This document introduces briefly seven topics, in relation to the Symposium on:

The Building as the Cornerstone of our Future Energy Infrastructure

The importance of dynamic and real data for reliable assessment

Introduction

In the transition towards a new energy system, based on minimal carbon use and circular economy principles, the building is the cornerstone of the future energy infrastructure. Energy use in European buildings is still around 40 % of the total final energy use. Decarbonisation of power and heat are high on the agenda of EU Member States. Present initiatives by governments for a proper energy transition are based on reducing energy consumption, increased use of renewable energy resources and making the energy infrastructure more intelligent (SRI as mentioned in the EPBD). Presently, the major part of final energy in buildings is heat. In the near future, this will be converted more from (renewable) electricity. This transition should be a play between governments, industry and end-users. Often not considered, the citizen should become at the centre of the energy system; from passive consumers to engaged energy customers. For that purpose digitisation is essential, enabling monitoring and control of optimised energy use for a comfortable living and working environment.

The energy infrastructure needs to address the balancing for energy at different levels (TSO and DSO). The energy markets play an important role in managing the flows of energy in multi-directions. The level of balancing between the building end-user and the climate is not often carefully considered. Also, the energy flow between buildings and the energy networks will become more and more multi-directional. Buildings will produce energy: electricity that is partly delivered to the grid, and heat that is stored in the building or underground. The near future may see more self-consumption in buildings, including the electricity stored in electric cars. One may conclude that buildings in which presently 40% of final energy is consumed, will take a more prominent position in the energy infrastructure. Seven invited experts will present the challenges and innovation aspects that may facilitate the energy transition.

The Symposium is organised around seven topics that are briefly presented below.

- Measurement for validation (in-situ and real data)
- Building simulation and dynamics (IBPSA)
- Building energy related standards – CEN/ISO (EPB Center)
- Renovation projects for buildings and cities (EPBD, EED and the building stock)
- Renewable Energy integration (Danish CITIES project)
- Electric Vehicles integration (electrical storage)
- Urban dimension (from building to city modelling; CityGML)

Measurements for validation (in-situ and real data)

To analyse and compare existing methods for the assessment of the energy performance of buildings, *dynamic measured data* from metering and in-situ measurements is required. Quantifying the actual performance of buildings can only be effectively realised by optimized in-situ measurements combined with dynamic data analysis techniques. Two approaches may be distinguished: -1 Co-Heating measurements on site (CEN TC89 WG13 is developing a standard) and -2 Metering data of electricity, gas, heat, water (regular readings with intervals ranging from a few minutes up to daily values). The roll-out of new intelligent metering equipment is at full speed in most EU countries. The advantage of metering data is that a growing amount of data is coming available and hence an improved accuracy is feasible. In

order to split building related energy use from occupant energy consumption a combined statistical and dynamic method is investigated for the analysis of time series. *Validation* of the selected methods with measured data from field experiments or from metering readings (e.g. electricity, heat, gas and water) is required. These collected data may be linked with different data sources (via internet) and analyses to manage new domestic devices and building comfort in an energy efficient way.

Building simulation for future urban energy system (IBPSA)

Reliable simulation tools for building design that should deal with variable aspects in terms of energy performance and consumption as well as storage of thermal and electrical energy, have to be available. Discussions are ongoing on the issue of the *gap* between design and real performance of buildings. Questions are put on the table in order to understand and reduce this *gap*. This may lead to the important question if building simulation is ready to deal with present development in the building energy sector. Since most of the reference climate data sets are created from > 10 years measured data one may ask the question: does the climate data used for simulation reflect future conditions and does it address the particular aspects of low energy buildings? In addition, does simulation deal with optimised balancing when taking into account the self-consumption of produced energy?

Building Energy related standards – CEN/ISO

The assessment of the energy performance of a building, as required by the EPBD, is related to a single building (or building unit) and requires an energy performance certificate, expressed in primary energy. The EPBD links directly to standards for calculation as well as measurements when it concerns performance assessment. The EPBD addresses new as well as renovated buildings. The EPB Directive 2010/31/EU mentions in article 2:

> *The 'energy performance of a building' means the **calculated** or **measured** amount of energy needed to meet the energy demand associated with a typical use of the building, which includes, inter alia, energy used for heating, cooling, ventilation, hot water and lighting;*

Developments of a third, more ***holistic*** assessment approach are presented in several projects, based on administrative data and the application of reference buildings (which are measured for that purpose).

The European Committee for Standardisation (CEN) has been working on bringing the present EPBD related energy standards in-line with these requirements. The CEN/TC 371 Energy Performance of Buildings Project Group has been responsible for the overall consistency and horizontal harmonization of the set of EPB standards. This includes the preparation and maintenance of overarching EPB standards and other EPB framework documents and the management of the overall consistency as well as other common quality and usability aspects of the subseries of EPB standards that are developed and maintained by the other CEN Technical Committees. Further work is necessary to support the development of reliable procedures that are needed to implement new standards and regulations in this field. This development will facilitate the application of the EPBD contributing towards saving energy in buildings. Associated tools should be made available to practitioners.

Renovation projects for buildings and cities (EPBD, EED and the building stock).

Renovation of buildings is key to meet the EU's energy efficiency targets. Recent revisions of the Energy Efficiency Directive (EED) and the Energy Performance of Buildings Directive

(EPBD) address this issue. Much of the European building stock is in need of renovation (estimated about 50% of 210 million buildings) however both relevant Directives define 'renovation' in an ambiguous way. The EED defines 'deep renovations' in a very broad way, as "renovations which lead to a refurbishment that reduces both the delivered and the final energy consumption of a building by a significant percentage compared with the pre-renovation levels leading to a very high energy performance". To justify energetical and economic measures, practical and reliable methods have to be developed.

