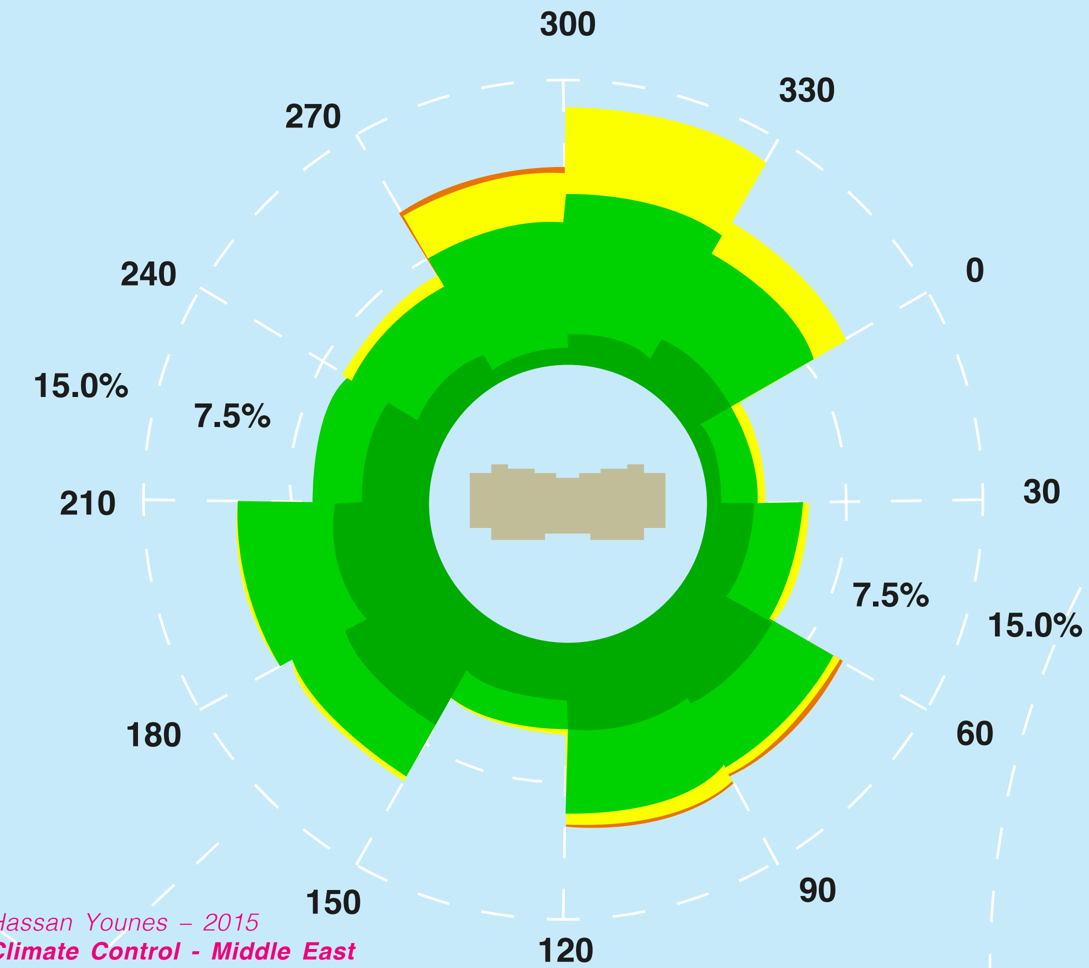
Energy Modeling / Need for a Revisit



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“it is easy to create a model, run a simulation and get flashy results. But are those results correct?”

Pointing out that energy modelling software simulation often yields results that do not necessarily reflect future or current operation and use of a building, Hassan Younes makes a cogent case for more accurate models that could not only give a realistic picture but also contribute to the calculation of a building’s lifecycle cost and energy conservation.

Prediction is something humans have always craved. Reinventing a city’s future into a sustainable one requires a data-driven approach and a vision that is supported by accurate predictions. The prime pillar of sustainable cities is low energy consumption and low environmental impact. And the main contributor to energy consumption and carbon emissions in a city is the built environment. No wonder then that building performance is an aspect that is most focused on when devising an urban sustainability road map.

