

CitA
BIM GATHERING 2019

Digital Engineering,
Data Analytics &
Model Calibration
The future of building
operation?



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Delivering **better outcomes**
for Irish Construction



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Pioneers of Building Simulation



VE Technology & IES people at the core of all we do

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In over 140+ countries IES are helping... Architects, Engineers, FMs, Cost Consultants, BREEAM Assessors, LEED Assessors, Developers, ESCOs, Contractors, Local Authorities, Governments & Academia







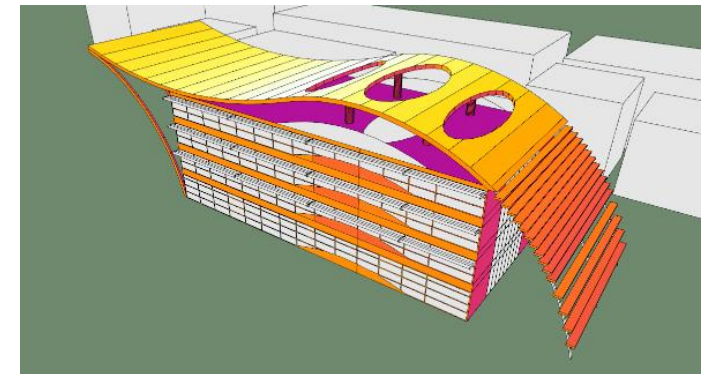
- When speaking to building owners/occupiers, we regularly encounter a situation where the buildings they have had designed and now occupy do not perform as they expect in terms of energy consumption.
- What are the clients expectations based on? BER's/EPC's?
- Why is this not a good approach?
- Utilizing a combination of Building Simulation Tools and Operational Building Data will lead to the Building Owner and Project Team Better being better Informed.



“If you can't measure it, you can't improve it.”

From Lord Kelvin

Digital engineering, data analytics, energy performance simulation and calibration now give the opportunity for building owners to measure building performance across the entire lifecycle of a building.





