a sufficient scale to enable systemic change (e.g. a district of a city, or a corridor) by means of providing them with better information, facilitating two-way adaptation to inputs received.

Annex II – The SCC cross-cutting themes

- **Smart buildings and neighbourhoods**

Examples: integration and management of local and renewable energy sources; ICT solutions for design as well as operation of urban districts or corridors with different building typologies; high efficiency heating and cooling (using inter alia biomass, solar thermal, ambient thermal and geothermal with heat storage, co-generation and district heating); development of green infrastructure to reduce heating and cooling needs and reduce air pollution;smart urban lighting; construction of nearly zero-energy buildings and positive energy buildings and neighbourhoods; deep retrofitting of existing buildings and sustainable building materials (cutting energy usage by at least 50 %).

- **Smart supply and demand systems and services for better-informed citizens**

Examples: demand response; provision of data and information to citizens and end-users on energy consumption/production and multimodal transport and mobility services; waste generation, smart metering and related services for energy, water, waste; monitoring and balancing the grid; real-time energy management; energy storage (including virtual energy storage) and supply to stationary applications and vehicles; common data formats; feedback mechanisms and adaptive systems.

- **Sustainable urban mobility**

Examples: energy and fuelling infrastructure and the operation of vehicle fleets powered by alternative energy carriers for public transport, freight distribution, alternative transport options and private transport using ICT-based solutions for urban traffic and transport management supporting the reduction of energy consumption and emissions. This could include:

  - Matching energy supply from distributed renewable electricity generation in buildings with forecast energy demand from buildings and transport, using smart electric vehicle charging systems and smart electricity grid networks, controlled by ICT;
  - Electric public transport vehicles (for example trolley buses, trams, metro vehicles) that are able to exchange surplus energy (braking and accelerating energy) with the energy system – using ICT to manage energy flows;
  - Using hydrogen as an energy carrier for storing energy and balancing demand at city level for energy and stationary power – controlled by ICT using forecasts for demand patterns based on weather forecasts, event planning, vehicle route patterns, etc.

- **Smart and sustainable digital infrastructures**

Examples: reducing the carbon footprint of the Internet, in particular data centres and telecommunications equipment, including broadband; intelligent heating, cooling and lighting solutions; exploitation of synergies between requirements for smart grids and broadband infrastructure including sharing engineering works and reusing infrastructures and services.

- **Strategic planning for identification, integration and optimisation of flows (energy, emissions, people, goods, services)**

Examples: integration and optimisation of different energy, transport and data flows; traffic management using information systems; logistics; development of green infrastructure and use of smart ICT to manage it; optimised waste collection and energy generation therefrom, optimised water treatment and distribution; business models; open data platforms including semantics and data sharing.