PREDICTED VS. ACTUAL ENERGY CONSUMPTION OF NON-DOMESTIC BUILDINGS

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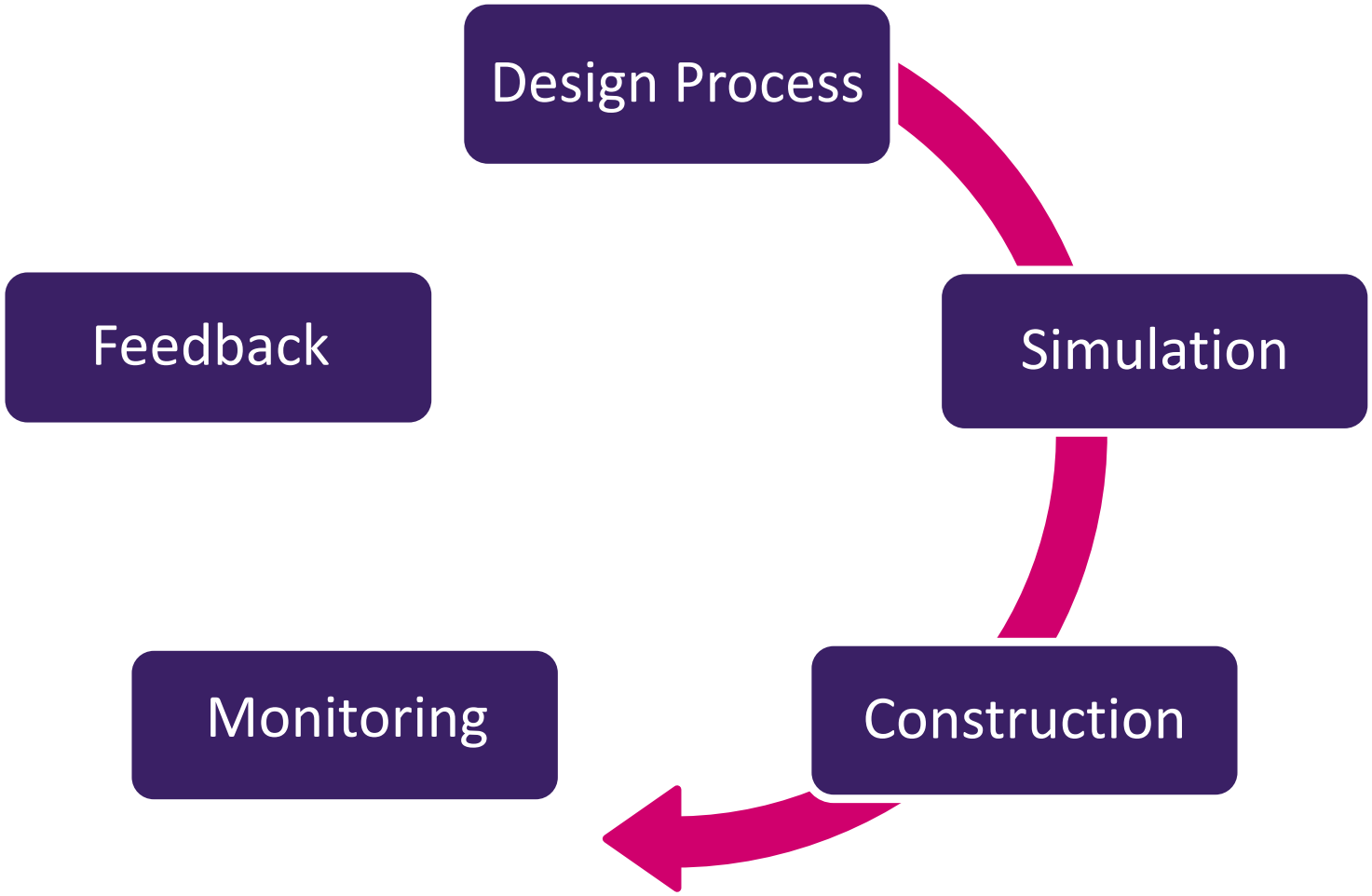
AECOM

