NCM CALL FOR EVIDENCE
JOINT SUBMISSION BY CIBSE AND LETI

Rev 1
21 November 2022

OVERVIEW OF OUR RESPONSE

This is submitted by email, as the online portal does not allow the submission of graphics.

In order to collate the most information possible in this short space of time, and in a single location making it more straightforward for the BRE and DLUHC to analyse, CIBSE and LETI have worked together to provide this joint submission. A large number of companies have provided support to this submission, through their expertise and modelling, including: Buro Happold, Elementa, Etude, Hawkins Brown, Inkling, and Max Fordham.

We have previously noted that the NCM call for evidence did not receive much publicity, which combined with the lack of deadline did not encourage submissions. Once a deadline was published, it was relatively short (2 weeks).

We have therefore focused here on essential points, including 3.4 Space Heating, but stress that more comments and more evidence could be gathered given proper time.

This is just a snapshot of issues and evidence. **We strongly recommend a comprehensive review of the NCM, starting with a scoping study** in a similar fashion as was carried out for SAP11, to ensure the NCM is suitable for the Future Building Standard and for future versions of Part L applied to work on existing buildings.

2 - NCM ACTIVITY DATABASES

To comment meaningfully on all assumptions within the NCM, including occupancy density and profiles, assumed heating gains, and set points, for all building uses, is a significant undertaking. This should receive dedicated attention through a systematic study.

We only cover include here a small number of comments gathered in the short time available. They should not be viewed as the only comments warranting attention, but instead an illustration of the type of issues that would be found should the topic be given proper attention.

- The profiles do not assume any occupancy and related activities (e.g. lighting and equipment) outside of hours. This is unrealistic as in practice there will be various types of occupancy due to late workers, cleaning teams and facilities management e.g. NABERS defaults assumes 5% out of hours lighting and equipment use for an office.
- All rooms in schools are assumed to be occupied at full occupancy all the time, rather than varying due to natural flow of students between rooms. This has the effect of over-estimating internal heat gains, and therefore under-estimating space heating demand – see details in submission by Etude to this call for evidence, included in Appendix 4 for completeness.
- All bedrooms in hotels are assumed to be occupied every day, all year. This is likely to lead to over-estimating hot water demand – see section 3.3.

3 - UNDERLYING METHODOLOGY ASSUMPTIONS

3.1 HOURLY VS MONTHLY (FOR SBEM)

Do you agree with the proposed solution, i.e. monthly/hourly hybrid to support the FSB consultation potentially moving to simplified hourly in the longer term?

A hybrid or hourly approach in SBEM may be useful but it could introduce complexities with yet unclear benefits.

Smaller time steps should not be confused with increased accuracy, and they do make results more dependent on assumed profiles, so this would place even more emphasis on the need to review the database assumptions.

On balance, given the significant issues to address in in the NCM, this is probably not a priority for development, as long as DSM remains an option. As alternative, an option may be to expand the occasions where DSM should be used: not only does DSM offer smaller time steps, it also takes account of more complex interactions between the building elements and systems.

3.3 WATER HEATING

Do you have any additional comments?

Hot water in hotels: We have received comments and evidence on 4 hotels, from 2 separate large consultancies, that hot water user in hotels tends to be significantly over-estimated, representing on average 64% of regulated energy uses (between 52% and 70% across these 4 projects). Two projects are illustrated in more detail in Appendix 1. Calculations on equivalent number of showers are illustrated in Appendix 2, with a comparison against hot water assumed in NCM in university residences and general residences: the differences are very large and difficult to explain. Explanations seem to include: assumed number of occupants per hotel room (always 2, while often it is designed for and occupied by 1); bedrooms occupied every day.

This high estimate of hot water use is problematic because it leads to:

- significantly under-estimating the value of fabric and system efficiencies in other areas, since emissions from hot water use become so dominant in total carbon emissions. This is of course compounded by the under-estimation of space heating, as detailed in section 3.4.
- skewing the assessment of appropriate heat decarbonisation options.

Unregulated energy uses: as expressed previously by CIBSE, we strongly question why uses which are clearly “fixed”, such as hot water uses in spas and swimming pools (other than showers) are unregulated, especially when they may be served from the same systems as the regulated domestic hot water uses. At the very least, whether or not they are regulated and how, they should be part of the model in order to be part of the appraisal of options.

3.4 SPACE HEATING

Does SBEM consistently under/overestimate space heating demand?

Yes.

LETI and CIBSE have consistently received the feedback that:

- the NCM under-estimates space heating demand. We stress this is not related to SBEM only, but also DSM. See summary of evidence below, and details in Appendices.
- This is a significant problem as it under-estimates the importance and the benefits achieved through demand reduction and energy efficiency measures, both in new builds and in retrofit projects: this means that significant components of heat decarbonisation are missed. As testimony to this, see for example the submission from Hawkins Brown to this call for evidence, which is also included in Appendix 3 for completeness.

We have provided 4 types of evidence in support of this:

Type 1: NCM methodological issues

Type 2: Comparisons between NCM calculations (DSM or SBEM) and exemplar practice space heating demand as exemplified by Passivhaus. NCM calculations

Type 3: Comparisons between NCM and performance modelling results

Type 4: Comparisons between NCM and in-use data.

Comparisons with models and in-use data were obtained from:

- A review of data obtained through the CIBSE awards: We would like to stress that in this exercise we did not look for projects where space heating demand was under-estimated: all projects where a comparison was available were used in evidence to this call.
- Additional project data provided to CIBSE and/or LETI for this call for evidence.

We are of course very aware that:

- The NCM is not meant as predictive modelling
- Performance modelling results are not guaranteed themselves to be an accurate prediction
- Many buildings do not operate efficiently, so differences between in-use data and modelled results are at least in part due to operation rather than the model.

Therefore, on their own, the comparisons between NCM results and performance model results, and between NCM results and in-use space heating demand (or energy use) are not always sufficient. However, taken together, given the fact that both types of comparison show the same trends, and significantly so, then we firmly believe that the NCM consistently and significantly under-estimates space heating.

Evidence type 1: NCM methodological issues

A number of aspects of the methodology are likely to lead to under-estimates of space heating demand. They are also clear areas to look for solutions to improve this aspect of the NCM. They include:

Space heating "in the space" vs at central AHU: An important reason put forward by a large number of modellers, and already put forward to the BRE and DLUHC on several occasions, is that the NCM disregards pre-heating (and cooling) happening in the central AHU, before it is supplied to the space: minimum fresh air is assumed to be supplied to the occupied zone at outside temperature with no preheating/ cooling. In fact, for mechanically ventilated areas, the air would usually be preheated /cooled (and possibly also dehumidified) in an AHU before being supplied to the zone: there is both heating/cooling in the AHU and at zone level. This is a gross simplification and leads to the following problems:

- Heating required is under-estimated on the basis of the potential contribution from solar gains and internal gains, while in fact regardless of these gains, air will be heated before being introduced into the occupied zone
- Simultaneous heating and cooling energy is ignored e.g. overcooling for dehumidification or e.g. air heated to 20 degrees in the AHU and then cooled by Fan Coil Units at zone level for zones with high solar gains or high internal heat gains
- The air and room loads may be provided by different heating sources so the SEERs/ SCoPs will be incorrect if one system is assumed.

Internal gains: Another reason that has been put forward in that, at least in some sectors, the NCM over-estimates internal heat gains, which results in under-estimating space heating demand. This is detailed for example in the evidence submitted by Etude, repeated in Appendix 4 for completeness.

Ventilation losses: NCM tends to under-estimate or ignore a number of sources of heat losses through ventilation – see submission from Etude / Appendix 4 for more details

External doors: air exchange and associated heat loss can be significant in buildings with a large number of occupants. See submission from Etude / Appendix 4 for more details.

Evidence type 2: Comparisons with exemplar space heating demand (Passivhaus).

Space heating demand estimated by the NCM has been collated for 10 projects, selected at random from projects recently submitted to the Greater London Authority. They were simply chosen for being submitted reasonably recently, and with BRUKL reports available from the planning register. These projects therefore are all at the design stage, and from a range of building sectors including hospitals, nursing homes, offices, retail etc.

