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Inputs from EERA-JP Smart cities in purple
3.2: Smart Cities and Communities
*(*Create technologies and services for smart urban planning, infrastructure management and
solutions for energy consumers*)*

- The original subtitle may be too limiting, as smart homes alone don't make a smart city.
- Generally, four levels should be taken into account:
    o Smart homes
    o Smart Buildings
    o Smart Districts
    o Smart Cities including also the link to core Priority 4 transport and mobility

The focus for the SET plan implementation should be on these four levels across all sectors (energy, mobility, ICT-infrastructure and services,…).

Purpose of this document

This document[1] is intended to progress the implementation of the actions contained in the SET-Plan Communication[2], and specifically the actions concerned with Action 3 "Create technologies and services for smart homes that provide smart solutions to energy consumers". It is part of a series of Issues Papers jointly prepared by the European Commission and discussed with the representatives of the EU Member States and countries part of the SET-Plan, working together in the SET-Plan Steering Group.

The Issues Papers are sent to stakeholders for comments/feed-back. They are meant to propose to stakeholders strategic targets/priorities in different areas of the energy sector. They will frame the discussions of the SET-Plan Steering Group with the stakeholders within Action 3 and will be used to come to an agreement on targets/priorities.

The issue paper for this action is split in two parts looking first at Smart solutions for energy consumers (3.1), i.e. mostly households and then at building/district level with the Smart Cities and Communities initiative (3.2). An energy system level perspective is taken under Action 4 dealing with energy systems.

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[1] This document is a working document of the European Commission services for consultation and does not prejudge the final form of any future decisions by the Commission.
[2] "Towards an Integrated Strategic Energy Technology (SET) Plan: Accelerating the European Energy System Transformation" (C(2015)6317)

Stakeholders are invited to take position on the proposed targets in accordance with the guidelines set out in the paper "The SET Plan actions: implementation process and expected outcomes" and submit their positions to SET-PLAN-SECRETARIAT@ec.europa.eu by 08/01/2016 at the latest. All relevant documents and material are available on the SETIS website https://setis.ec.europa.eu/.

Introduction

Cities and urban communities have a crucial role to play in the implementation of the energy policy for 2020 and 2030. About 3/4 of the population in Europe lives in and around urban areas, consuming 70% of the EU energy and emitting about the same share of greenhouse gases and the trend is rising. Mobility in cities is at the same time an imperative need and an issue, transport being also source of congestion, greenhouse gas emissions and pollutants / particles which can be harmful to the health of citizens owing to the use of internal combustion engines using hydrocarbon fuels. Quality of life and the attractiveness of cities as environments for learning, innovation, doing business and job creation are now key parameters for success in the global competition for talent, growth and investments. On top of that, cities need to handle the increasing complexity of challenges due to climate adaption needs. On this basis, the Commission established the European Innovation Partnership on Smart Cities and Communities (EIP SCC, COM(2012) 4701 final). SCC aims at bringing together local authorities, industry and citizens as well as research and technology organisations (RTOs) and universities to develop and accelerate the market rollout of sustainable innovative solutions integrating energy, ICT and transport.

For a successful implementation it is necessary to include not only local authorities, industry and citizens but also research and technology organizations (RTOs) and universities, in order to allow for accompanying research, monitoring and developing of KPIs, development of necessary tools…This was also recommended in the recommendations of the AGE (Advisory Board on Energy Research) for 2015[3] : *Integrated research alongside the innovation chain is urgently needed.*

In the global smart city market, which is evaluated to be around €1.3 trillion in 2020, one of the key challenges to provide solutions that significantly increase cities' overall energy and resource efficiency through actions addressing the building stock, energy systems and mobility.

Urban population should be involved in decision processes, should contribute to smart city solutions aiming to use secure, affordable and clean energy, smart electro-mobility, smart tools and services. Showcasing economic viability as well as user acceptance of these solutions will help to create new markets and new jobs. Therefore, it is important to bring together cities, industry and citizens and RTOs as well as universities

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[3] AGE recommendation 2015: One key factor for a sustainable development for Europe`s society is sustainable development of cities. Integrated research alongside the innovation chain is urgently needed. AGE recommends strongly to see Smart City topics much broader, including integrating various innovation dimensions, e.g. social innovation, economic innovation, bringing different actors together working towards a common objective. Main infrastructure related research tasks are: decision support, designing, implementing and monitoring of (nearly) Zero Energy Urban Districts, on-site integration of renewable energy systems, increasing demand side management and storage capacities. Local authorities, being closest to their citizen (=consumers), can thus promote the "shift" from consumers to prosumers (including community energy projects) and emphasise the real benefits for this…..

to demonstrate solutions and business models that can be scaled up and replicated, and that lead to measurable benefits in energy and resource efficiency.