The Problem

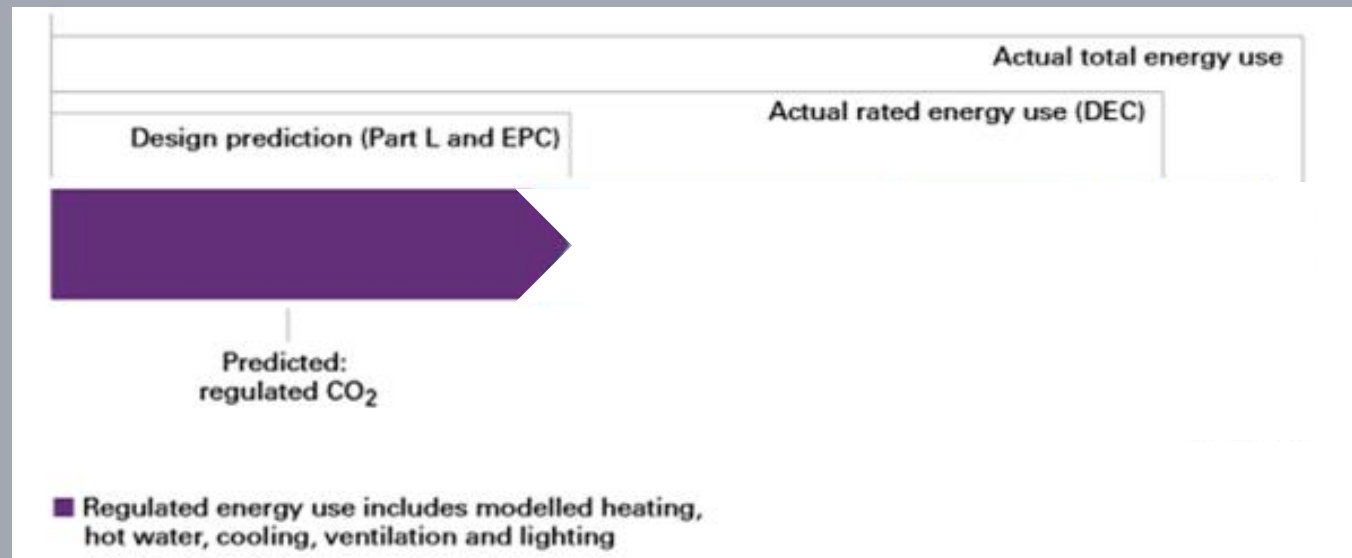


Part of the Problem and Part of the Solution



Root Causes of Performance Gap

Predictions based on compliance models

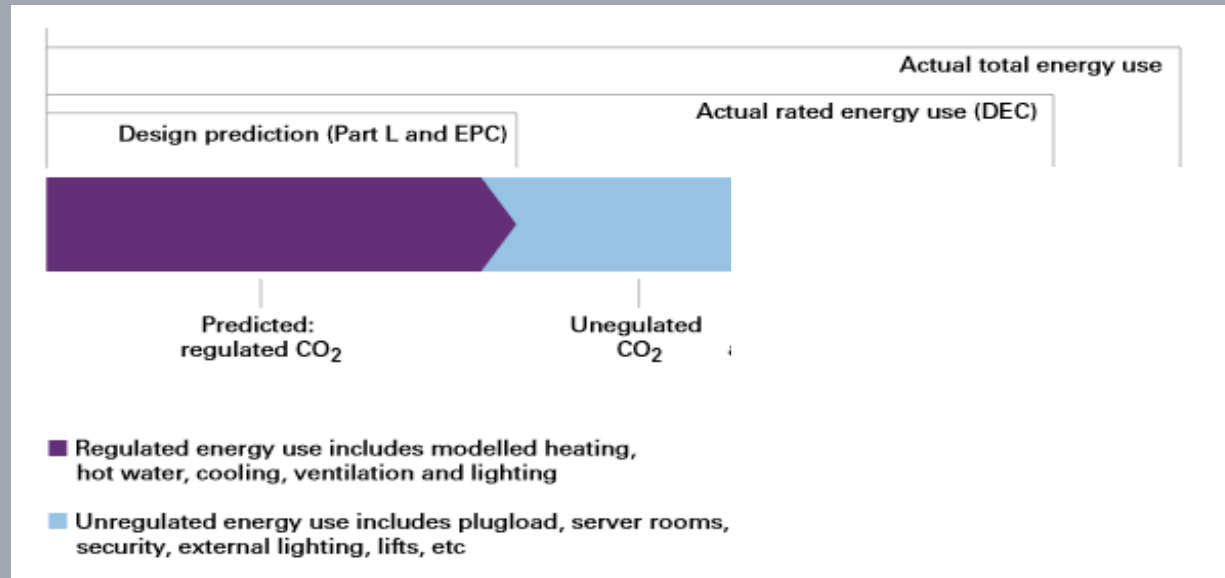


From Carbon Trust: Closing The Gap



Root Causes of Performance Gap

Predictions based on compliance models

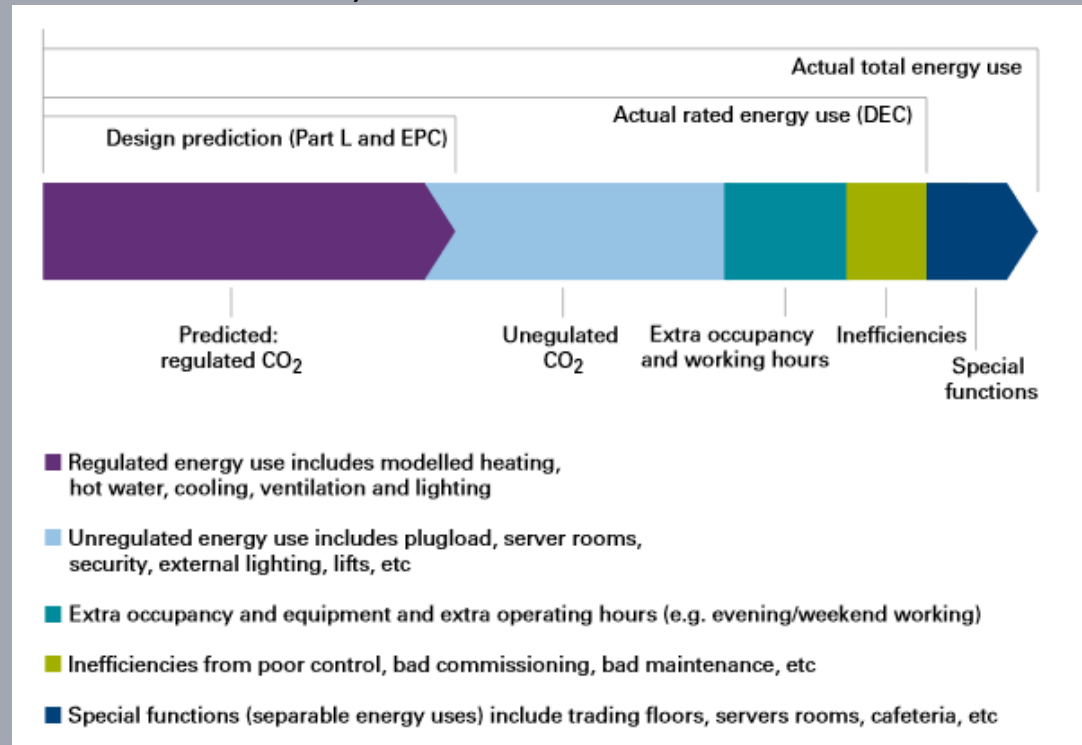


From Carbon Trust: Closing The Gap



Root Causes of Performance Gap

Inefficiencies: Poor Control, Bad Maintenance





The Opportunity



- The key finding from the recent Design for Performance feasibility study was that the power of advanced modelling, now routine in Australia, is rarely used in the UK because clients do not ask for it and don't know why they should.
- The additional cost of undertaking advance modelling is minimal compared to the returns you can get.



- In 2016, HOK in the US published Return on Investment figures related to Energy Modelling undertaken on their projects.
- They tracked both modelling costs and predicted energy savings for a large number of projects over several years.

Value of Advanced Modelling



- Energy modelling was found to have a typical payback period of 1 or 2 months!
- The most common example of this was through the elimination of oversized and unnecessarily expensive, HVAC systems.

Project Name	% Modeling Fees vs Gross Fees	Annual Modeled Energy Cost Savings	Payback on Modeling Fees in MONTHS
Office Building	0.7%	\$122,876	2
Office Building	0.5%	\$306,692	1
Justice Center	0.8%	\$350,000	3
Convention Hotel	0.6%	\$233,791	1
Regional Hospital	2.4%	\$3,300,000	1
Government Office Building	3.3%	\$186,000	4
Government Building 20	1.1%	\$224,276	2
Cancer & Critical Care Tower	0.6%	\$853,013	3