The majority of projects (8) used DSM, and 2 used SBEM. The majority of projects (7) followed Part L 2013, but 3 used Part L 2021.

The results are illustrated in Appendix 5.

The data used is that for the <u>notional building</u> i.e. without taking account of the building's energy efficiency measures; therefore, the figures cannot be attributed to the buildings themselves, but rather to the NCM.

Across these 10 random projects, **the average space heating demand of the notional building is 11.1 kWh/sqmTFA/yr.**

This is **extremely low**. It is **35% lower than the space heating demand limit to achieve Passivhaus**. While that limit can be met, and some Passivhaus building do show a lower space heating demand, this is really quite rare and linked to truly exemplar efforts.

The calculated demand ranges from 25.8 (which is already quite low) down to 1.1 (!) kWh/sqmTFA/yr. Four projects (3 offices and 1 hospital) have a calculated notional building demand below 4 kWh/sqm/yr. The notional building of only 4 projects had a demand approaching or exceeding Passivhaus…

The fact that the space heating demand of the notional building, in Part L 2013 or even in Part L 2021, is so much lower than known exemplar levels, when it is not associated with similar levels of fabric performance nor (by far) evidenced by measured performance, is clearly evidence that it is significantly under-estimated by the NCM. The NCM should not predict such low levels of space heating, as if buildings were exemplar, when they merely represent compliance with 2013 or 2021 Part L.

The detailed modelling of an office project against Part L 2021, provided in Appendix 9: the space heating demand estimated by NCM is so low that improvement measures that actually are known to have an impact hardly make a difference on the calculated load. This clearly does not incentivise demand reduction and energy efficiency.

Evidence type 3: Comparisons with performance modelling.

Evidence is provided for 6 projects, across a range of sectors and with comparison between energy use for space heating calculated by NCM (all in DSM) and that against TM54, PHPP, or both - see Appendix 6, and details on individual projects in Appendices 4, 7 and 8.

In all cases, energy use for space heating calculated in NCM is below that estimated by performance models – in several cases by a factor of more than 10.

Evidence type 4: Comparisons with in-use energy performance.

This is provided for 3 projects (in one case, as total space heating + hot water), all of them also including a comparison with performance models - see Appendix 6, and details on individual projects in Appendices 4, 7 and 8.

Energy use calculated by NCM is consistently below that measured in practice. While there is also a difference between measured energy and that calculated by performance models, that difference is much smaller: the performance models are much closer to the measured figure – sometimes very close.

4 - ANY OTHER COMMENTS?

Other methodological comments

- A method to incorporate non repeating thermal bridges by psi and chi value should be required at a suitable level of detail
- Methods to calculate U values for constructions incorporating repeating metal elements should be included as mandatory. Currently this often gets missed leading to overly optimistic U value assumptions.
- The standard internal heat gains should be reviewed and updated to reflect current and anticipated future practice. In particular office small power
- Better models of heat losses from heating system distribution are required for all building types but in particular for communal heating and district heating systems..
  The methods should require input of pipe length and sizes estimates, insulation types, ambient temperatures, similar. At the moment these are a massive hole in the method leading to gross under estimates of heat energy demands (for both space and DHW). For district heating systems, it should be mandatory to include on-site substation

losses in the assessment (they can be very large). The PHPP method is a good reference starting point. However, it is not ideal for district heating either.
- Better HVAC models for systems such as thermally activated building slabs and VRF, are needed
- The current method of estimating the energy benefit of mixed mode cooling is overly optimistic
- Heat losses from duct work should be included.
- Mandatory assumptions for non -ideal infiltration/ventilation should be incorporated into the method. e.g. people always leave the windows and doors open to some degree in winter
- The methods should include efficiency de-rating factors for key items of plant. Manufacturers always present figures of the most optimistic situation, which rarely (if ever) materialise in practise. Specifiers are under pressure to use these figures in order to not increase cost on a project due to their own opinion of what de-rating factors should be used. This leads to poor design decisions and large performance gaps. There is a sizable body of evidence for this including the following :
  https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/606829/DECC_RHPP_160428_On_performance_variations_v20.pdf
  https://www.energysavingtrust.org.uk/sites/default/files/reports/TheHeatisOnweb(1).pdf

NCM in its context: Part L

While we understand that NCM is the calculation methodology, and is to some extent independent from its context, in order to effective energy and carbon savings it needs to operate within a supportive ecosystem of regulations. Both CIBSE and LETI have expanded on this previously, and we would be very happy to have the opportunity to discuss this in more detail. In summary:

- the **notional building** approach needs to be reviewed, as it hinders comparisons between building design options and over time, and does not drive absolute improvements. It is very difficult for policy-makers, clients and designers to actually compare design options.
- Regulations on **commissioning** should be enforced. Ways to incentivise this through the Part L assessment should be investigated e.g. penalty on building systems efficiency used in as-built Part L calculations unless evidence is provided that commissioning has been carried out.
- The ADL2A requirement for **energy forecasting** should be meaningful i.e. through performance modelling such as TM54, NABERS or PHPP. Current options such as “benchmarks” and “design calculations” can mean all sorts of things. They may be of very little use, or even misleading, to building occupiers.
- A significant measure to reduce the performance gap would be to require **monitoring and disclosure of in-use energy performance**. There was a previous government working group on proposals to introduce such a measure beyond public buildings. This workstream needs to be re-invigorated, and the policy should be finalised and implemented.

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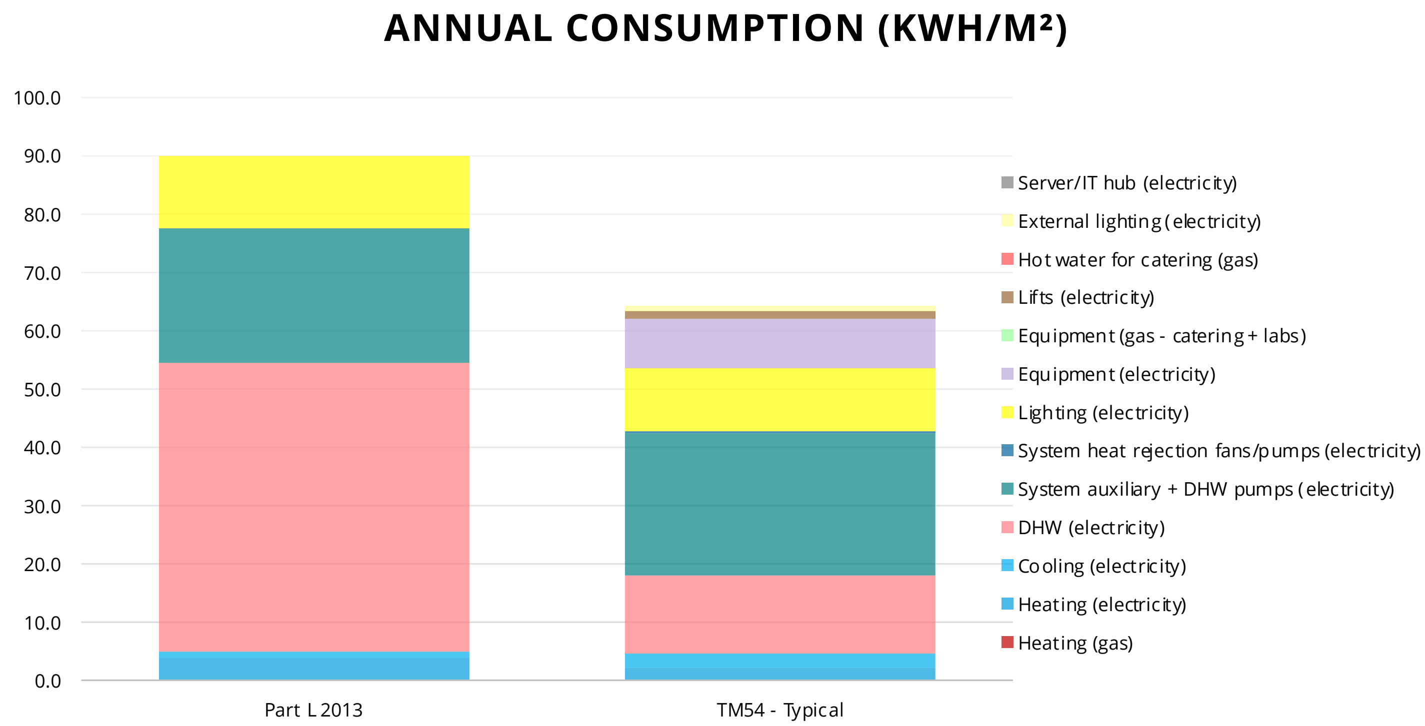
APPENDICES: EVIDENCE