The Smart Cities and Communities initiative is not specifically aiming at one technology but is integrating many of the technologies and issues. There is therefore a number of links with other actions of the SET-Plan such as consumers, energy systems, energy efficiency, and sustainable transport.

Targets The main challenges in view of climate change and the need for a resilient energy system in growing cities are to reduce energy use, enhance the share of renewable energy sources, mitigating the environmental impact and the carbon footprint, upgrading existing buildings and infrastructures and adapting them to new needs, entail competitive industries for jobs and growth and ensure societal and social development and the well-being of citizens. And at the same time cities need to adapt to the impacts of climate change such as heat islands, storms, flooding, fire hazard,…).

Therefore, Smart Cities and Communities innovation is particularly needed in the integration of the different components and actors of the complex urban system (including energy, mobility, ICT,…) as well of the information and communication services in building synergies. Other important aspects are the empowerment of consumers and the creation of robust business models to make smart city projects to be financed. Scientific support is necessary for ex ante assessments in order to choose the right scenarios and for ex-post analysis to learn for future projects.

Systems and approaches to scale up and to best harness innovative technologies and their synergies are needed. Alongside, the deployment of these solutions at large scale is calling for innovative funding mechanisms and business models involving public authorities, private investors and banks together with product developers and service providers.

The EPBD (Directive 2010/31/EU on the Energy Performance of Buildings) is requesting that, all new buildings must be nearly zero energy buildings by 31 December 2020 (public buildings by 31 December 2018). Renovation of buildings has also an important role to play.

The proposed targets are:

Smart homes and buildings

- Bring smart appliances, building control- and energy management systems of to a readiness level that guarantees user acceptance and full integration in the overall system enabling large-scale roll out. These should be capable of handling in a smart way heating and cooling, variable renewables, energy storage, electric car (charging and storing), etc. and tend to meet the target of (Nearly-) Zero-Energy-Houses/Buildings for new buildings in 2020, as set out in the EPBD and EED and develop smart and affordable "deep renovation packages" for existing buildings.

- Provide cities in the coming years with information on demonstrated technologies and systems for new and refurbished buildings which will help cities to reduce their primary energy consumption / GHG emissions, in particular those who committed to reduce their CO emissions by 20% by 2020 in the Covenant of Mayors.

Smart districts

- Develop the necessary interfaces/technologies to connect (Nearly-)Zero-Energy-Houses/Buildings to create zero-energy blocks and districts by 2020

- For renovation on district level, we would like to add one target on renovation rate e.g. ambition up to 2-3%, number of large scale smart city projects,…

- Support cities in CO_2 emission reduction scenarios combined with resilience strategies. Roll-out of tools, which can be used by city authorities for planning support and decision support. (Necessary tools: seamless tooling from strategic system simulation and scenario development, infrastructure development and management to GIS based detailed ex ante/ ex post evaluation….). On top of providing information, stimulating mutual learning processes, including online learning course, interactive information platforms, and also (physical) staff exchange would be better should be offered.

Smart cities

- Development of tools and methods for the planning and operation of city-wide infrastructure

- Provide cities with integrated mobility monitoring - and management systems, convenient travelling information systems on traffic load with congestion warning, individual travel time estimation, parking management and transportation mode switching alternatives with attractive public transport tariffs. Develop SMART distribution of urban functions to establish a city of short distances to reduce number and length of trips and to avoid motorized traffic

- Establish a wide range of transportation modes with information platforms and organizational settings, with easy mode switch possibilities from walking, cycling, tram- und bus-use, taxi hire, car-sharing use to private motorized car use.

- New approaches for architectural and urban design, exploiting the full potential of new technologies in a integrated way for a higher quality of the built environment and, in general, a better quality of urban life.