Institutional Research Center	0.6%	\$340,000	3
Energy Institute	2.5%	\$169,432	7
Institutional Research Facility	1.0%	\$302,169	1
Science Teaching and Research Facility	0.8%	\$419,599	1
Corporate Headquarters	1.0%	\$239,835	4



“Owners and project managers do not accept reduced HVAC systems based on engineering judgment—they demand to see numbers!” Modelling may not be necessary to designing an energy-efficient building, but it is necessary to getting that energy-efficient design built.

Anica Landreneau, director of sustainability consulting at global architecture and engineering firm HOK

In the UK and Ireland, the value of advanced modelling is being increasingly recognised as firms such as Arup, Hoare Lea, and WSP set up building performance and digital engineering groups.

Modelling, Commissioning and Metering



- A well-developed model which produces an accurate estimation of building consumption is a valuable tool during the commissioning process.
- Differences between building performance and modelled behavior can be investigated to determine whether the differences are driven by building faults or by incorrect assumptions in the model.
- A well thought out sub- metering strategy which provides granular data on end-uses facilitates this comparison between model and reality reducing uncertainty in the diagnosis of building issues.



A Potential Solution



- Calibration is the process of improving and verifying the accuracy of a simulation model by systematically comparing model outputs to real measured data from a building.
- Generally, at a minimum, whole building electricity and heating fuel energy will be the key model outputs but additional comparisons against sub-metered energy improves model accuracy and reduces uncertainty.