APPENDIX 1: ENERGY USE BREAKDOWN IN HOTELS: HOT WATER DOMINATES

Evidence provided by Elementa

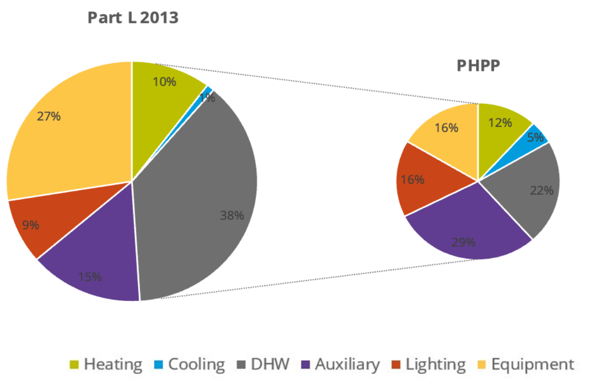
Hotel 1 (Chiswick) – Part L 2013 vs. TM54

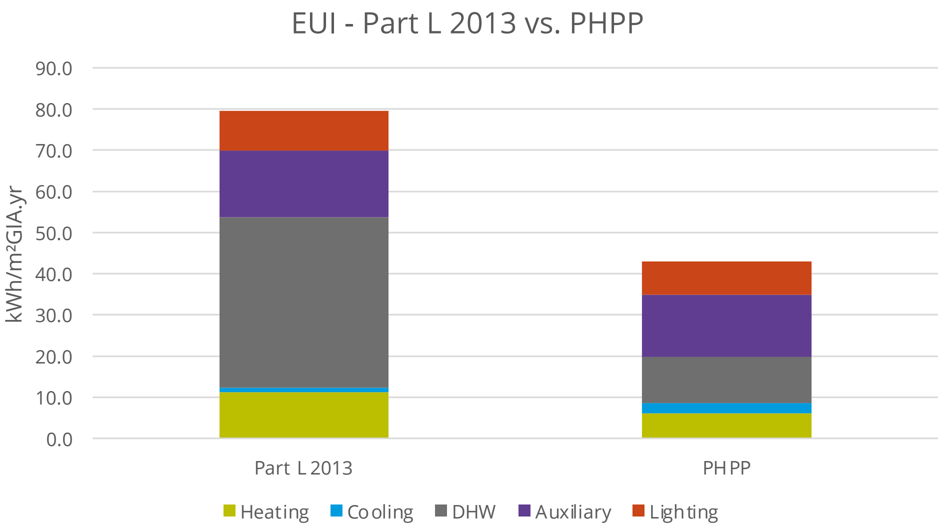
- NCM overestimation of DHW energy consumption in hotels in particular



Hotel 2 (Exeter) – Part L 2013 vs. PHPP

- NCM overestimation of DHW energy consumption in hotels in particular





APPENDIX 2: HOT WATER USE IN HOTELS AND RESIDENTIAL USES

Evidence provided by Max Fordham

In this project, the designer sought to ascertain which NCM templates to use for a 'co-living' residential block - hotel, university or general residential. The NCM DHW demand is based on litres/hour/person, occupancy density and schedules, which vary significantly between the different building types.

The hotel template DHW use corresponds to 2 showers per day per room (although the rooms are only designed for single occupancy in reality), and rooms occupied every day (again, usually not the case in hotels). This resulted in DHW energy use accounting for ~70% of the regulated energy use, meaning the DHW heating efficiency and WWHR dominate the end result.

However, the other two building types corresponded to 0.1 showers a day - which is probably even more unrealistic.

Sample Bedroom Room Area	22.4			
Sample Bathroom Room Area	3.7			
Hours per year	8760			
Days per year	365			
		NCM Hotel	**NCM Residential**	**NCM Uni Resi**
Occupancy				
Bedroom	m2/person	20	43.6	8.3
Bathroom	m2/person	3.86	53.4	4.4
Bedroom	people	1.12	0.51	2.69
Bathroom	people	0.96	0.07	0.85
Bedroom Occ Hours	hrs/day	10.25	8.75	10.25
Bathroom Occ Hours	hrs/day	3.8	3.8	3.8
DHW Consumption				
Bedroom	l/h/person	31.7	2.6	0.3
Bathroom	l/h/person	0.0	14.9	1.2
Bedroom	l/h	35.4	1.4	0.7
Bathroom	l/h	0.0	1.0	1.0
Bedroom	l/day	363.2	11.9	7.3
Bathroom	l/day	0.0	3.9	3.9
Bed/Bathroom combo per day	l/day	363.2	15.8	11.2
Bed/Bathroom combo per year	l/year	132581	5760	4087
Typical shower flow rate	l/s	0.25	0.25	0.25
Duration	mins	12	12	12
Consumption	litres	180	180	180
Typical showers / day		2.0	0.09	0.06

APPENDIX 3: SPACE HEATING IS UNDER-ESTIMATED, AND THE ISSUES IS CAUSES
Evidence provided by Hawkins Brown

NCM/SBEM call for evidence

Hawkins Brown's Response

We are an architectural practice that is focused on delivering a built environment that reduces carbon emissions while enhancing society.

For several years now we have realised that the Part L results are not reflective of the energy a building will use in real life. This was shown to us when we worked with Buro Happold on our Urban Sciences Building in Newcastle. They insisted on doing a CIBSE TM54 Operational Energy Analysis alongside the Part L. this was 10 years ago and we were struck by significant difference between the Part L results, TM54 results and then how the building performed in real life which was much closer to the TM 54. It is our view that the inaccuracy of Part L results that has been driving the performance gap.

Since then we have strongly advocated for this analysis to be carried out alongside the compliance measuring. It can be hard to argue as clients trust in the national regulation and understandably don't want to pay the additional costs of another analysis. There is still a lack of understanding about how inaccurate Part L results can be and this is driving the performance gap. Our understanding is that the NCM is at the heart of the discrepancy.

To us it seems this is even more urgent to solve given many of our clients are asking us to design Net Zero Carbon buildings and map Net Zero Carbon pathways for their portfolios. if we can't measure energy use accurately at design stage and use that data to design ways to actively reduce emissions and energy then we are going to completely fail to design truly Net Zero Carbon buildings.

Our observations since Part L 2021 was introduced is that planners have not changing their expectations for carbon emission reduction percentages in relation to the standard, compared to Part L 2013, even though the modelling appears to be different in a few places. Within our practice this has led to some perverse outcomes on at least two buildings so far. We have observed that the fabric efficiency measures we are putting into our buildings are not having the effect of reducing emissions sufficiently. In order to meet the standards and the reductions required (over 40% in some cases) we are having to add a lot more renewables into the scheme.

For example on a recent scheme in Oxford while undertaking the Part L compliance for planning the engineers told us that in order to achieve the reductions we needed to add more PV which wasn't possible because of the constrained roof area and ground plane available. The other option suggested was a wind turbine. While the Part L modelling may have seen the wind turbine as a positive asset we know in real life it's just not going to work and it does not fit within the budget.

Obviously, we need to expand our renewable grid but we can't do it at the expense of pretending we're designing low energy buildings when actually all we're doing is adding more renewables because of the inflexibility of the modelling.

Through internal reviews and discussions with external consultants we know that there are discrepancies in the NCM conditions assumed for each building type including internal conditions, occupancy profiling and ventilation rates. This simplifies the model which is then significantly different to how the building would function and operate in reality. For a recent building the engineers designed the ventilation system to provide 6ACH but the building use types available in Part L could not mimic this design parameter so failed to achieve the reductions required. because the notational building was incorrectly specified from the start. The 'actual building' generated by NCM is being compared to a 'notional' building that is performing exceptionally well. Hence, we are not able to see clear benefits of the design decisions and strategies as they are not being accurately translated or compared.

