Introduction to Panel 5 Smart and sustainable communities

Panel Leader: **Agneta Persson**
Anthesis
Sweden
agneta.persson@anthesisgroup.com

Panel Leader: **Pedro Moura**
Institute of Systems and Robotics, University of Coimbra
Portugal
pmoura@isr.uc.pt

Introduction

Currently, 55 % of the world's and 74 % of Europe's population lives in urban areas, and by 2050, the numbers are expected to increase to 68 % and 84 %, respectively. Cities generate great opportunities for simultaneous environmentally and socially sustainable development, economic development, employment and wealth generation. However, in order to reach this, the opportunities and synergies need to be leveraged, while at the same time the risks and the conflicts of interests in exponential growth have to be handled very carefully. Although cities worldwide only occupy 2 % of the land area, they use 75 % of global energy and generate 80 % of the greenhouse gas emissions. Thus, sustainable development of urban areas and multidisciplinary planning is a challenge of key importance.

In order to manage urban areas in a sustainable manner, the local governments in partnerships with the local business life and civil society, the citizens and all the relevant stakeholders need to cooperate more closely together on making cities smarter. In this context, new innovative systems can be used to enhance the typical provider-consumer model, leading to the higher energy-efficiency awareness on both sides, with consumers being able to assist the energy service providers in their processes of integration of renewable generation.

Smart urban technologies can provide an important contribution to the sustainable development of cities, with Information and Communication Technologies (ICT) offering new interdisciplinary opportunities to improve services while reducing energy consumption and emissions. ICT is also a key for implementing new roles along the energy value chain, where traditional business models are rapidly becoming outdated, with more demanding consumers and sustainability policies. However, it is of utmost importance to design the smart solutions, so their added value exceeds the resources necessary for implementing the measure. Sustainable is always smart, but smart is not necessarily sustainable.

Panel 5 submissions have been grouped into three themes:

- Sustainable communities and urban planning – the papers in this theme are focused on aspects such as the urban planning and governance; cooperation, equity and innovation in sustainable communities, as well as in benchmarking and procurement at the local level;
- ICT for energy management and demand flexibility – the papers in this theme are focused on the adoption of ICT technology at the community level, as well as on its use to ensure demand flexibility;
- Integration of renewable energy sources (RES) and district heating – the papers in this theme are focused on the integration of renewable energy generation sources at the community level, as well as the control of district heating systems to provide demand flexibility.

Sustainable communities and urban planning

Urban planning and governance are crucial elements in achieving sustainable communities, being important aspects such as the use of alternative urban governance concepts, innovative community energy plans and new business models of municipal energy companies. Glad & Gramfält (5-017-19) present the innovative and sustainable results of "the Vallastaden model", a cross-sectoral governance concept and energy system designed at the local level in Sweden. The research assessed the use and implementation of alternative urban governance concepts, concluding that alternative urban governance concepts can provide long-term commitments and joint efforts across sectors. Sanguinetti et al. (5-071-19) present a community called "The Sustainable City" with more than 2,000 residents, shops, a school, and a hotel, in Dubai. The research investigates the community culture, with attention to similarities and differences relative to grassroots intentional communities with sustainability goals. Brinker & Satchwell (5-377-19) compare the business models across multiple dimensions of new municipal energy companies operating in different jurisdictions: California, Germany, and Great Britain. The relative opportunities and potential impacts are then assessed in terms of decarbonization, economic sustainability, and social objectives.

To achieve sustainable communities, it is fundamental to ensure equity and promote cooperation in energy communities, as well as to promote the implementation of sustainability innovations. Janda et al. (5-389-19) focus on slum areas, which include populations that are hard to reach, underserved by current energy systems, and largely absent from urban building energy models, concluding that additional social science research is needed to reduce the impacts of exclusion and to co-produce new methodologies with energy modellers. Sebi et al. (5-014-19) study the cooperation in energy communities, benchmarking the structure of a citizen-led energy production "world" in France and The Netherlands, to better understand what is key for such cooperation chains to function and to map the chains of cooperation. Dütschke et al. (5-108-19) present a project where sustainability innovations on low-carbon heat grids using renewable sources or waste heat, sustainable water management, and community housing were analysed. The assessed aspects included the stage of development, the drivers, barriers, success factors and synergies between the fields of action.

The comparison of cities and communities is important to promote sustainability examples, being needed the availability of benchmarking tools and performance indicators. Another relevant aspect is the availability of information and procurement criteria. Matosović et al. (5-328-19) developed a City Capacity Assessment Framework, focused on city planning, financing and implementation capacity for Sustainable Energy Climate Action Plans related projects. The framework is intended to benchmark the cities' ability to attract investments, identify and utilise diverse funding sources and implement investment projects. Lien et al. (5-250-19) propose a methodology for selecting indicators for the specific low-carbon transformation of urban community projects, selecting the most relevant indicators through multiple attribute decision making. The methodology was applied in a Norwegian setting, and the selected indicators were tested in an indicator planning tool. Roscetti et al. (5-325-19) present the implementation of local actions for lighting systems in the tertiary, based on training, policy-instruments, and the development of an improved information service, including the design of procurement criteria and planning-guidelines for LED-lighting solutions.