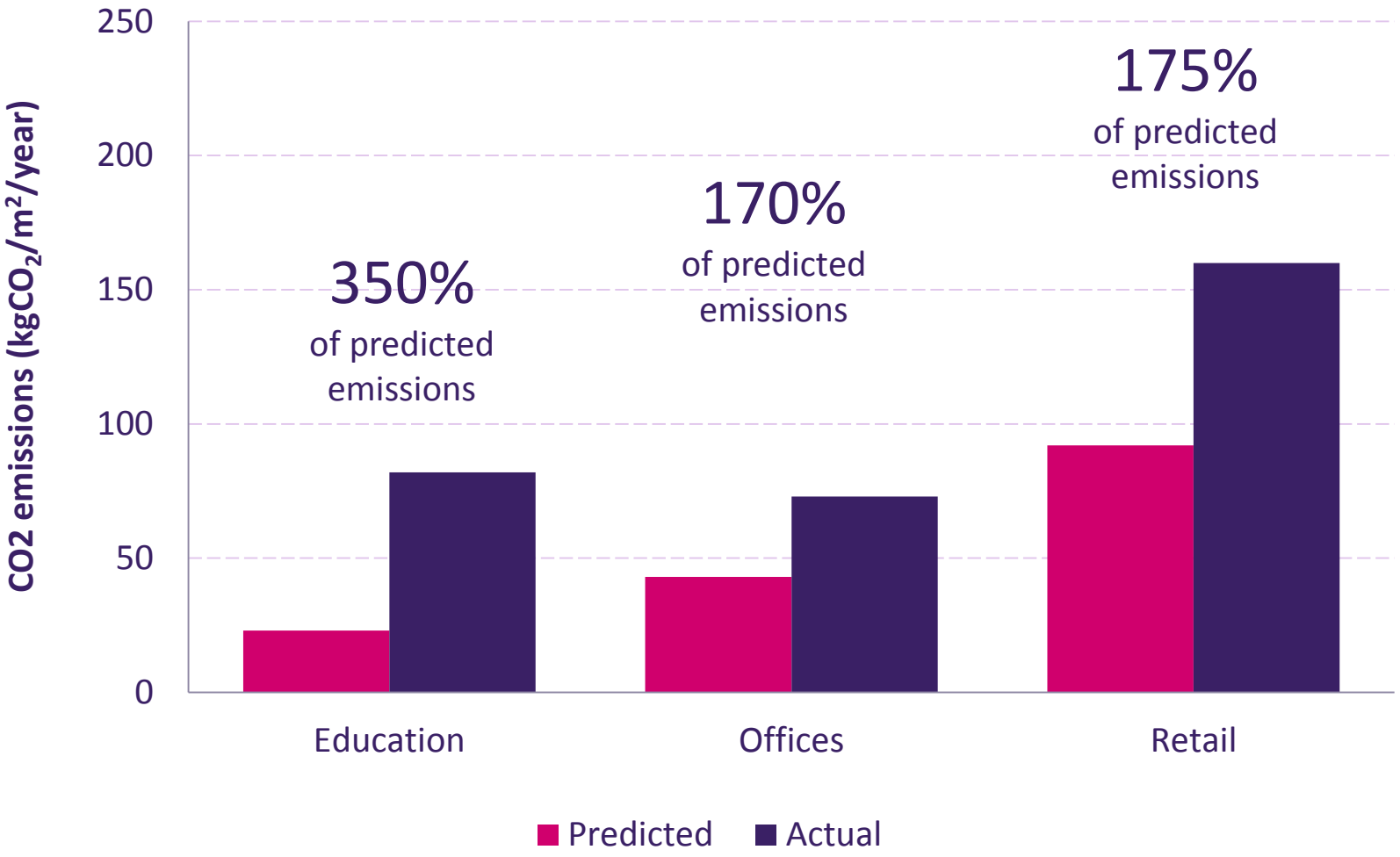
PRESENTATION OVERVIEW

- Introduction to ‘The Performance Gap’
- Case study of multi-tenanted office building in London
- Detailed analysis of single tenant electricity consumption
- Predictive models based on monitoring data
- Results & conclusion
- Future work

INTRODUCTION

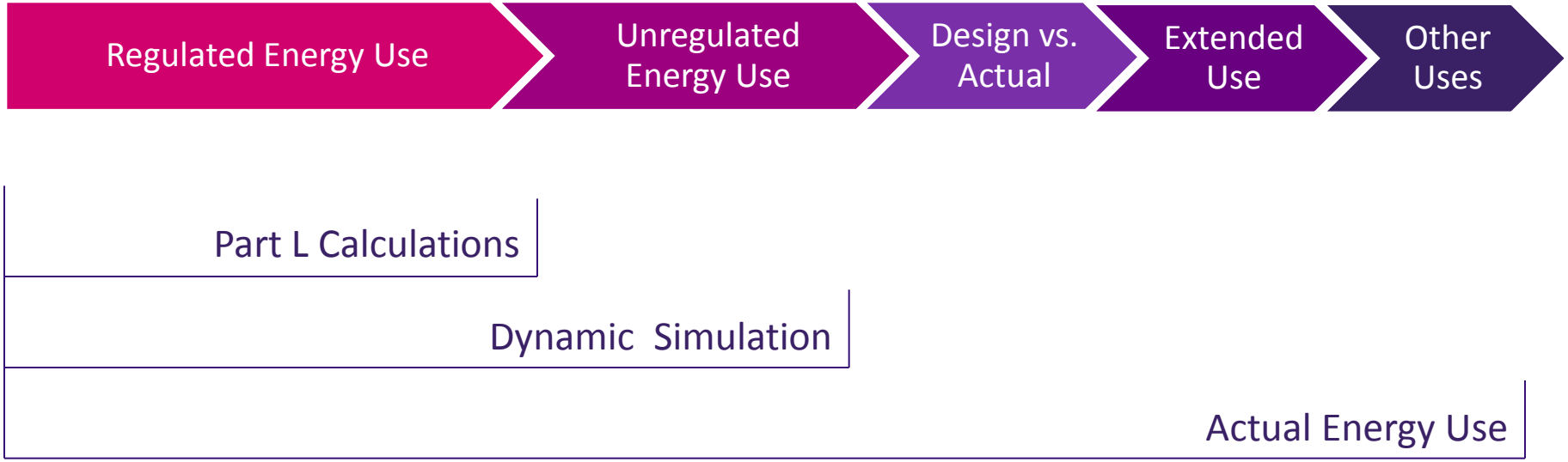


THE PERFORMANCE GAP



Source: www.carbonbuzz.org

THE PERFORMANCE GAP



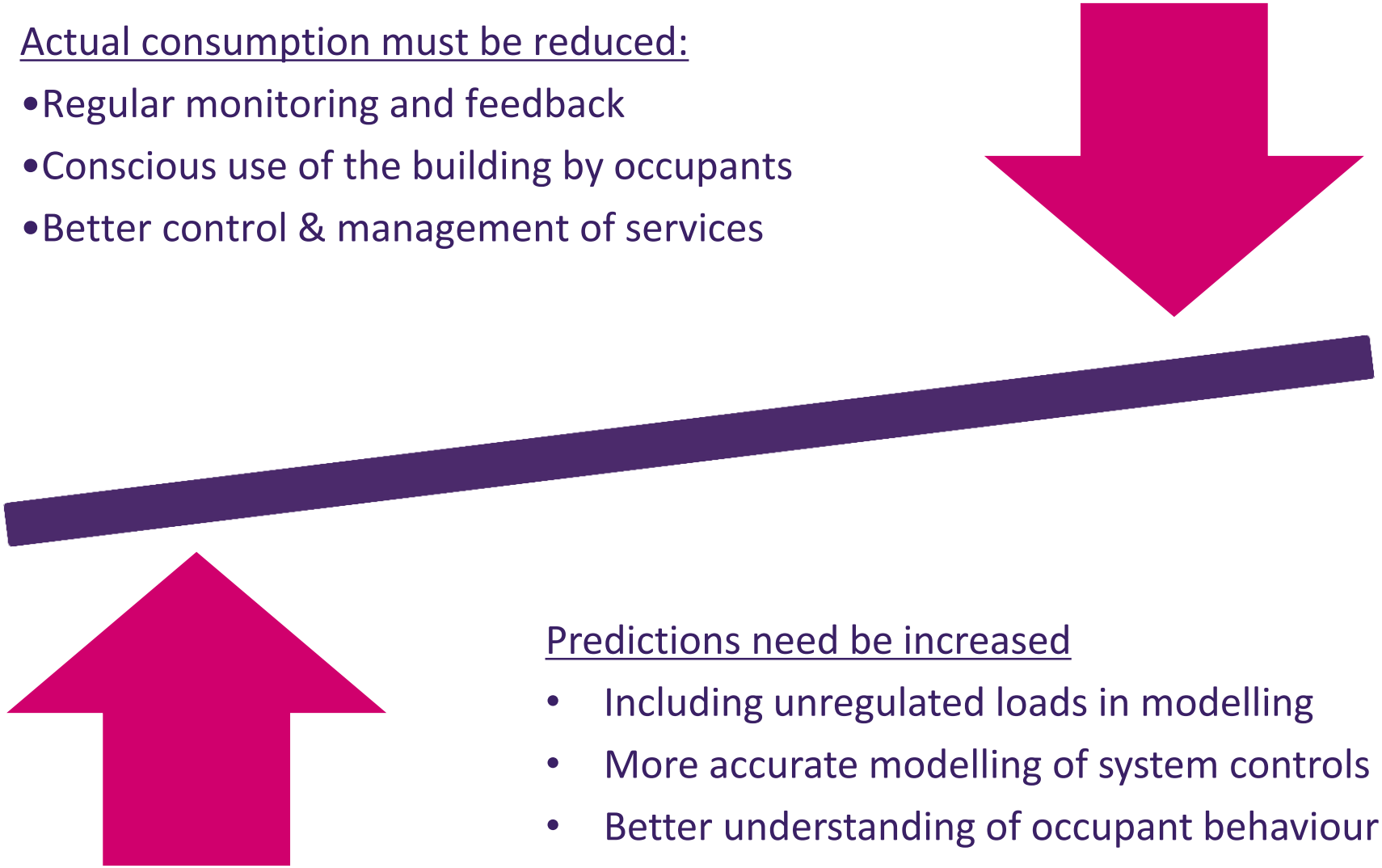
Regulated Energy: Fixed building services, heating/cooling & internal lighting