This is detrimental to the design process. The fact that Part L concentrates on a set and simplified route of compliance rather than being a useful exercise for a design team for us is a missed opportunity. All engineers we work with would recommend a more iterative and flexible modelling protocol for iterative low energy design, but we should have a system that can do both compliance and design.

Therefore, we request for DLUHC's immediate attention to investigate the NCM modelling protocols to better enable design teams to design low energy buildings and chart an accurate pathway to Net Zero.

APPENDIX 4: SPACE HEATING IS UNDER-ESTIMATED, AND SOME OF THE LIKELY CAUSES (AND SOLUTIONS)

Evidence provided by Etude

21 November 2022

Etude

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Dear Sir or Madam,

UK NCM Call for Evidence 2022

Thank you for giving us the opportunity to provide feedback on improving Part L calculations for non-domestic buildings.

A common issue that has been identified with non-domestic Part L calculations is **a huge underestimation of space heating demand** due to issues in the methodology. The following pages give examples of three projects highlighting a very significant underestimation of space heating demand compared to better predictions/reality and setting out some of the reasons for these. A summary is given on the final page, and the key reasons summarised below:

1. Internal occupancy gains are much higher in NCM modelling than reality;
2. Ventilation flow rates are per person and do not present actual building ventilation rates;
3. External doors opening accounts for high heating losses in many non-domestic building types, and this is not accounted for in NCM modelling.

While it is understood that NCM is not intended as a compliance tool and not an accurate prediction of energy demand, the difference is far too significant to be ignored. It is also crucial for DLUHC to understand that this **huge disparity influences design decisions negatively**. Improvements to insulation, airtightness, ventilation design and heating system efficiency provide very little benefit to the Part L performance of modelled buildings, which means that these important factors are not incentivised.

This also leads to a massive gap between predicted and actual energy use.

Please see the following pages for more detail on three case studies and a summary of our concerns on NCM modelling.

Kind regards,

Leon Tatlock

ETUDE

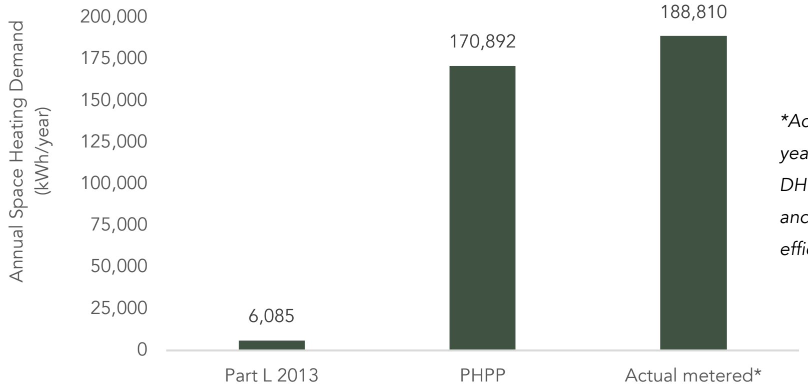
Case study 01

Sector: Primary School

Modelling software: DSM

Region: London, England

This primary school incorporated high levels of insulation and air tightness in its design and construction to help reduce CO_2 emissions and reduce energy bills. Energy modelling was carried out on the proposed building using both Part L 2013 (DSM) and PHPP. The school was completed in 2021 and has one full year of recorded post-occupancy assessment energy data available. A comparison of the Part L and PHPP modelled space heating consumption and actual building's energy meter data is shown below:



**Actual metered data is based on 1 year of gas meter readings removing DHW usage (taken from a sub-meter) and adjusted for a 90% boiler efficiency and 10% distribution*

Chart 1: Comparison of Part L, PHPP and actual metered space heating demand for a new-build primary school building

The above graph demonstrates the enormous disparity between the Part L 2013 space heating demand and PHPP, as well as with the actual metered energy data. One of the key reasons identified behind this, is the large difference between assumed NCM occupancy and actual building occupancy.

Chart 2 below illustrates this point by plotting the Part L modelled NCM occupancy (red), of a typical school day, against the actual average building occupancy (green). For reference, the grey line shows the sum of all rooms at maximum occupant capacity (assuming all areas of the building were simultaneously fully occupied). This overestimation in occupancy would result in an additional 94kW of free heating output that obviously would not existing in the real building. As a further point in the case of schools, Part L NCM occupancy heat gains do not appear to make any allowance for children having lower metabolic gains than adults. Therefore, the disparity is likely to be even greater.

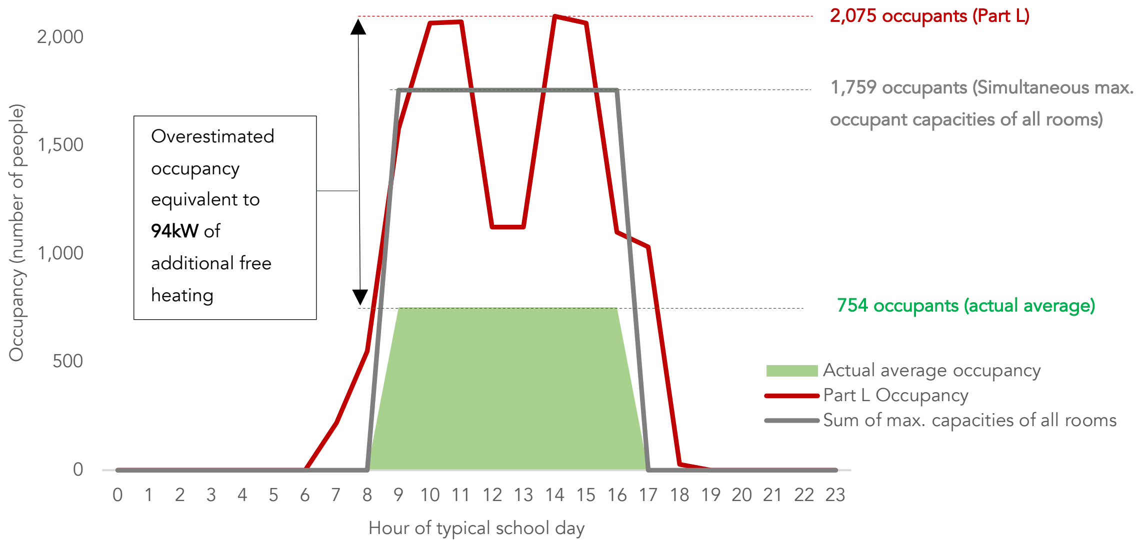


Chart 2: Comparison of assumed Part L building occupancy against actual average occupancy and the sum of all rooms' maximum capacity.

Case study 02

Sector: Student Residential Accommodation
Modelling software: DSM
Region: Southeast England

Another example is this large student accommodation block, currently at design stage, which has been modelled under two scenarios, the first was with minimum Part L 2021 compliant fabric insulation and air tightness, and the second was with best practice Passivhaus level fabric insulation and air tightness (0.6 m^3/m^2.hr at 50Pa). All building service inputs, and other parameters were kept identical. The modelled energy demand breakdown for both cases is shown below:

