Improving energy efficiency in buildings is a major priority for the European Union, yet current modelling processes do not accurately reflect consumption. The MOEEBIUS framework will provide the basis for more accurate energy performance assessment, underpinning efforts to improve efficiency and opening up new commercial opportunities, as **Dawid Krysiński** explains

A new era in the energy performance of buildings

Buildings are responsible for 40 percent of energy consumption and 36 percent of CO2 emissions in the European Union. Given this fact, the EU promotes solutions which reduce energy consumption in the buildings sector. With increasing demand for more energy efficient buildings, the construction and energy services industries are faced with the challenge of ensuring that predicted energy performance and savings are achieved during operation. However, this is very difficult because of a 'performance gap' which is caused by occupants' behaviours and the lack of a 'magic formula' that accurately captures the dynamic aspects of building operations. As a result, current modelling processes and simulation tools do not accurately reflect the realistic use and operation of buildings. Due to this, post-occupancy evaluation studies in built and occupied buildings show significant gaps between predicted and actual energy consumption.

MOEEBIUS closes 'performance gap'

This underperformance highlights the need for a deeper understanding of the critical underlying performance factors related to the behavior of occupants, as well as other major active building elements. MOEEBIUS is the answer to these challenges, introducing a holistic modelling approach that focuses on appropriately addressing all sources of uncertainty and inaccuracy in building and district performance assessment. As Ander Romero, project coordinator, emphasizes, "these highly accurate predictions, simulations and optimization are possible due to implementation of dynamic models reflecting user comfort and overall behaviour in the built environment, enhanced district heating models, novel Indoor Environmental Quality models and short-term weather forecasts."

The MOEEBIUS Framework comprises the configuration and integration of an innovative suite of end-user tools and applications enabling improved building energy performance assessment, precise allocation of detailed performance contributions of critical building components, near real-time building performance optimization, optimized retrofitting decision making and near real-time peak-load management optimization at the district level. Thanks to that, MOEEBIUS is able to deeply grasp and describe real-life building operation complexities in accurate simulation predictions that significantly reduce the 'performance gap'. This is a key factor for improving energy efficiency in buildings and meeting the European Commission's 20 percent energy savings target by 2020. MOEEBIUS will also contribute to better development of Energy Service Companies (ESCOs) which are responsible for different energy solutions, including the design and implementation of energy savings projects, retrofitting and energy conservation.

'Performance gap' as a challenge for ESCOs

Current predictions tend to be unrealistically low whilst actual energy performance is usually unnecessarily high . Post-Occupancy Evaluation studies in built and occupied buildings have demonstrated that the measured energy use can be as much as 2.5 times the predicted energy use (more than 70 percent in the retail sector, 100 percent in residential, 150 percent in offices, and over 250 percent in the education sector).

In more detail, the 'performance gap' generates a consequent gap between payback estimates and techno-commercial Return-On-Investment calculations in ESCO projects which still use previous energy audits based on simplistic and inaccurate calculations. Due to this, ESCOs are not able to provide customers with appropriate simulations on acceptable paybacks of 2-5 years using low-cost interventions.

This constitutes a significant barrier to the development of the ESCO market. In the opinion of Ander Romero, "ESCOs are forced to add installation and commissioning services, project management, man effort, measurement and verification costs to hedge the risks induced by prediction uncertainty and inaccuracy". It makes many contracts

totally unattractive, also in cases where the ESCO takes over the full implementation of a refurbishment project (from auditing to design and implementation). This introduces extra risks for ESCOs and significantly reduces their profit margins.

Through significant reduction of the 'performance gap', the holistic approach introduced in MOEEBIUS enhances the ability of ESCOs to guarantee attractive energy savings. "This will, in turn, eliminate the need for the addition of risk-hedging costs on-top of pure energy services, consequently increasing the payback attractiveness of energy performance contracts and reinforcing confidence of customers regarding EPC effectiveness. This is crucial for the growth of the ESCO market, especially at EU level," says Ander Romero.

and automated adjustment of heating, ventilation and air conditioning systems as well as lighting loads. The introduction of a user-driven innovation approach in MOEEBIUS will also ensure the involvement of end-users throughout the whole duration of the project, so as to fully cover their needs and expectations.

To achieve this goal, the innovative MOEEBIUS solutions will be validated in real-life conditions over an extensive 20-month pilot roll-out period in a variety of buildings. This evaluation will be performed under different environmental, social and cultural contexts/criteria in three dispersed geographical areas: London (UK), Mafra (PT) and Belgrade (RS).

