CIBSE YEPG and BSG Event
Advanced Simulation & Design for Performance
Hoare Lea, 12-13 Stable Street, London N1

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By following the process in a NABERS Commitment Agreement, Australian teams can now routinely achieve in-use operational energy performance ratings in line with the predictions of design stage models.
Delineation of whole building energy use between landlord (base building) and tenants to define a suitable metric for building energy efficiency and give agency to each party.

Energy scope for Base building rating

Energy for Tenant A rating
Energy for Tenant B rating
Energy for Tenant C rating
Energy for Tenant D rating

All energy use for the building

Tenants lighting, small power, ICT, etc.

All in common parts
- Lifts
- Hot water
- Whole building HVAC

By delineating, measuring, rating and disclosing base building operational energy performance, the base building rating expressed as NABERS stars has become a KPI for all stakeholders, FM to FD.
What has been achieved in Australia (new office buildings)

Annual energy use (kWh/m²NLA)

Base building star rating

MARKET TRANSFORMATION

2.5 stars Melbourne Average 2002
4.5 stars Melbourne Minimum 2018
5 stars Melbourne Average 2018
6 stars Melbourne Best 2018

What has been achieved in Australia (new office buildings)
How does London compare with Melbourne Australia?

Annual energy use (kWhe/m²NLA) vs. Base building star rating.
How achievable is a 5-star rating in UK?
DfP pilot study: measured vs modelled vs benchmarks

-1.1 stars
2.4 stars
3.0 stars
4.5 stars
5 stars

Gas (catering)
Gas for heating + hot water or District heating
District cooling
Refrigeration and heat rejection
Fans, pumps and controls
Humidification - if fitted (in Other elec for 5ES)
Catering and vending
Other electricity

Base building annual energy use (kWhe/m² NLA)
Factors behind change
What has been transformational in Australia 1 of 2:
Market asks for and values operational performance

- Virtuous circle when Better rating equated to Better building
- Investor decisions influenced by rating
- Developer competes to offer higher ratings
- Supply chain prioritises higher ratings
- Leasing agent recognise ratings in valuations and rent
- Occupiers demand higher ratings
What has been transformational in Australia 2 of 2: Commitment Agreements and Design for Performance

- Set target for measured base building rating
  - Integrate target into requirements for supply chain
  - Advanced simulation model to predict base building performance
- Independent Design Review to check target will be achieved
  - Intensive fine-tuning and monitoring against model targets
  - Verify & disclose rating; lessons learnt by supply chain
Project Agreement implications

Documentation to be provided to Scheme Administrator to demonstrate completion of:

• Advanced simulation
• Independent Design Review
• Responses to Independent Design Review
• Control plan
• Validation plan
• Quarterly monitoring reports
• Measured performance rating & disclosure (govt planning to mandate)
The point of much better modelling
Model confirms performance target is achievable under likely scenarios

Tests ability of design to perform efficiently under non-standard conditions

To improve performance, we must target performance

>>>>> weather
>>>>> hours of use and occupant/equipment densities in each tenancy
>>>>> voids
>>>>> all of the above

Strengthens resilience of design to whatever actual operational parameters might occur
Model empowers designers to specify optimum control and plant capacity

Tests benefits of “advanced” control strategies, leads to optimum approach

Underpins design of systems and controls which tailor services to demand through space and time: e.g. CO2 control of fresh air to each zone, VSD fans and pumps

Creates greater confidence to reduce plant capacity contingencies after off-axis scenario analysis quantifies load duration curves

Reduces costs and whole life carbon by avoiding wasteful systems over-capacity
Model helps defend design intent during RIBA stages 5 - 6

Prevents value engineering which undermines performance
  e.g. Proving the value of more sophisticated controls

Manages tenant fit-out proposals to sustain design intent
Model underpins commissioning, tuning-up and verification activities

Model creates collateral which identifies to all parties what should happen which can then be verified by detailed measurements

Operation teams can tune the actual building (BMS) to the simulation

Monitoring & Verification teams with monthly targets (budgets) for each sub-meter can track progress towards achieving rating and identify remedial measures where necessary

Original designers will improve their next design by learning from feedback

To improve performance, we must measure performance
Pilot study: measured performance vs advanced sim

Source: Darren Coppins, Built Physics Ltd
Conclusions
How engineers can make the difference

**Delineation**
Enables unfettered agency for whole supply chain to pursue achievable outcome

**Transparency**
Through measurement and disclosure - entrains all stakeholders into endeavour
Creates feedback for continuous improvement

**Accountability**
Design team commits to target
Simulation provides confidence design can achieve challenge
Engineers have skin in game: delivering target is KPI for success - owner and occupiers obtain the quality of building they asked for
Aiming to achieve zero