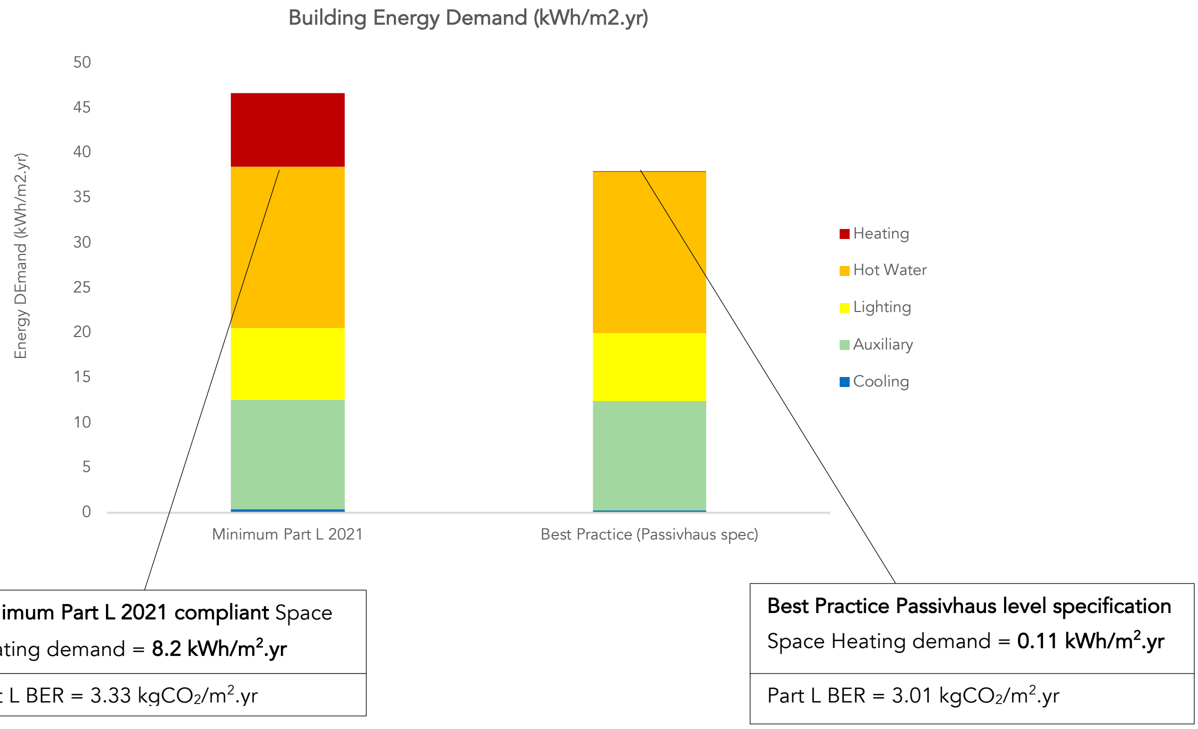


Chart 3: Comparison of Part L 2021 Energy Demand breakdown between minimum Part L compliant fabric and best practice Passivhaus specification for student accommodation building

The graph shows how minimal the space heating energy demand is compared to hot water, lighting and auxiliary (fans and pumps). The degree of underestimation of space heating in Part L appears to increase exponentially with buildings that have a more energy efficient fabric and improved air tightness. For example, it is known that the actual space heating demand of the best practice specification case would be in the region of 15 kWh/m^2.yr, or approximately 13,600% greater than modelled under Part L. The minimum Part L compliant case would be expected to have an actual space heating demand in the region of 40-80 kWh/m^2.yr, which would be a more modest 500-1000% greater than is modelled under Part L.

With a heat pump specified for heating, the modelled difference in the Part L Building Emissions Rate (BER) between minimum Part L compliance and best practice fabric was only 0.32 $kgCO_2/m^2$.yr.

Case study 03

Sector: School

Modelling software: DSM

This large school building was modelled using three different form factors, and to three different fabric standards. The Part L space heating demand results are consistently lower than the PHPP modelling results. The Part L modelling of the standard practice school with the highest form factor was lower than the best practice school with the lowest form factor.

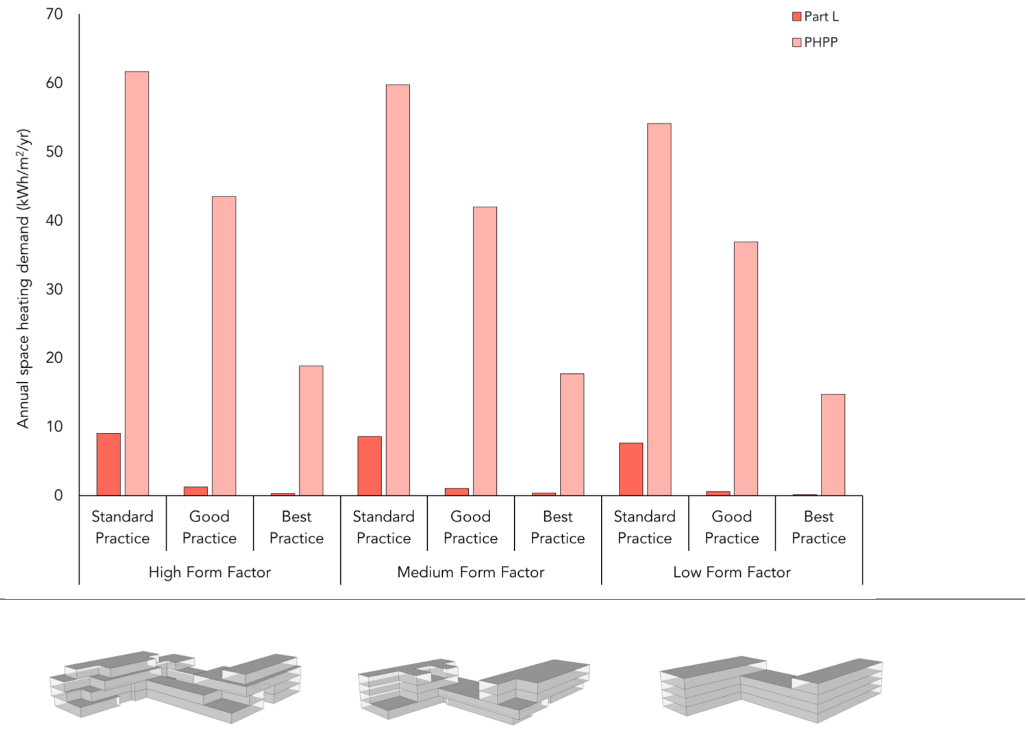


Chart 4: Comparison of Part L and PHPP modelling for the three school buildings and three fabric standard

Chart 5 shows that the breakdown of total heating consumption between Part L, PHPP and TM54, assuming a medium form and standard practice specification. Despite some differences, the scale of energy consumption based on PHPP and TM54 is very similar and much higher than Part L.

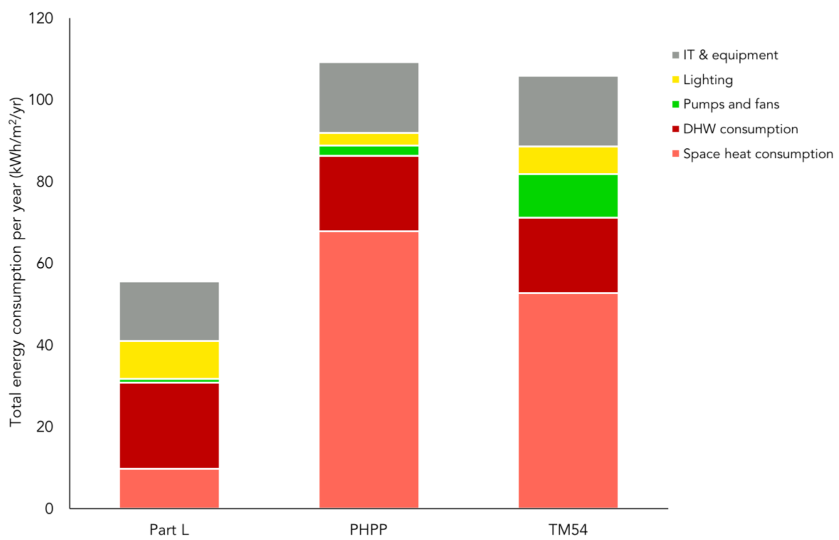


Chart 5: Assessment of total energy use using Part L, PHPP or TM54 (medium form factor and standard specifications)

Case study 04

Sector: University research facility

Modelling software: DSM

Region: Manchester

This large research facility was modelled using Part L and TM-54 modelling. Chart 6 below illustrates the differences in predicted space heating demand, also shown as part of process ventilation in the TM-54. This also shows other major omissions from the Part L modelling in a more complex building. Chart 7 shows actual energy use of similar buildings, which suggests the Part L modelling could represent as little as 10% of the measured consumption.