Unregulated Energy: Plug loads, servers, external lighting, vertical transport, etc.

BRIDGING THE GAP

Actual consumption must be reduced:

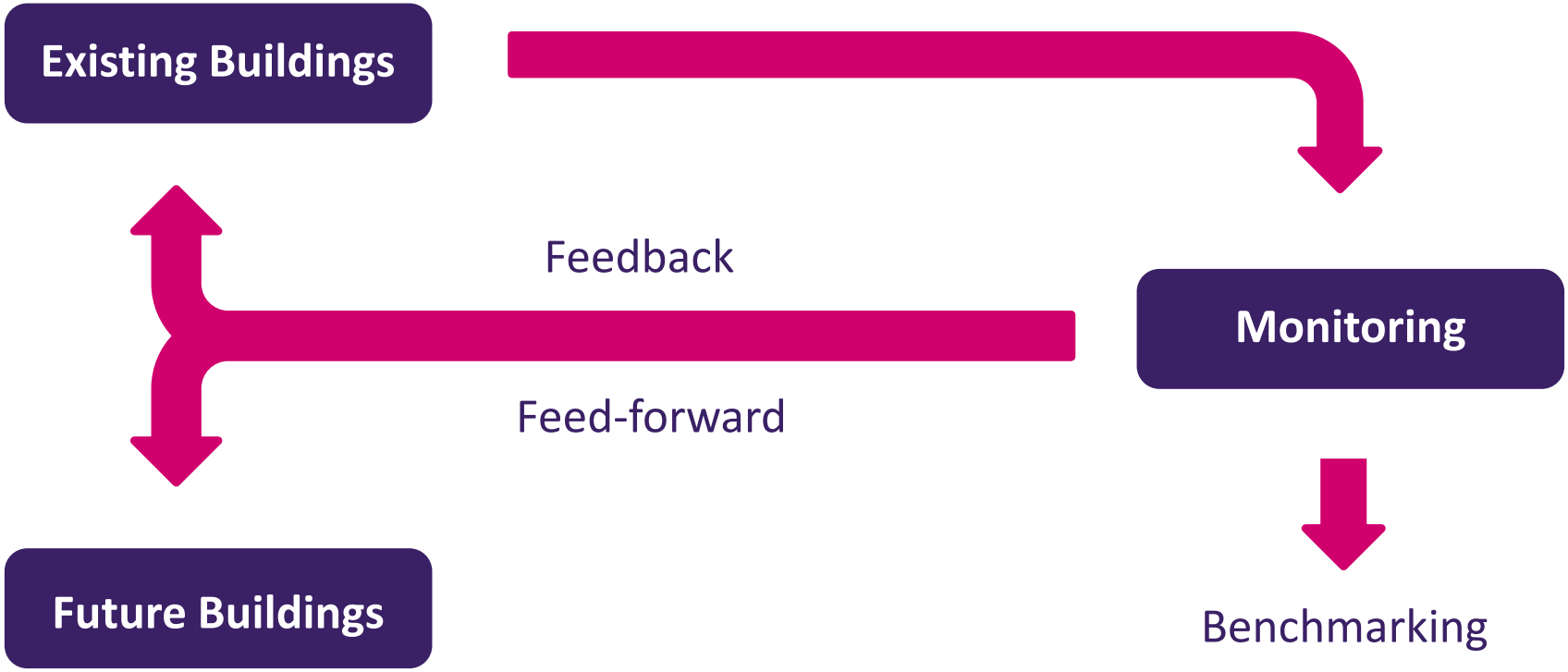
- Regular monitoring and feedback
- Conscious use of the building by occupants
- Better control & management of services



Predictions need be increased

- Including unregulated loads in modelling
- More accurate modelling of system controls
- Better understanding of occupant behaviour