To achieve these targets several of the following things are needed:

- Use of latest generation ICT, smart meters, smart appliances, smart energy management, thermal mass; smart management of electricity, heat, cold, gas or other grid systems (including water), smart mobility - and parking management;

- Incorporated RES based to a large degree on a high level of local resources (including waste heat combined with district heating, energy generation by building integrated PV, electricity and/or heat storage) and high shares of self-consumption;

- smart EV charging (grid to vehicle and vehicle to grid) ensuring a positive impact on the whole energy system from a technical and economic point of view;

- Integrated planning processes including new governance structures and stakeholder involvement; Tools for theoretical analysis and simulation tools capable of handling cross-sectoral and cross-level-data.

and the following issues have to be tackled:

1. Study and evaluation of all synergies between these single building components; (façade elements, envelope, building integrated PV, HVAC-system,…); a balance between energy efficiency and renewable generation should be given.

2. Creation of (Nearly-) Zero-Energy-Building-Blocks / district through intensive interaction between the buildings for increased synergies, efficiency and decreased costs. Creation of respective building interfaces allowing to cluster single buildings into integrated blocks / districts;

3. A stronger and more interactive inclusion and empowerment of the Citizens and other end users;

4. Improved planning management, design, control and maintenance of physical urban infrastructures and operational technologies in buildings, energy and transport;

5. Development of innovative Business Models to demonstrate that both technical and financial risks are low enough for large scale investments in cities; As a basis of new business models a detailed analysis and discussion of the "new" value chains is necessary; these value chains are the essential structure to define some major breakthroughs.

6. Development of tools for scalable integrated design, simulation and multi-criteria optimisation to enable multi-stakeholder analyses of different spatial and sectorial perspectives; that will need tools on several levels: Long-term scenarios, strategic planning, detailed design, operation and control, monitoring and evaluation, mutual learning and citizen engagement.

7. Cyber security,data protection and privacy in an increasingly data intensive smart city environment.

8. Monitoring – KPI`s Diskussion auf EU Ebene, tools, evaluierung, Abweichungsmanagement..?

Monitoring of the targets:

Smart homes

- To assess the progress and performance of the tested smart appliances and energy management systems, it is proposed to use the following indicators:
  1) An estimate of the cost of construction / renovation per square meter, (discuss the integration of the "system cost"? E.g. local storage system will of course increase renovation cost but will have positive effect e.g. on cost for enhanced capacity of distribution lines, transformers; this is exactly the new system approach that will change the business models, otherwise the old model -just based on a "what does the custormer pays" (remains of course important) - will prevail.)
  2) The amount of energy and GHG savings per square meter and per year,
  3) The amount of GHG savings from the transport solutions per inhabitant
  4) An ad-hoc 'Technology Readiness Levels' evaluating how close the solutions are from market combined with a market readiness level indicator and an user acceptance indicator.
  5) Comfort-service-target is to be considered (energy will evolve towards a service instead of a commodity; discussions on how to measure this are required.)

Smart buildings

- To assess the level of connection between buildings / districts allowed by new technologies and systems:

1) An estimate of the cost for the interconnection per number of connect square meter,

2) The amount of energy exchanged between buildings per square meter,

3) Improvement in the difference between peak and min power demand as a percentage of peak power,

4) An ad-hoc 'Technology Readiness Levels' evaluating how close the solutions are from market.

5) Energy supply indicator considering also ancillary features (voltage regulation, energy security,…)

Smart cities and districts

To Asses the energy efficiency of a city
1. Average reduction of energy bills
2. Population density
3. Average CO_2 generation per capita
4. Increase of share of renewables
5. Average reduction of energy bills

In close cooperation with Core priority 4: Diversify and strenghten energy options for sustainable transport
To assess energy consumption for mobility purposes:

1. Change of share of travelled km per traffic mode
2. Change of share of goods transportation in ton-km by fuel type
3. Change of share of fossil- vs. non fossil fuelled cars , lorries, busses
4. Change in average travel time, travel distance and number of trips
5. Change in energy consumption by energy carrier of km travelled
6. Change of CO2 emissions by km travelled
7. Change in total energy consumtion and CO2 emission

To assess the level of life and economic quality, the following indicators shall be used:
1. Number of citizens / tennants involved in the testing or demonstration
2. Level of end user satisfaction
3. Number of local jobs created
4. Number of co-created solutions involving citizens
5. Green space per capita
6. GDP
7. Empoyment

- The availability of information on demonstrated technologies and systems for new and refurbished buildings should materialize via a publicly accessible web site.