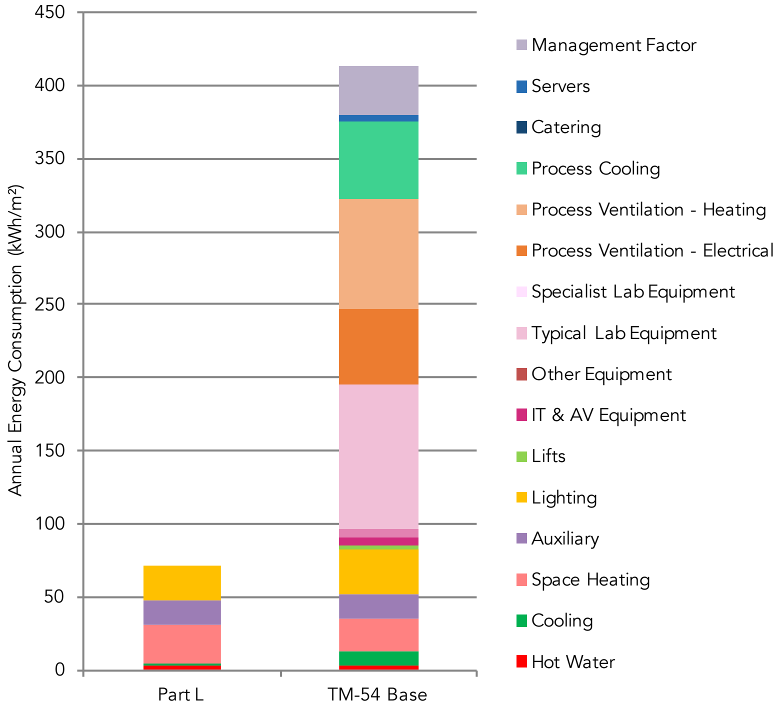


Chart 6: Comparison of Part L and TM-54 modelling for the research facility

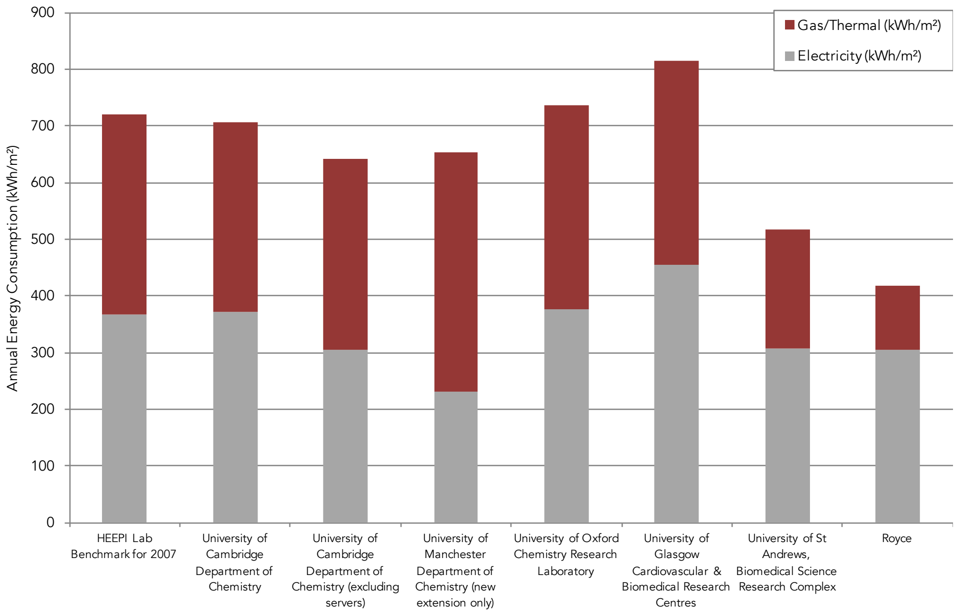


Chart 7: Benchmarking against actual energy use by other similar buildings

Summary

Why is this important?

Allowing Part L to significantly underestimate space heating relative to other building energy uses, is to actively remove one of the key drivers towards developing well insulated and airtight buildings, which are critical element of energy efficiency and, ultimately, Net Zero. Currently, Part L for non-domestic buildings rewards mainly improvements to a few building service components such as lighting, fan power and solar PV panels, which is not good enough.

What are the reasons Part L underestimates space heating demand?

There are some key reasons why Part L NCM modelling results in such a significant underestimation of space heating demand. These are summarised below:

1. **Internal occupancy gains in the NCM Internal Activities are often much higher than reality and often represent peak occupied conditions on a continuous basis.** They also often double count occupancy, such as within schools where classrooms, circulation areas and assembly halls are assumed to all be at full occupancy at the same time.

2. **Part L tends to underestimate heat losses from ventilation.** Ventilation flow rates are usually just limited to a basic litres per second per person flow rate for each zone type as stipulated in the NCM Internal Conditions. This doesn't account for actual building ventilation flow rates and also other process ventilation uses such as cooker hood extractors and fume cupboards, which can have a significant impact on space heating.

3. **Part L models don't account for any openings of external doors** and people traffic into and out of the building. This is especially noticeable in retail units which despite having a very high heating demand only have a negligible heating demand in Part L.

'The Part L NCM is a compliance tool and not a design tool' – Is it a valid excuse?

There is an argument often made that the NCM is intended to be a compliance tool rather than a design tool that accurately predicts energy demand. To make compliance fair between different buildings, a degree of normalisation and fixing of parameters is a perfectly reasonable approach. In this way, the performance of two or more buildings can be compared in an equivalent setting.

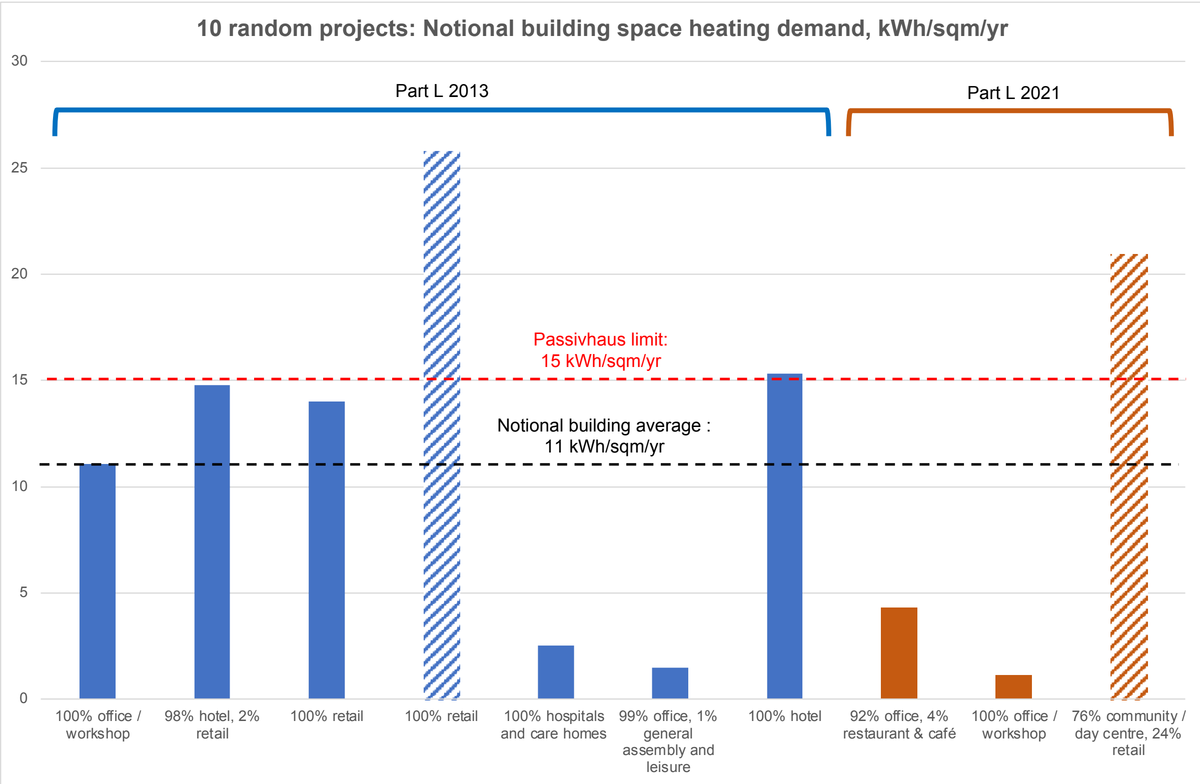
However, as building's have become more energy efficient, especially compared to the 1990's when the methodology was originally produced, the relative proportional differences between different energy uses has become completely skewed and no longer provides an output that is comparable to reality. If nothing else, ensuring that the relative proportions between different building energy uses is representative of reality is essential for driving building developers towards targeting, and being rewarded for, genuine energy efficiency improvements.