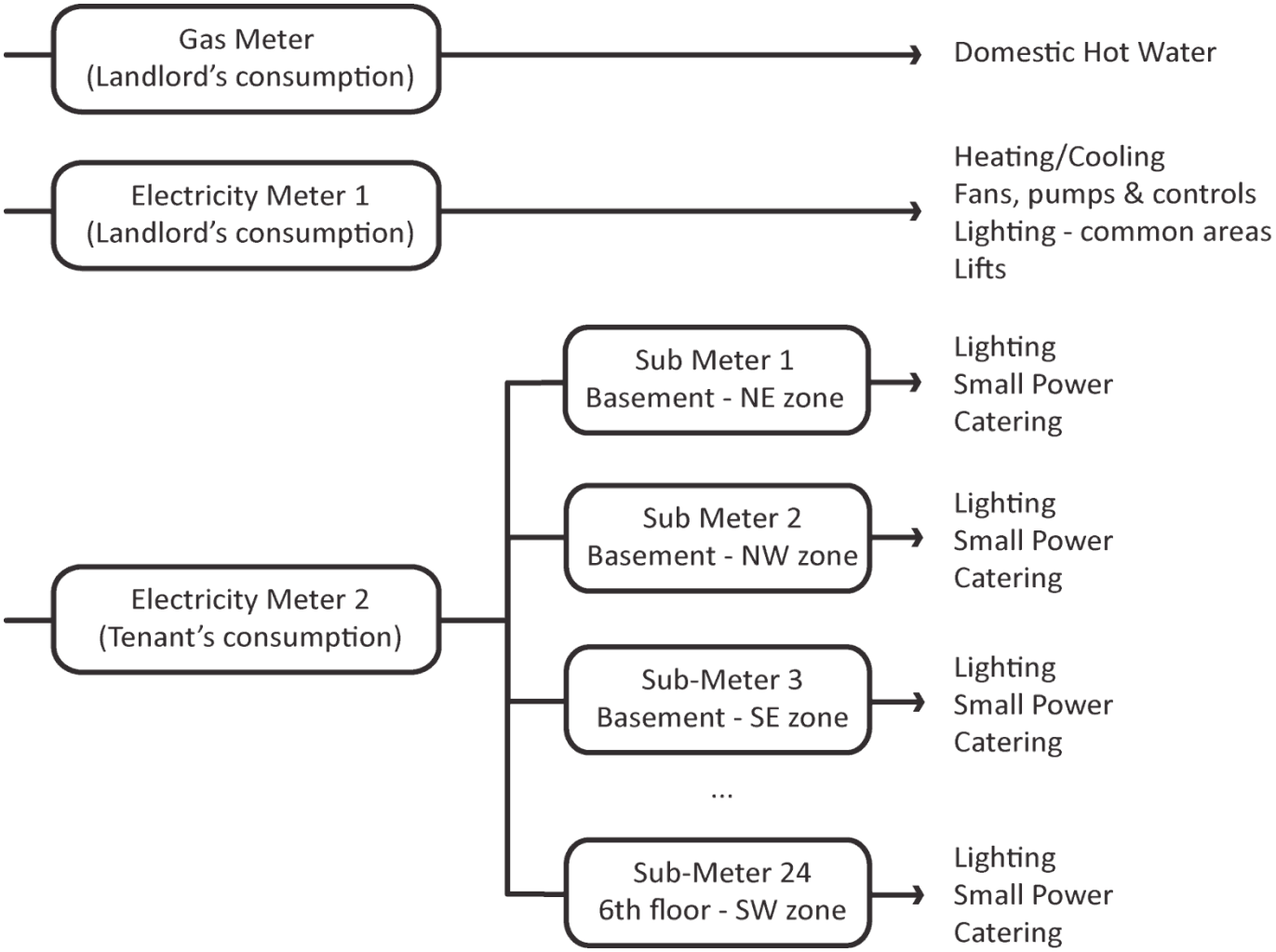
THE FEEDBACK LOOP



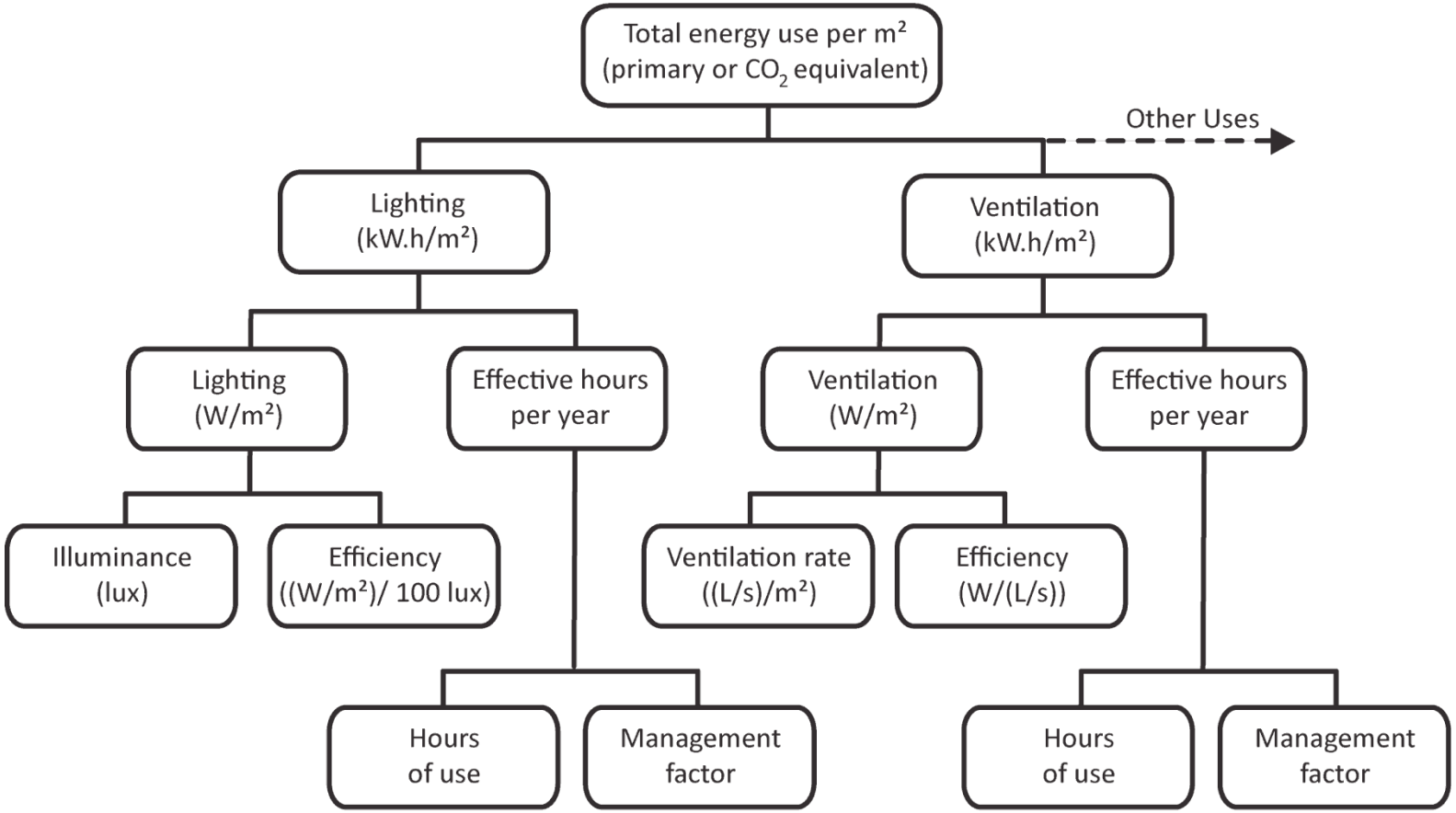
CASE STUDY

MULTI-TENANTED OFFICE BUILDING

METERING STRATEGY



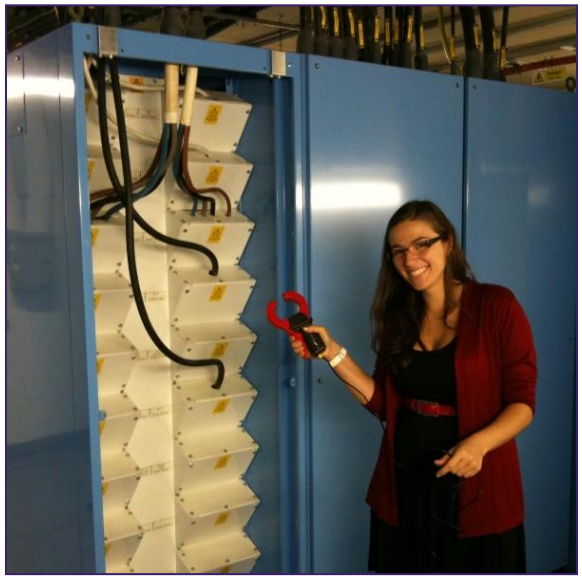
MONITORING METHODOLGY