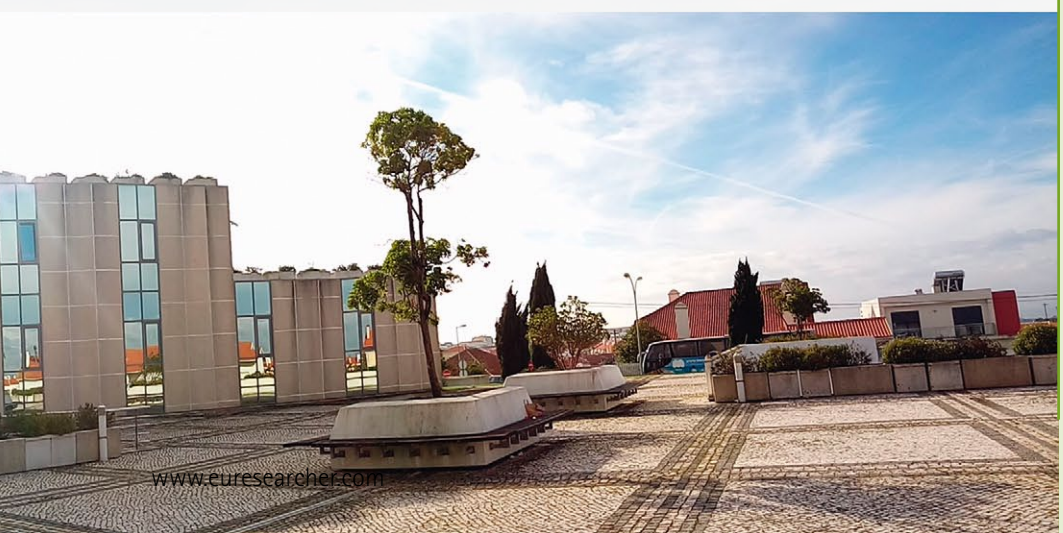
Moreover, "MOEEBIUS will establish a complete awareness and communication with ESCOs, Maintenance Companies, Facility Managers, Aggregators, either involved in or affected by the project," says Ander Romero. To this end, the MOEEBIUS Living Lab involves end-users right from the genesis of a new idea, creating the motivation to share and discuss their experiences, expectations and requirements. This is a collaborative environment where all stakeholders co-create the solutions leading to a natural acceptance by all MOEEBIUS end-users – people who will be empowered not only to test, evaluate and report their own experience with the MOEEBIUS framework, but mainly to live with it and smoothly accept and incorporate the MOEEBIUS system in their everyday lives.

These highly accurate predictions, simulations and optimizations are possible due to implementation of dynamic models reflecting user comfort and overall behaviour in the built environment, enhanced district heating models, novel Indoor Environmental Quality models and short-term weather forecasts

Humans at the centre of MOEEBIUS

Energy performance optimization in buildings relies heavily on the deep and comprehensive understanding of real-life complexities imposed during actual operation. Such complexities span not only physical systems (buildings, districts and their equipment) and weather fluctuations, but also occupants and their behaviours.

This is the reason why humans are placed at the centre of all optimization processes applied in MOEEBIUS. Energy performance optimization will use human-centric approaches that allow for continuous assessment of relevant aspects



At a glance

Full Project Title

Modelling Optimization of Energy Efficiency in Buildings for Urban Sustainability (MOEEBIUS)

Project Objectives

MOEEBIUS introduces a Holistic Energy Performance Optimization Framework that delivers innovative tools which deeply grasp and describe real-life building operation complexities in accurate simulation predictions. The system reduce the "performance gap" and enhance optimization of building energy performance.

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Ander Romero - MASc in Thermal Engineering, MSc Industrial Engineer - is a Project Manager in the Sustainable Construction Division of TECNALIA. He joined TECNALIA in 2007 as a senior researcher in the field of energy efficiency in building design and retrofitting, focusing on energy modelling and integration of innovative and sustainable solutions to optimize urban and building energy performance. He is currently coordinating several H2020 and FP7 projects related to energy efficiency and demand response.

Dr Pablo De Agustin is an energy efficiency researcher at TECNALIA, he has worked on energy efficiency in buildings and renewable energies' integration since 2011. His professional background includes simulation and experimental works focused on energy efficiency, electric and thermal metering, buildings as energy storage systems, and trigeneration and self-consumption solar heating and cooling systems.

Dawid Krysiński Ph.D. – Junior Project Manager at ASM – Market Research and Analysis Centre. His activity focuses on preparation of market and social analysis, exploitation plans, IPR strategies and business models in the field of energy efficiency and green construction practices. Currently, he is involved in several HORIZON 2020 projects leaded by ASM.

MOEEBIUS