Currently, Part L2A provides very little incentive towards making buildings more thermally efficient or improving the efficiency of their heating systems beyond minimum elemental compliance values. As explained in this note, this is mostly due to the overestimation of occupancy gains that effectively provides free continuous heating, making the modelled space heating demand effectively negligible.

APPENDIX 5: SPACE HEATING DEMAND IN THE NOTIONAL BUILDING (2013 AND 2021), ACROSS 10 PROJECTS SELECTED AT RANDOM

Evidence gathered by CIBSE

Hashed bars used SBEM, "full fill" used DSM.



APPENDIX 6: ENERGY FOR SPACE HEATING CALCULATED IN PART L, IN PERFORMANCE MODELS, AND MEASURED IN USE

We stress that:

- We are very confident that much more evidence could be gathered, given suitable time and a dedicated effort.
- The project were not selected on what they showed, but whether data was available: there was no bias in the selection.

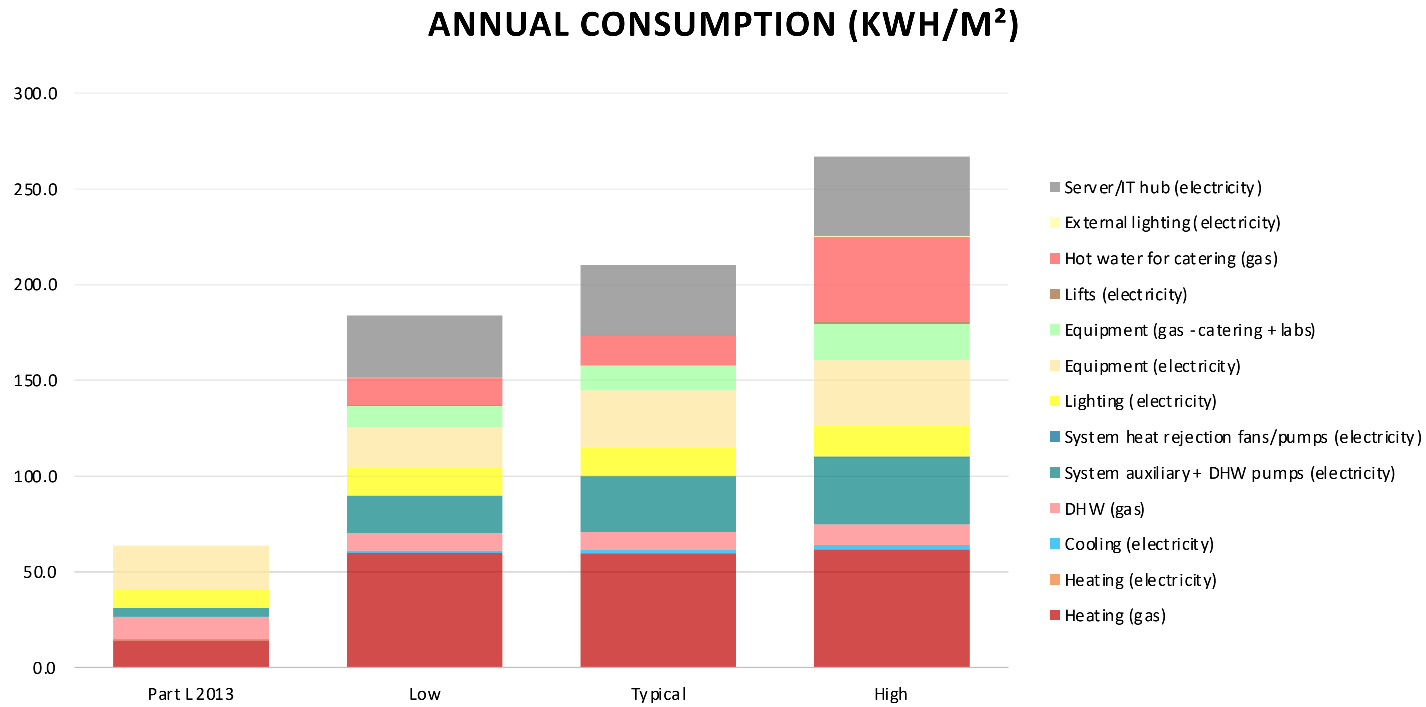
	Energy use for space heating								
		Part L		**Performance model**				**Measured in use**	
					base	**low**	**high**		
School	kWh/sqm/yr	DSM	14.3	TM54		59.6	61.9		Provided by Elementa - see Appendix 7
Primary school	kWh/yr	DSM	6085	PHPP	170892			188810	Provided by Etude - see Appendix 4
Primary school - varying form factors	kWh/sqm/yr	DSM	between 0.01 and 9	PHPP	between 15 and 63				Provided by Etude - see Appendix 4
Uni science lab	kWh/sqm/yr	DSM	6.6	TM54		10.7	14	18.2	Provided by Buro Happold - see Appendix 8
Uni research facility	kWh/sqm/yr	DSM	30	TM54	100				Provided by Etude - see Appendix 4
	Energy use for space heating + hot water								
Academy	SH, kWh/sqm/yr		0.4	PHPP	15				
	DHW, kWh/sqm/yr	DSM	10.5		12				
	total, kWh/sqm/yr		**10.9**		**27**			**24**	
	SH, kWh/sqm/yr			TM54		13.6	16.6		
	DHW, kWh/sqm/yr					14.5	21		
	total, kWh/sqm/yr					**28.1**	**37.6**		

APPENDIX 7: UNDER-ESTIMATE OF ENERGY USE FOR SPACE HEATING – SCHOOL PROJECT

Evidence provided by Elementa

School – Part L 2013 vs. TM54

- NCM exaggerating internal heat gains therefore resulting with low space heating energy consumption