Ultimately, estimation of the penetration of such solutions over the years and an overall estimate of primary energy savings, GHG savings and increase of share of renewables could be made.

Proposed actions

While Horizon 2020 will continue to support this action via Calls for Proposals in the field of Smart Cities and Communities, the goal of this round of consultation is to consult stakeholders (i.e. cities and city networks) and Member States to identify a limited number of priority actions which:

- have a strong added value to be carried out at EU level and or through collaboration between Member States,
- have a strong leverage i.e. will need a limited or no support from Horizon 2020 but will pool together a number of resources,
- for which the progress and achievements can be monitored with indicators.

We are therefore looking for your views. The annex below reproduces actions which were identified in the document 'Towards an Integrated Roadmap: Research & Innovation Challenges and Needs of the EU Energy System' and can be used as a basis but proposals for priority actions do not necessarily need to be based on this list.

Sustainable districts and built environment

Industrial research and demonstration:

- Develop new decision tools for local authorities on refurbishment of districts to near-zero energy levels, which need to be integrated in multi-criteria toolkits.
- Develop auditing tools and frameworks for policies on near zero energy districts & buildings and integrated modelling methods for refurbishment of districts, to increase the capacity of local authorities in planning and implementing renovation strategies.
- Develop solutions linking smart energy network applications and local storage at district level to buildings.

Innovation and market uptake:

- Validate digital platforms for city design and planning, to pilot the auditing frameworks developed, in order to enable their roll-out on a large scale, and to promote the integration of holistic zero energy district solutions and renovation projects in urban planning policies. In this regard, the regulatory aspect of data sharing must be addressed in order to define the different roles and tasks of different stakeholders to promote an effective and not discriminatory use of the data.

Networks of Infrastructures

Industrial research and demonstration:

- Develop and demonstrate technological solutions to increase the performance of existing urban infrastructures and enable new innovative services.
- Develop solutions to enhance the synergies between the various infrastructures as well as new communication solutions; demonstrate standardized and interoperable ICT real-time solutions as well as integrated metering solutions for the different networks.
- Integrate common electrical equipment and storage in different public transport network systems to optimize the infrastructures investments.

Innovation and market uptake:

- Optimize the costs of existing infrastructure and determine and demonstrate the value of integration across different infrastructures.

Integrated infrastructure-based services

Industrial research and demonstration:

- Develop tools for integrated infrastructure planning and new planning approaches for urban space used by the various networks.
- Deploy ICT-based tools, devices and interfaces enabling the citizens to be informed about infrastructure-based services and to provide information for the operation of local infrastructures.
- Create new architectures for integrated networks and new services, integrating information about customers' consumptions, in order to couple local energy sources and the various energy demands

Innovation and market uptake:

- Develop solutions and procedures to integrate public works and to foster common maintenance operations. Develop new business models to increase services based on common infrastructures.

Fuel and fleet diversification

Industrial research and demonstration:

- Demonstrate waste brake energy for batteries in buses and electro-mobility solutions for private

and public transportation vehicles; foster the use of bio-based fuels.
- Develop infrastructure and operational solutions to foster zero emission harbours and airports.

Innovation and market uptake:
- Address the non-technological barriers hampering the deployment of electric passenger cars, hydrogen-based transport and other mobility options in cities.

Energy performance of transportation systems

Industrial research and demonstration:
- Develop interoperable infrastructures and data solutions for services and logistics and smart charging solutions for electric vehicles fully integrated into the electricity network.

Innovation and market uptake:
- Design strategies for consumer acceptance of new mobility patterns.

Governance

Industrial research and demonstration and innovation and market uptake:
- Establish platforms for intra-city cross-department collaboration; develop an evaluation and monitoring framework for local policies; and educational programmes on policy evaluation.

Funding and Financing

Innovation and market uptake:

- Establish city strategies and assistance services for local authorities to improve the quality of potential projects in view of ensuring funding; develop platforms and frameworks to ensure the applicability of new innovative financial instruments; and develop business models and other capacity building measures to support complex projects combining several funding options.