Renewable Energy integration (Danish CITIES project)
One of the highly interesting projects is the Danish CITIES project that covers the complex issues of applying Information Technology for the Integration of Energy Systems, in particular the variable renewable resources such as solar and wind electricity. The Danish government has set an ambitious target of weaning Denmark off *fossil fuels* by 2050. District Heat is a major component that contributes to the aim of reaching a fossil free society, through renewable energy. In addition, Denmark is one of the world's most digitalised countries. CITIES plays an important role in activities of the International Energy Agency Annexes (e.g. Annex 58, 66, 67, and 71). Results from CITIES have been used internationally to define the concepts of flexibility for smart energy systems. The Flexibility Index implies that it will be possible to design buildings, districts and cities such that they are optimized towards the local characteristics of the renewable energy productions.

Electric Vehicles integration (electrical storage)
Governments have emphasised that renewable electricity resources will have a prominent part in the energy transition, in the transport as well as the building sector. In practice this may result in movable and variable sources of electrical energy that may or may not be connected to the building by means of batteries. The Electric Vehicle (full electric, hybrid or other types) will take a more prominent position in our society for several reasons. Future buildings may therefore be equipped with electrical storage facilities. Charging of the battery pack may double the consumption of electrical energy and increase the peak load to the grid. This may have a negative impact. However, the availability of electrical storage connected to the building may have a positive impact also. It is foreseen that, for doing so, communication between electric appliances in the building and the electricity network is required (Internet of Things). For buildings that produce electricity (by photovoltaic panels) for self-consumption, optimised management is evident.

The Urban dimension (from building to city modelling; CityGML)
Whereas the EPBD deals with individual buildings, buildings are part of urban areas, cities and will have a more important place when energy demand and production is concerned. The EED addresses upon this issue also. Several international projects are studying the urban area in terms of infrastructure (roads, underground, water, etc.) as well as energy (production and load). Modelling software is developed in a very sophisticated way and uses modern techniques for planning and assessment. CityGML is regarded as a very powerful IT environment to develop the necessary software tools putting the building in the urban environment.

Panel discussion.
Task leaders of the IEA-EBC Annex 71 project are invited to address the speakers with dedicated questions addressing the specific topics concerning their project, e.g. **Building energy performance assessment based on in-situ measurements (IEA-EBC Annex 71).**
(by DYNASTEE)

THE DYNASTEE NETWORK

DYNASTEE stands for: "**DYN**amic **A**nalysis, **S**imulation and **T**esting applied to the **E**nergy and **E**nvironmental performance of buildings". DYNASTEE is a platform for exchange of knowledge and information on the application of tools and methodologies for the assessment of the energy performance of buildings. DYNASTEE functions under the auspices of the INIVE EEIG and it is open to all researchers, industrial developers and designers, involved in these items.

The EU energy research projects PASSYS (1985-1992) COMPASS and PASLINK created the initial European network of outdoor test facilities, developed test methods, analysis methodologies and simulation techniques. It resulted eventually into the PASLINK EEIG network (1994). The grouping profiled itself as a scientific community of experts on Testing, Analysis and Modelling. In 1998, PASLINK EEIG started a new project PV-HYBRI-PAS on the overall performance assessment of photovoltaic technologies integrated in the building envelope. The use of the outdoor test facilities in several Member States situated in different climates, together with the available expertise on analysis and simulation techniques, offered the ingredients for more successful projects: IQ-TEST (2001), focussing on quality assurance in testing and analysis under outdoor test conditions as well as evaluation techniques of collected in-situ data. The expertise of the grouping was also offered to other European projects, such as DAME-BC, ROOFSOL, PRESCRIPT, IMPACT and PV-ROOF.

In 2005 the PASLINK EEIG was converted into an informal network that today is known as DYNASTEE. It is offering a network of excellence and should be considered as an open platform for sharing knowledge with industry, decision makers and researchers. It has been very active in supporting projects such as the IEA-EBC Annex 58 and recently the new project IEA-EBC Annex 71 '*Building energy performance assessment based on in-situ measurements'*.

DYNASTEE, being a network of competence in the field of outdoor testing, dynamic analysis and simulation, has over 30 years of experience through a series of EU research projects. Dynamic analysis methods are techniques to analyse dynamic processes and to identify typical parameters of physical processes like energy flows in buildings. Dynamic analysis, simulation and testing remains an area of high scientific interest. Dynamic mathematical and statistical technologies are recognised being crucial in optimisation of energy efficiency. Integration of renewable energy technologies in our built environment is rapidly evolving, giving another perspective to the use of available energy resources.

It is expected that buildings will play an active role in the integration of renewable energies in the energy system. Energy flexible buildings will allow to charge, store and discharge fluctuating energy flows and to manage the energy demand. Smart and intelligent meters and data management systems will play an important role in this transition. Dynamic methods are essential for Nearly Zero Energy Buildings (as requested by the EPBD) and imply that smart meters can be used for automated generation of reliable energy labels for buildings.

Regular trainings organised by DYNASTEE, take place in the form of workshops or Summer Schools and deal with the application of dynamic methods for outdoor testing, related analysis and modelling techniques. Seven yearly editions of the Summer Schools have trained over 180

people with academic or building technical background. In general it is targeted to energy researchers, engineers, building designers and energy system managers.

Today, the strength of the DYNASTEE network lays in its multi-disciplinary nature of academic and research teams. In addition the availability of high quality outdoor test facilities at several member organisations offers a direct interaction between realistic experimental testing and dynamic evaluation and simulation.

For more information please visit the DYNASTEE web site www.dynastee.info where regular published newsletters can be found as well. Follow us on twitter @DNSTEE

(Hans BLOEM, Luk VANDAELE)