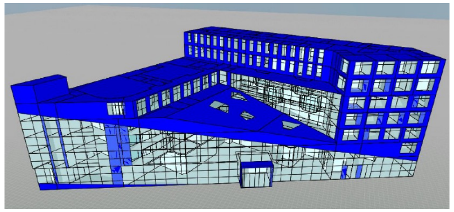


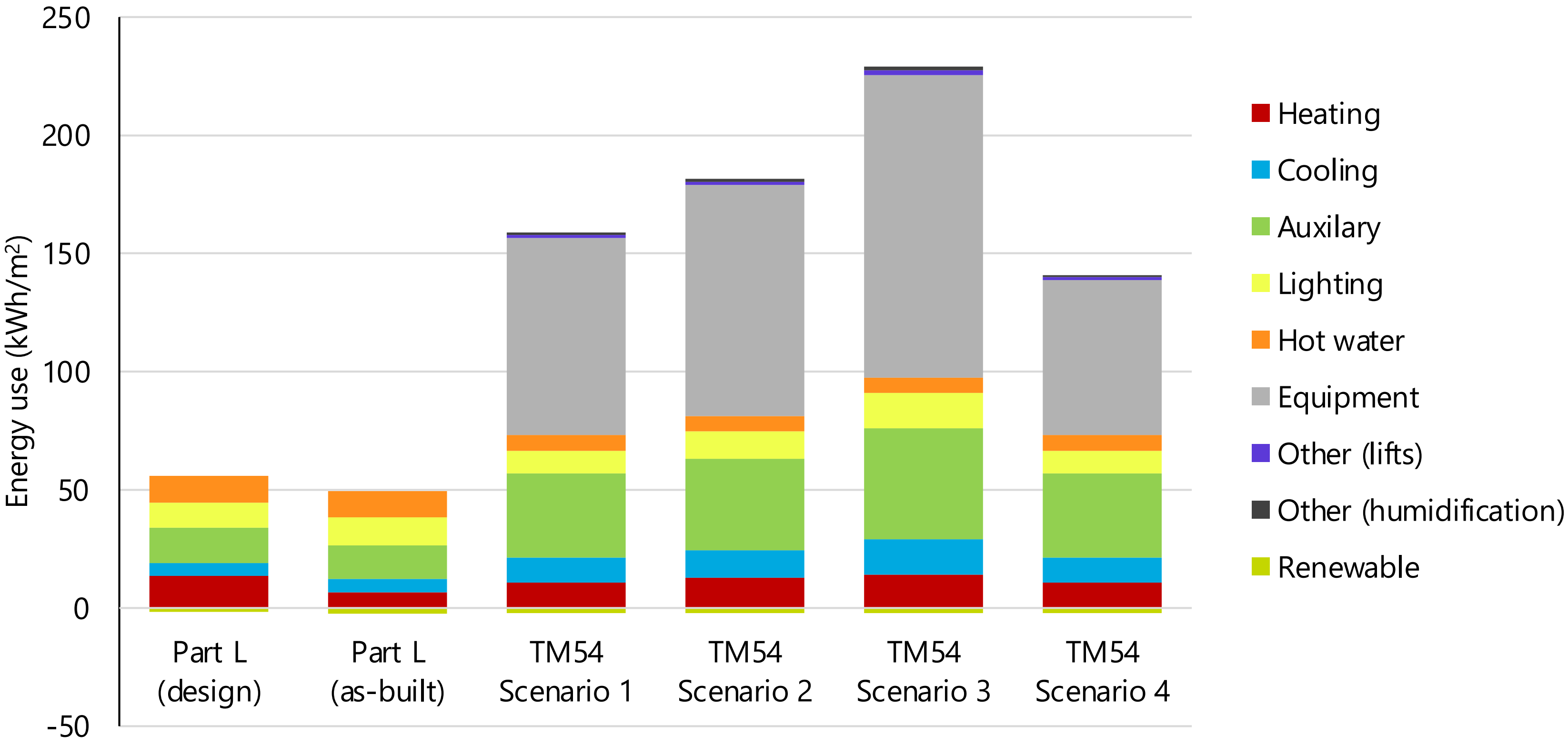
APPENDIX 8: UNDER-ESTIMATE OF ENERGY USE FOR SPACE HEATING – SCIENCE LAB PROJECT

Evidence provided by Buro Happold

OPERATIONAL ENERGY USE

PART L VS. TM54 RESULTS

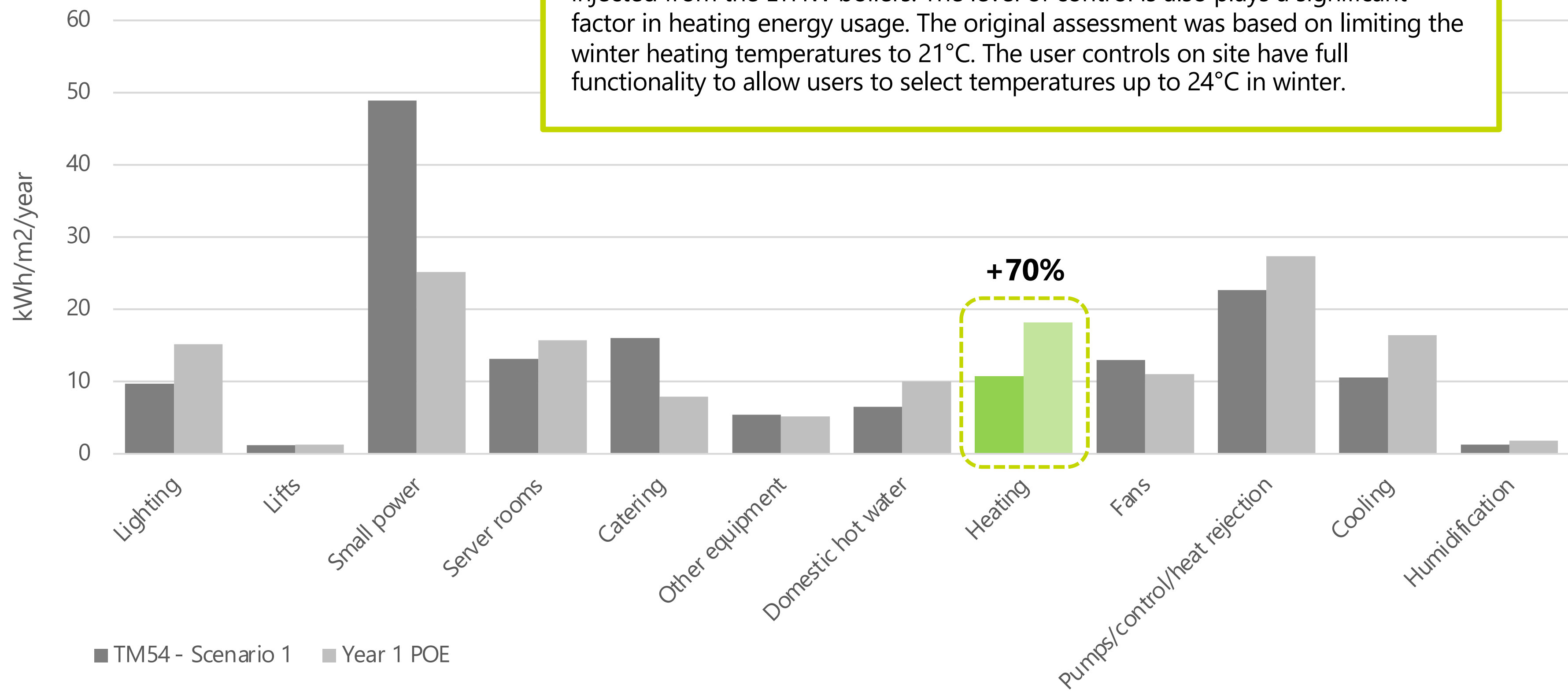




BUROHAPPOLD ENGINEERING

TM54 VS. POE

HEATING – The original IES model would have assumed that a larger proportion of the building heat loss would have been offset by the building equipment meaning in reality more heating is required from the LTHW and would need to be injected from the LTHW boilers. The level of control is also plays a significant factor in heating energy usage. The original assessment was based on limiting the winter heating temperatures to 21°C. The user controls on site have full functionality to allow users to select temperatures up to 24°C in winter.



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APPENDIX 9: UNDER-ESTIMATE OF ENERGY USE FOR SPACE HEATING – OFFICE

Evidence provided by Elementa

Part L 2021 – Be Lean (Electric Baseline)

- Part L 2021 notional building energy consumption is very low, which does not incentive the incorporation of fabric and services energy efficiency measures.

This table summarises the different energy efficiency assumptions modelled based on the three different fabric and ventilation scenarios. Modelling was carried out for a 7-storey office of 4000m² GIA.

	1 Business as Usual	2 Good Practice	3 Ultra Low Energy
Floor U-Value (W/m²K)	0.15	0.12	0.09
External wall U-Value (W/m²K)	0.25	0.18	0.13
Roof U-Value (W/m²K)	0.15	0.13	0.10
Windows U-value (W/m²K)* Windows g-value	 1.60 0.40	 1.40 0.40	 0.80 0.40
External doors (W/m²K)	2.0	1.5	1.5
Thermal bridging (W/m²K)	Good practice (5% of losses)	Better practice (3% of losses)	Best practice (1% of losses)
Air Permeability (m³/m²/hr)	5	3	1
Ventilation system and design	Standard quality AHU	Good quality AHU	Best practice AHU
AHU heat recovery efficiency	75%	80%	90%
Internal Lighting (lm/W)	95	105	115
Lighting Control	PIR Presence Detection + Daylight Dimming in Offices only	PIR Presence Detection + Daylight Dimming in Offices only	PIR Presence Detection + Daylight Dimming in Offices only