- The applications of calibration are growing rapidly, but can be classified into two main areas:
- Measurement and Verification (M&V) of achieved savings due to the implementation of an Energy Conservation Measure (ECM) whether that is a retrofit or an operational/control measure.
- Prediction or targeting of future savings; to assess impact of potential ECMs before their installation, undertake fault detection or use existing/past data to set future targets of energy reduction.

The Benefits of Calibrated Modelling



- Such models can be used in identifying sub-optimal performance, system faults, and can better determine and measure and verify the implications of proposed ECMs and retrofit options to the building in terms of consumption, cost and comfort.
- Another benefit of calibrated modelling is “Monitoring and Targeting” (M&T). By using calibrated model results to define targets for reducing energy consumption it is possible to eliminate operational drift within a building.

Barriers to Calibration



- The main barriers to calibration can be grouped into issues linked to lack of standards and the time/cost expense of model development, alongside the need to use different tools/methods to achieve high levels of accuracy.

Calibrated Modelling in Action

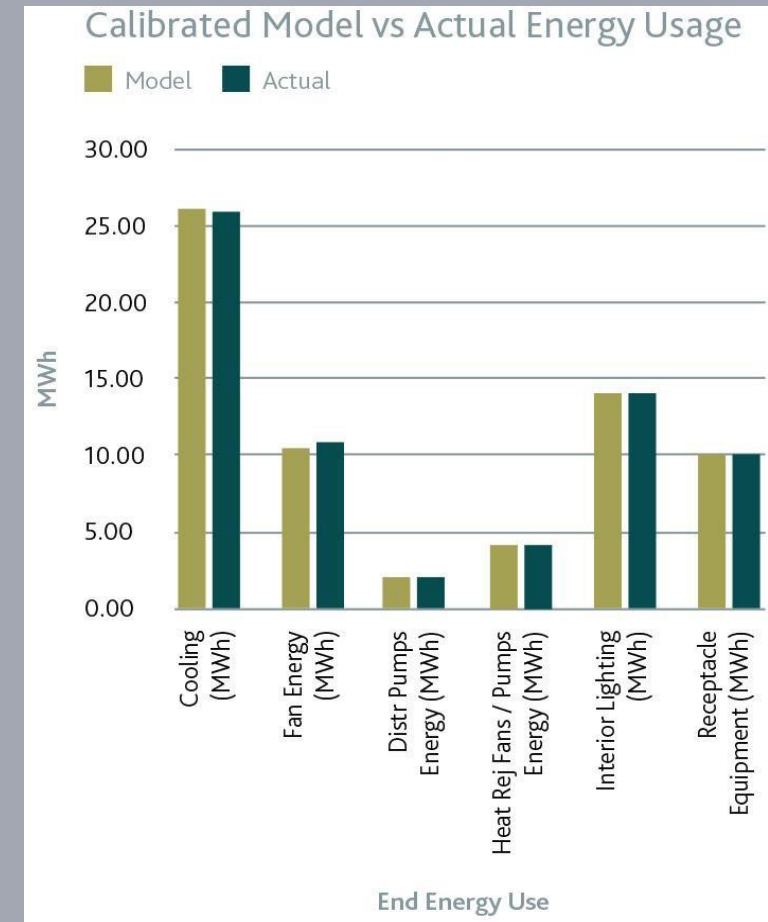


Building and Construction Authority Campus in Singapore project looked at the effectiveness of different levels of energy models for different performance analysis requirements from master planning to calibration at the BCA Academy Campus in Singapore.

BCA created a highly calibrated detailed model of an existing Zero Energy Building, where measured data was used to improve the level of accuracy between the model and the actual performance to within +/- 5%,



Options to improve the buildings' performance were virtually assessed, ahead of making actual changes in the building.



Calibrated Modelling in Action



Even in this tightly controlled and monitored building, it was possible using the calibrated model to find a number of potential data issues, sub-optimal performance and potential retrofit measures. Their effects and resulting savings were simulated in the model. This included lighting savings of 12% if night-time lighting was eliminated



Given the benefits presented through this paper on the use of digital technology and data in the better design and operation of the building stock, the construction industry needs to radically transform its current processes to really take advantage of the opportunities.





Thank you - Gary.Nixon@iesve.com