Energy modelling of a building involves modelling of heat, air, moisture, light, electrical energy and mechanical energy, to come up with a prediction of energy use and building thermal and environmental conditions that could guide the designer or operator into the most cost-effective and efficient path to “greening” a building. Simulation of energy requires not only a description of a building’s geometry, construction materials, energy systems and equipment but also a characterisation of the building utilisation through occupancy, and equipment schedules. In addition, a specification of the building operation is necessary, commonly through a definition of setpoint schedules, HVAC system availability and sequencing of multiple devices of HVAC equipment like chillers staging and control loops.

Energy modelling has become an essential part of building standards and rating systems, thanks to advancement over the years, its widespread availability, significance and proven benefits in lowering a building’s energy consumption.

In today’s market, especially in the GCC region, energy modelling is mainly used for compliance with rating systems. Developers and building owners do not require energy modelling as a project design deliverable, unless required by a sought-after building rating or an urban authority. Therefore, in most cases, once the approving or certifying authority accepts the modelling results, the energy model perishes, with the owner satisfied by the number of points achieved or the bare minimum that the project can get away with to receive the building permit. In this context, a lot of energy modellers have surfaced in the market to cope with the energy modelling demand from LEED and Estidama. Most of those modellers have become familiar with the energy modelling rules that are set by ASHRAE standard 90.1 Appendix G. Yet, only a few have mastered the sound theoretical background that is much needed to arrive at correct results. With the currently available software, it is easy to create a model, run a simulation and get flashy results. But are those results correct? Do they truly reflect the future or current operation of the building? Such low quality, inherently incorrect and totally deceptive energy simulation results create hurdles in the way of energy modelling, proving its worth and convincing developers of its tremendous benefits that outweigh the relatively insignificant added design cost. This is also the very reason why organisations like ASHRAE have taken it upon themselves to produce standards and guides to energy modelling, and to list energy modelling certifications for professionals that provide assurances that the certified professional is well-versed in the skills required to build sound energy simulation models.

In addition to containing and limiting the operational energy consumptions, a well-developed, accurately built and fine-tuned energy simulation model could be an essential and major contributor to the calculation of a building’s lifecycle cost – an aspect that is indispensable to assessing the success of a development. Not only that, but a living model that evolves from design to construction, and construction to operation, being fine-tuned throughout the way, would help inform decisions of future retrofits, drive energy management, and help in measurement and verification, and reduce the lifecycle cost of a building.

Only a few consultants in the GCC region, and even worldwide, revisit buildings that they have modelled to compare the design modelling results with the actual figures from measured data and energy bills. Recent studies conducted on schools in the UK have attempted to determine the extent of the difference between predicted and actual energy use. An average energy consumption of 2.4 times the design value was reported for new schools. The worst case studied was 10 times the design figure. This clearly indicates that there is a disconnect between how the building has been designed to be used and how it is actually being used. Either that, or the problem lies in the methodology and correctness of how the design energy value has been calculated.

Moving forward, some developers worldwide have started asking for performance in use and energy use intensity (EUI) thresholds to be met by the designer/contractor. Ideally, designers and contractors could be held responsible for a wide discrepancy between actual energy use index and the one predicted during the design and construction stages. Such practices will raise the level of professionalism in the energy modelling sector and will help reduce the number of uninformed modellers, by distinguishing them from the experienced and certified ones.

It is also, however, vital to note that differences between predicted and actual energy usages are not always attributed to poor modelling practices. A design that shows adequate performance, when subjected to computer simulation at the design stage, may depend on assumptions that are not reflected in the actual use of the building. This is why it is important to revisit the building in the post-occupancy stage and update the model to reflect real operational patterns. By doing so, designers can defend their positions by noting operational behaviours that are different from the agreed assumptions during the design stage, like occupancy hours, or pinpointing wrong facility management operation of different energy consuming systems. This exercise would also help designers in adopting more realistic assumptions for their ensuing projects.

In a nutshell, and for the construction market to realise and reap the benefits of energy modelling, it will take knowledgeable and experienced modellers to showcase those benefits on the one hand, and well-versed developers and building owners, on the other, to insist on accurate and calibrated living models that would span the life of a building, and for those models to be developed by certified professionals. Only then can the sector evolve and prove its worth in the sustainability revolution of cities. ■