Source: CIBSE TM22 Energy Assessment Reporting Methodology

MONITORING EQUIPMENT

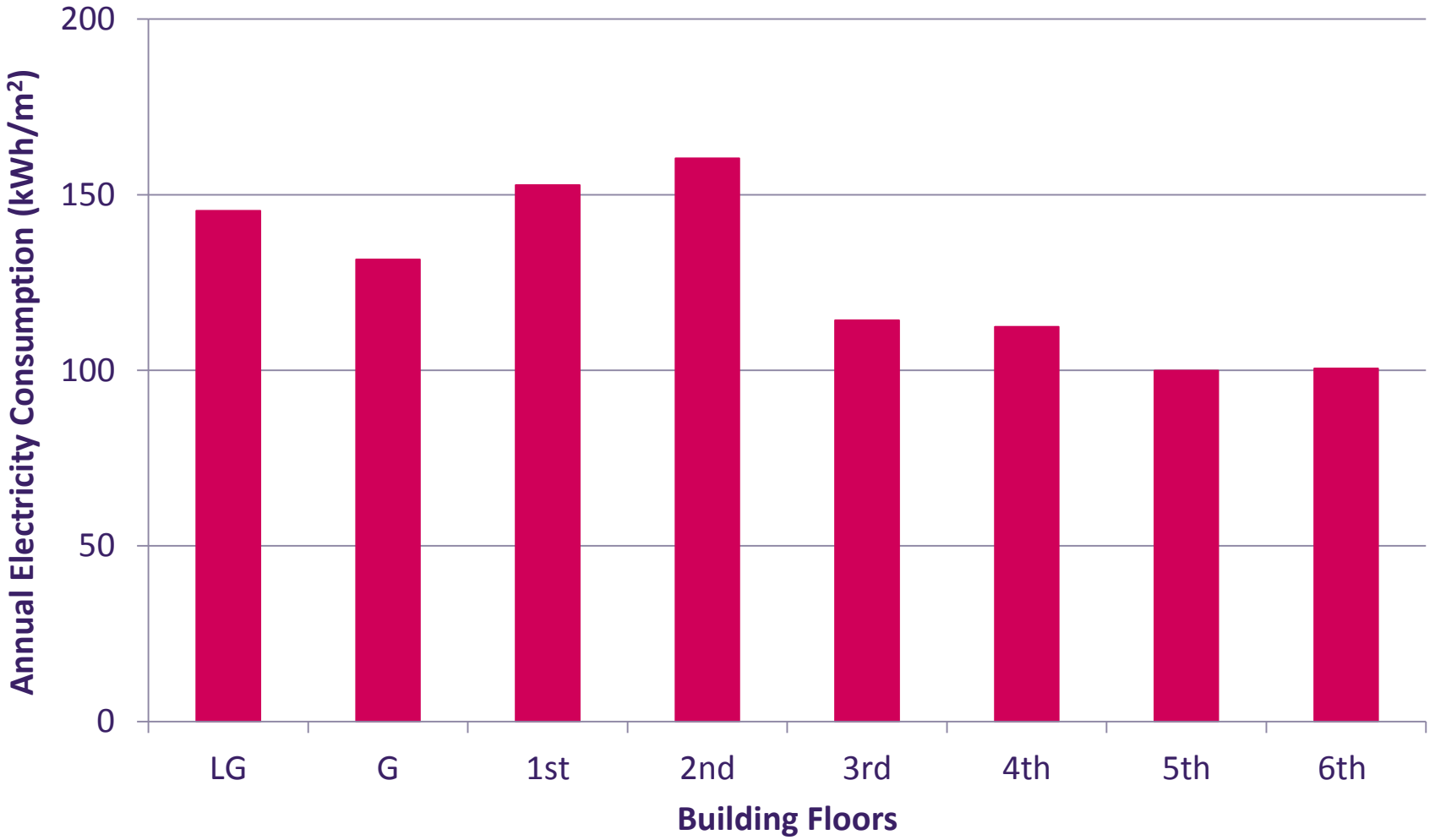
Monthly Meter Readings



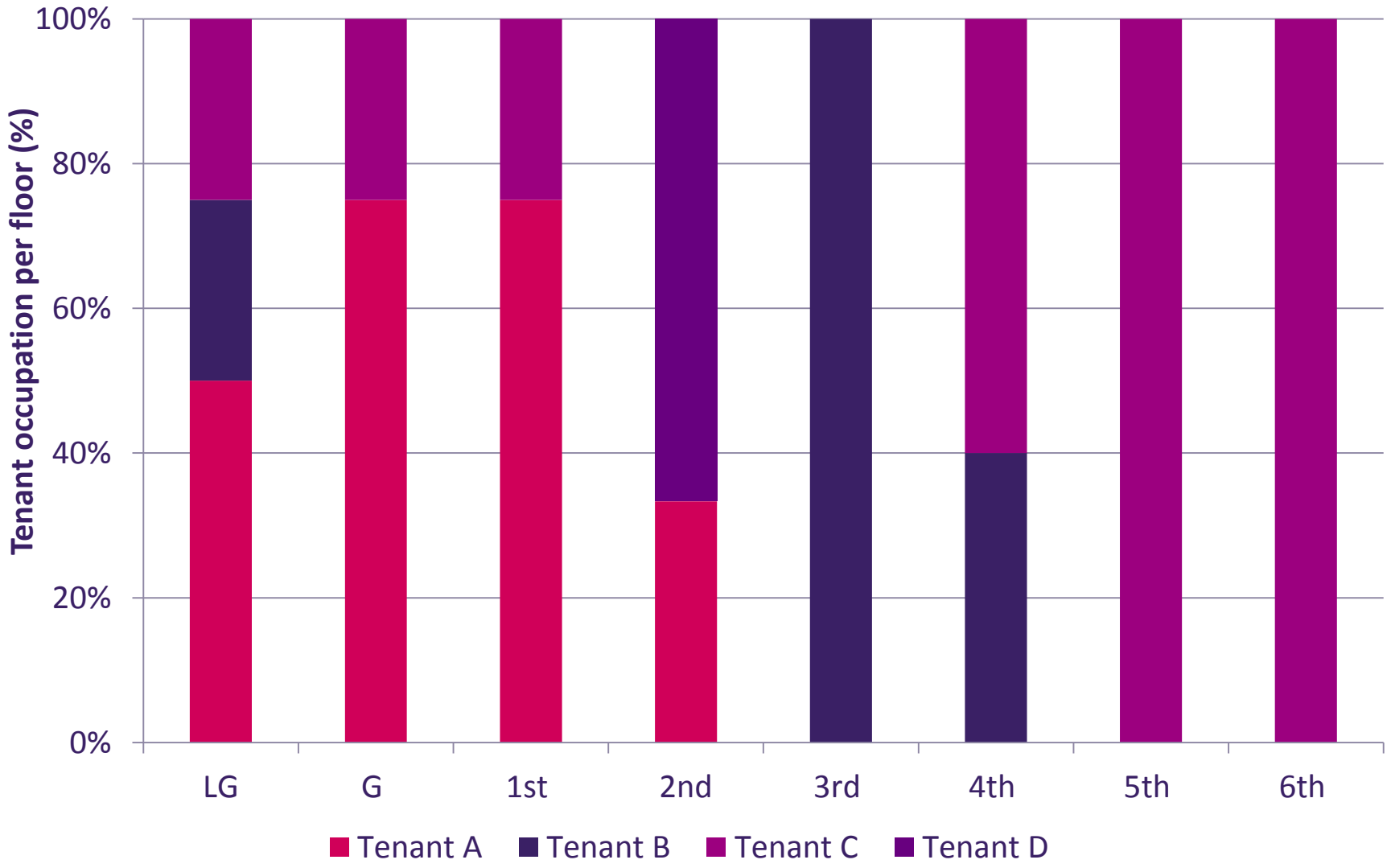
3-Phase CT Clamps connected to a SP Max Data Logger