ICT for energy management and demand flexibility

ICT technologies, such as smart meters, smart appliances, and monitoring and control systems, are already fundamental tools for the energy management at community and city level, presenting a high potential for energy and costs savings, as well as to improve quality of life. However, the adoption of ICT technologies is not an easy and quick process. Darby (5-318-19) outlines two examples of smart energy innovation at different scales: a large-scale demonstration of smart residential storage heating in three contrasting European countries and a project to enable a rural community to gain more value from local solar generation. The smart technologies took longer than expected to establish, devices and people acted unexpectedly, longstanding rules stood in the way of implementing socio-technical possibilities, and 'middle actors' were able to play an important role in negotiating challenges and making it possible for environmental and social benefits to emerge. Bull et al. (5-047-19) present results of feedback from interviews with selected building users about the individual, social and institutional changes prompted by the use of energy focused ICT tools with functionalities such as the track and communication of energy performance, communication between stakeholders and management of intervention plans for energy efficiency. Morton et al. (5-084-19) present a summary of some of the common problems relating to user engagement with energy interventions faced by many research projects, as well as presenting findings from a project aimed at empowering energy end-users by enabling behaviour change via a set of ICT solutions.

The availability of ICT technologies ensures the needed infrastructure to implement demand flexibility, with load shifting and demand response. There are still barriers to the use of demand flexibility in several sectors, but simultaneously several examples of a successful implementation can be highlighted. Lopes et al. (5-077-19) propose a multidisciplinary approach to assess Demand Response barriers and enablers in Small and Medium Enterprises (SMEs) to support the design of pilot programs. A set of 20 interviews were performed to SMEs selected based on the technical potential of controllable demand-side resources and the impact of business sectors on national electricity consumption. Parag et al. (5-145-19) present a 'middle out' strategy developed and applied for reducing mid-week summer peak demand in two local communities in Israel. Generic and tailored SMS messages were sent, and an economic incentive was offered to households that saved 10 % of their electricity during peak hours. Reis et al. (5-056-19) propose a multi-agent modelling approach to exploit the influence of demand-side flexibility of different activities within an energy community, and Snape (5-354-19) presents an approach to understanding the interactions between technology, economics, community members and policy via agent-based modelling. Marchi et al. (5-239-19) investigated how blockchain can transform the current energy market in order to highlight advantages and disadvantages and to understand the related potentials and risks for prosumers and grid operators.

Integration of renewable energy sources and district heating

Demand flexibility and energy storage will have a fundamental role for the grid integration of intermittent renewable generation, ensuring the matching between local generation and consumption, as well as to provide ancillary services to enhance grid reliability. Kishida et al. (5-193-19) evaluate feasible solutions in order to understand the future prospects of self-consumption of photovoltaic generation in Japan, considering the implications of three aspects of future self-consumption: policy trends, business decisions, and prosumer's awareness and intentions. Amaha et al. (5-265-19) investigate the factors affecting the customers' contract switching behaviour in the liberalized electricity market, namely be choosing community-based energy companies or renewable energy companies. Fagerström et al. (5-342-19) investigate the profitability with peak shaving in Norway for a commercial building, developing a forecasting algorithm for load prediction, and the economic value of forecasting was determined for a PV-battery system.

The integration of renewable generation in district heating, as well as the use of the demand flexibility in such systems to improve the matching between generation and consumption, are very important to achieve sustainability goals at the district level. Nösperger et al. (5-048-19) propose an operational assessment of potential co-benefits of a real smart energy project for an urban district currently under renovation and extension, considering a partial or total integration of thermal RES in a district heating and the integration of a collective renewable power production capacity. Larsen et al. (5-088-19) create a classification of smart home technology in a district heating system, exploring several cases in real-world settings in the context of Denmark, and highlight the implications of everyday life and social practices when integrating smart home technology for enabling a flexible heating demand. Holzleitner & Moser (5-124-19) discuss how feed-in of waste heat into an existing district heating network often is hampered by technical, economic and legal obstacles. Article 24 (4) of the RED II is analysed with regard to new legal possibilities for third party RES or waste heat generators. Lambert et al. (5-300-19) document the experience of implementing peak power optimisation using demand side management through predictive control on a cluster of 45k apartments to optimize the overall energy performance of an entire district-heating system with multiple energy carriers. Kovač et al. (5-033-19) assess the use of heat storage in district heating systems in microgrids with solar photovoltaic generation, presenting a numerical model covering most important features of micro-grids with solar photovoltaic generation, battery and heat storage, taking into account the weather pattern, load curves and roof orientation. Fritz & Aydemir (5-096-19) evaluate the potential for transporting industrial excess heat via sewer networks, to be used in district heating networks, using a data set of more than 900 industrial sites and more than 26,000 sewage treatment plants.