ZigBee Plogg Electricity Monitor

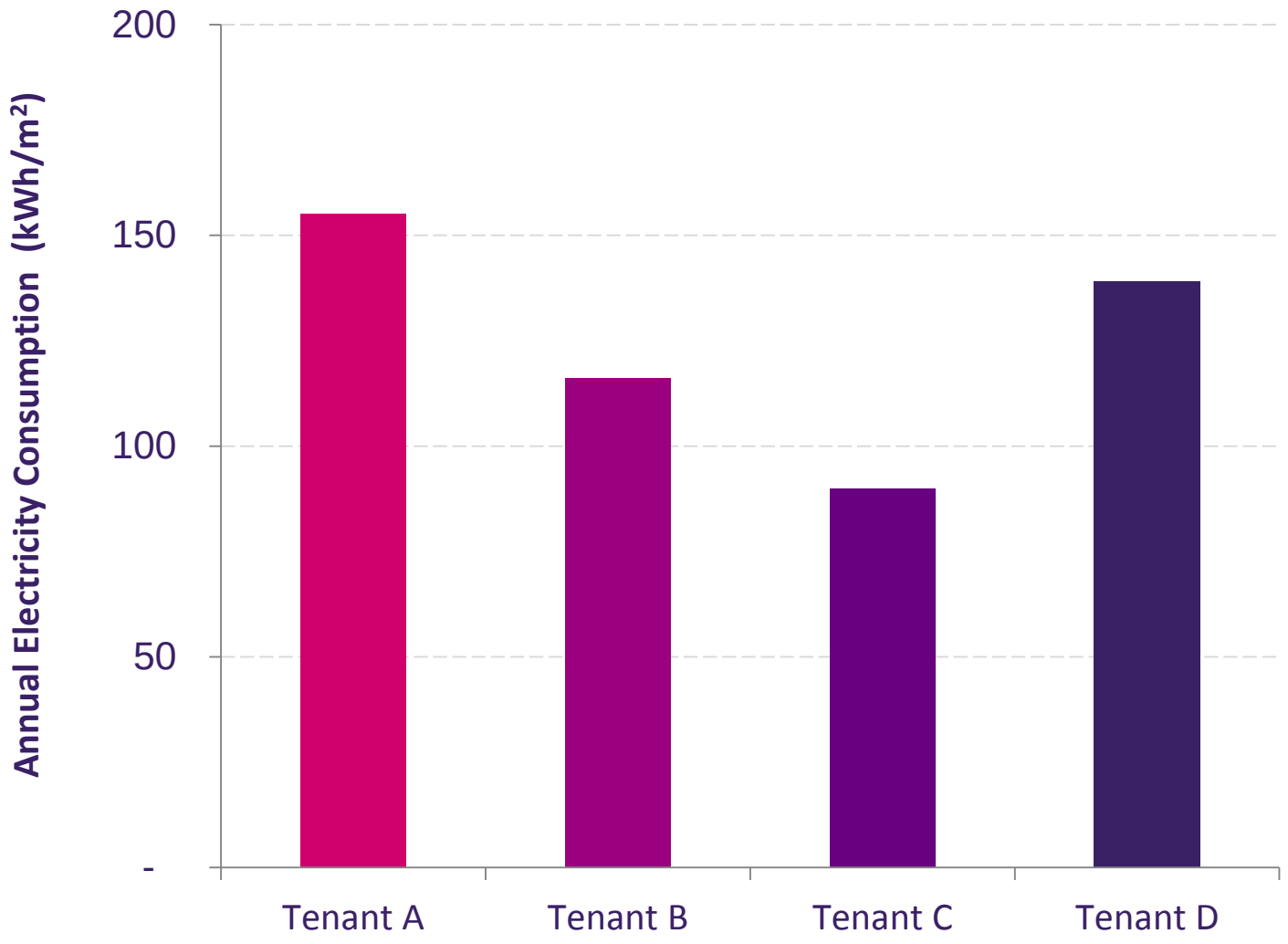
ELECTRICITY CONSUMPTION BY FLOOR



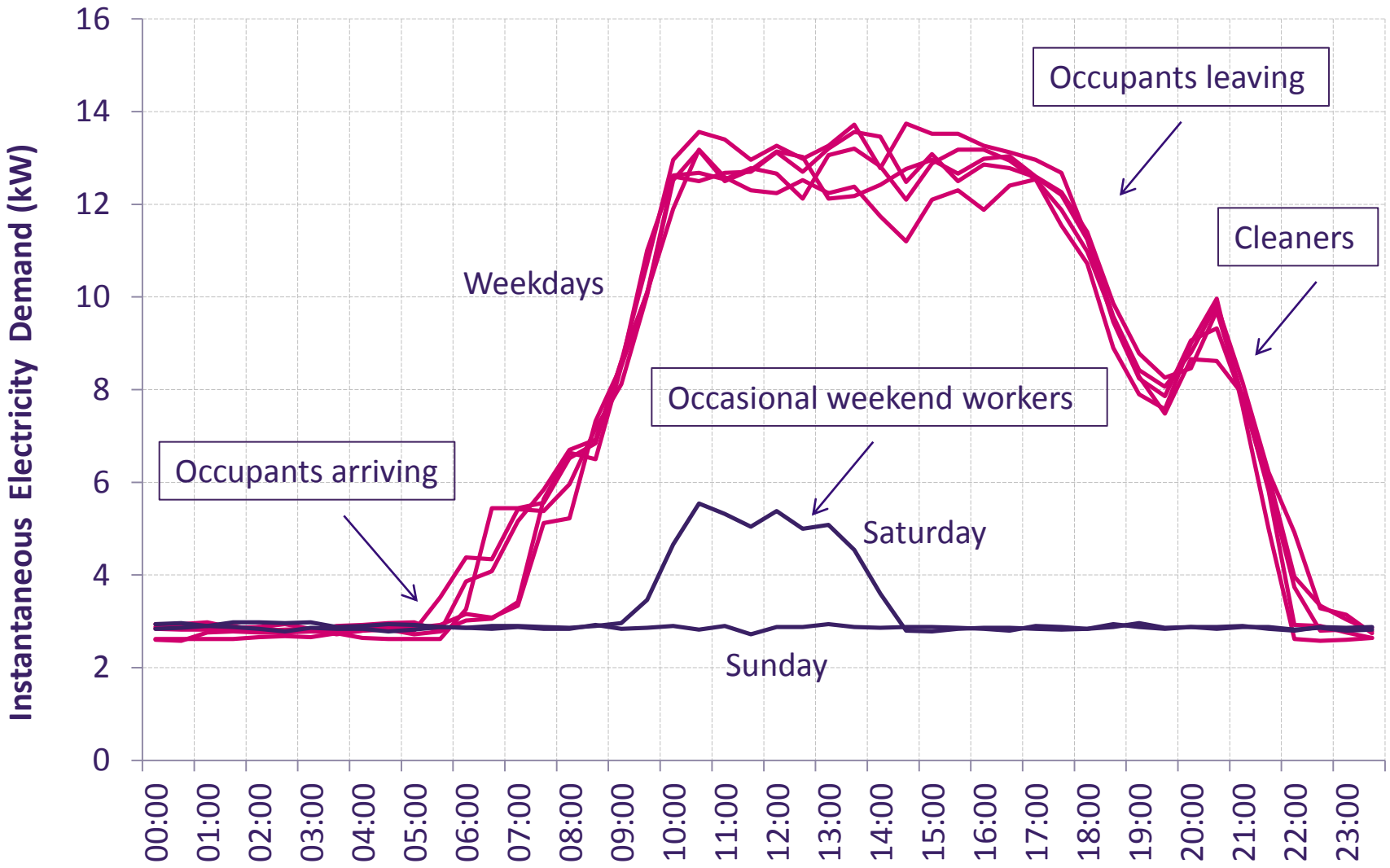
TENANT OCCUPATION BY FLOOR



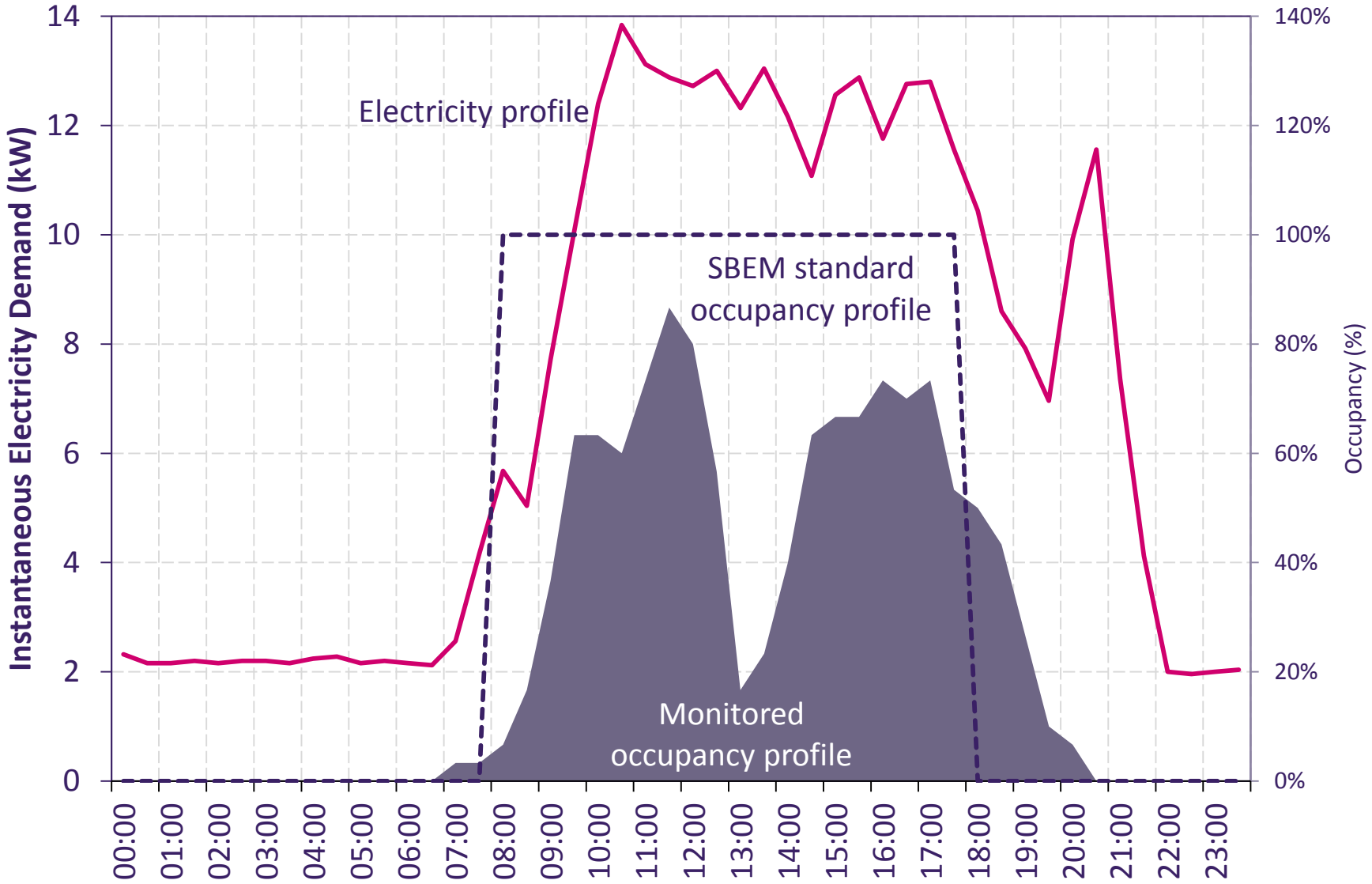
ELECTRICITY CONSUMPTION BY TENANT



ELECTRICITY CONSUMPTION PROFILES



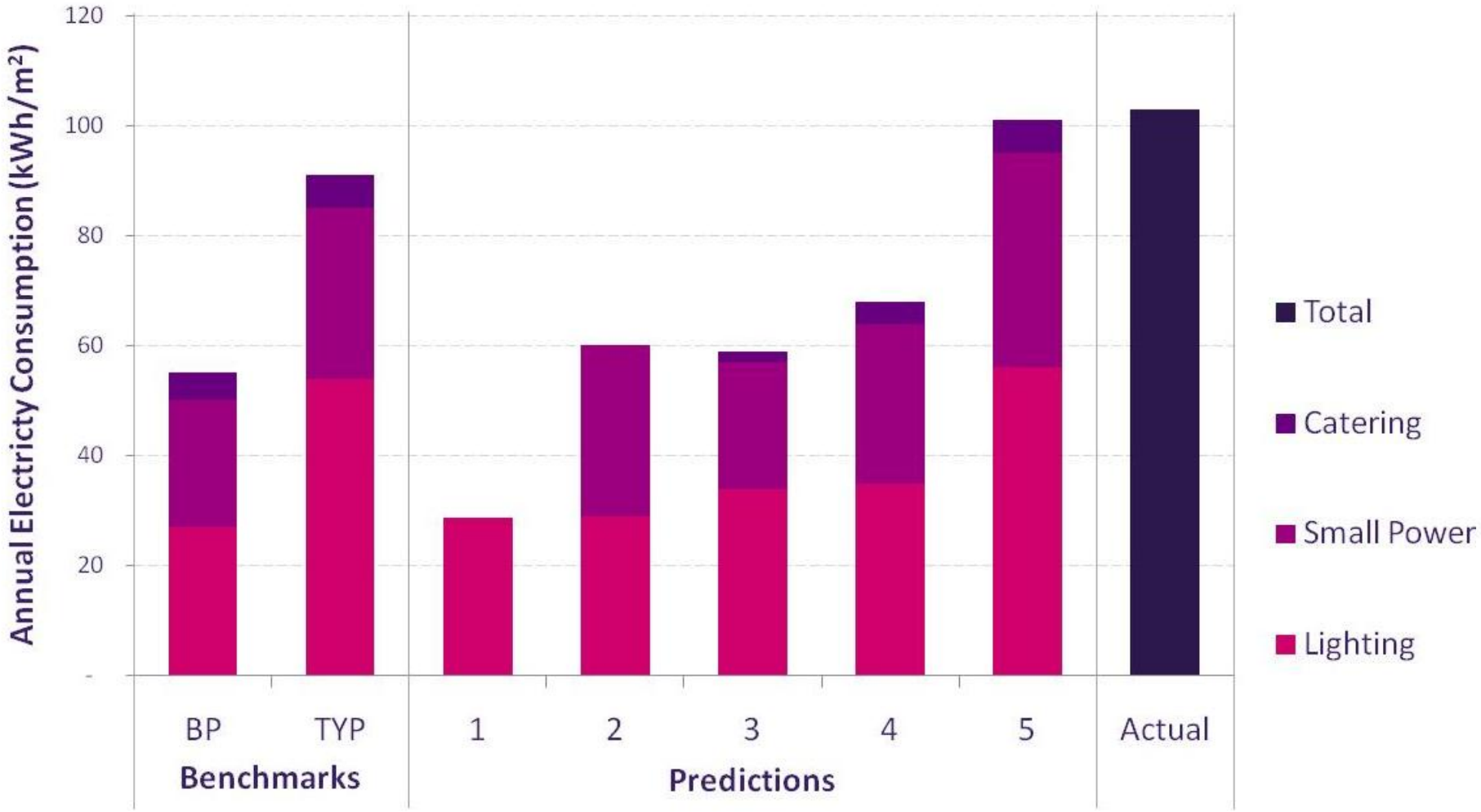
OCCUPANCY VS. ELECTRICITY CONSUMPTION



MODELLING INPUTS

	Brief description	Lighting	Small Power	Catering
1	Typical compliance model	11 W/m^2 (design load) SBEM occupancy	Not considered	Not considered
2	'Enhanced' compliance model	11 W/m^2 (design load) SBEM occupancy	15 W/m^2 (design load) SBEM occupancy	Not considered
3	Initial bespoke model	13 W/m^2 (benchmark) SBEM occupancy	11 W/m^2 (benchmark) SBEM occupancy	0.3 W/m^2 (benchmark) SBEM occupancy
4	Intermediate bespoke model	13 W/m^2 (design load) SBEM occupancy	11.5 W/m^2 (installed load) SBEM occupancy	1 W/m^2 (installed load) SBEM occupancy
5	Advanced bespoke model	13 W/m^2 (installed load) Monitored occupancy	11.5 W/m^2 (installed load) Monitored occupancy	1 W/m^2 (installed load) Monitored occupancy

MODELLING RESULTS



CONCLUSIONS

- The Performance Gap is a huge barrier to achieving real reductions in CO_2 emissions
- Monitoring and feedback is essential to minimise this gap
- This case study has demonstrated that the use of realistic inputs can result in models that are highly representative of reality (e.g. within 5% of actual consumption data)
- Key elements to consider are:

Occupant Behaviour

Occupancy Hours

Management Behaviour

•The applicability is limited to existing or non speculative office developments

FUTURE WORK

- Further monitoring of existing office buildings in-use
- Use of an occupant survey to determine impact of occupant behaviour on energy use
- Development of tailoring benchmark approach whereby occupancy and management elements can be considered and used to determine appropriate simulation inputs
- This can be increasing useful considering new legislation such as the CRC as well as the potential roll-out of Display Energy Certificates to all commercial buildings

THANK YOU FOR LISTENING

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This study has been published in the Applied Energy Journal and the paper can be downloaded through Science Direct at:

http://www.sciencedirect.com/science/article/pii/S0306261911007811