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Funding Agency

Output Specification

Building Performance Evaluation Methodology

Version 2

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For technical professionals involved in the design and construction of school premises

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Contents

1	Introduction	4
2	Methodology	5
2.1	Scope of the Building Performance Evaluation (BPE) process	5
2.2	Stage 1 - Data collection setup (handover period - pre-occupancy)	9
2.3	Stage 2 - Initial performance review (3 to 6 months post occupancy)	10
2.3.2	Desktop analysis	11
2.3.3	Site walk round	11
2.3.4	Facilities staff questionnaires/interview	12
2.3.5	Teaching staff questionnaires	12
2.3.6	Energy data collection and review	13
2.3.7	Analysis of the performance data and user feedback	14
2.3.8	Reporting format for initial BPE review	14
2.3.9	Action plan for resolving issues identified	14
2.4	Stage 3 Final performance review (9-12 months post occupancy)	15
2.4.2	Energy data collection and review	15
2.4.3	Energy data comparison against energy targets	16
2.4.4	Facility staff	18
2.4.5	Teaching staff	18
2.4.6	Analysis of the performance data and user feedback	18
2.4.7	Reporting format for final BPE report	18
2.4.8	Action plan for any outstanding items	18
	Appendix A Facilities staff questionnaire	19
	Appendix B Teaching staff interview questionnaire	25
	Appendix C Initial Building Performance Evaluation report template	30
	Appendix D Final Building Performance Evaluation report template	46
	Appendix E In-use energy monitoring using ISERV reporting methodology	64

1 Introduction

- 1.1.1.1 Research carried out by the Education and Skills Funding Agency (ESFA) into newly completed and occupied school buildings has identified there is often a performance gap between the Contractor's design intent and the in-use performance of the building. As a result ESFA has developed a strategy to carry out Building Performance Evaluations (BPE) of all new school buildings.
- 1.1.1.2 The aim for the evaluations, as part of the normal procurement process, is to:
- indicate the factors impacting on the operational performance of the building in use
 - identify the root cause of performance issues
 - inform action to improve performance
- 1.1.1.3 Many factors impact the performance of school buildings including:
- design strategies and complexity of systems
 - cost cutting during the design development and construction phases
 - configuration of controls
 - commissioning of systems
 - handover and aftercare service
 - user understanding of systems and training in their use
 - operational management of the school
- 1.1.1.4 Poor performance increases running costs and can have a detrimental impact on educational attainment. For example, poor ventilation can affect concentration levels as teaching spaces become increasingly stuffy through the day.
- 1.1.1.5 The factors that contribute to the poor performance of a school building may be due to site specific issues and it is not the aim of this methodology to define the solution to any problems that are uncovered. Rather the focus is on providing a structured and auditable procedure for uncovering these issues. It is then up to parties involved to decide upon the most appropriate course of action to remedy the problems.
- 1.1.1.6 Contractors and their designers are key players in unlocking good building performance. Therefore the BPE methodology has been specifically

designed to be used within the first year of operation of the school building whilst there is still a contractor responsibility with the school through the defects liability period.

- 1.1.1.7 The ESFA's Output Specification contains a requirement for the contractor to ensure that BPE's are provided and is a specific contract deliverable.
- 1.1.1.8 Whilst there are various approaches that can be taken to achieve a successful BPE, the methodology described in this document provides a robust set of instructions for meeting the requirements. The process is designed to be led by contractors who have a good understanding of the building and its systems. Some of the issues highlighted through the BPE process are addressable through the normal snagging/defects resolution activities carried out by contractors. However it is fully expected that some of the issues go beyond the contractor's original responsibilities and therefore will be considered on a case by case basis.
- 1.1.1.9 The BPE methodology is intended to be used on new and refurbished buildings. These buildings should have good thermal insulation, air tightness, limited glare, and limited thermal bridging in line with the requirements of Building Regulations and the Output Specification that is part of the ESFA's Contractors Framework (Capital). The installed building's metering systems should as a minimum allow data to be logged for the electricity, gas and water consumption.
- 1.1.1.10 It is not appropriate for use with older school buildings where many of the building performance issues are likely to be around the physical condition of the building fabric and where fuel and water consumption data is less likely to be automatically logged.

2 Methodology

2.1 Scope of the Building Performance Evaluation (BPE) process

- 2.1.1.1 The scope of the BPE process is:
 - a. to provide an objective understanding of what is successful and what are areas for improvement
 - b. to monitor the result of fine tuning the building performance through seasonal adjustments to the building controls

- c. to establish across the range of schools where there are common issues in order to learn lessons for future school building projects

2.1.1.2 This is a process that looks at various interrelated aspects of school buildings. The assessment looks for areas that can be improved and then suggests actions. It comprises:

- a. a desk-top analysis of specific design and construction information on the school before the school visit, with option for BPE client team
- b. a school visit with a walk round the school – generally with the headteacher or bursar (responsible budget holder), school site supervisor (caretaker/premises manager), the contractor (including M&E, and controls specialist), with option for BPE client team
- c. records made through photos, notes, observations and conversations on walk around
- d. a review of the Building Management System (BMS) demonstrated by site staff. This provides an easy indication of the level of training provided by the Contractor to the school technical staff and the level of commissioning of the system
- e. the second part of school visit includes a meeting with the school on the benefits of the BPE including a briefing on the completion of the two questionnaires i.e. Teaching staff and technical site staff
- f. post school visit: Desk-top analysis of energy data and questionnaire responses with write up of findings using evidence of data; action plan for the different parties, ie contractor, school and ESFA. This is supported by analysis of any further energy, temperature or CO₂ data that can be obtained
- g. the Contractor shall carry out two BPE reviews: Initial Review at 3-6 months and Final Review at 9-12 months after handover in accordance with the Employer's Requirements Deliverables
- h. compilation of a report on all findings, energy trends and observations from each school – issued to ESFA and clear actions by Contractor provided using the ESFA templates for Initial and Final BPE reports
- i. compilation of short summary report for the school
- j. overall report on the batch of schools for ESFA, if part of a batch project

2.1.1.3 The BPE process is primarily concerned with evaluating the performance of buildings in use, however in order to get meaningful outputs it is necessary

that preparations for the main BPE activities are made at the design and construction stages. These preparations revolve around the provision of suitable data monitoring and collection systems for the electricity, gas and water consumption in the building and training that forms part of the building handover. Once the building is in-use these monitoring systems will be vital in providing the hard technical data used in the assessment of the building's performance.

- 2.1.1.4 The activities carried out in the first year of operation are split over two distinct stages, post handover. The first stage will ideally be performed within the first 6 months after handover and is focused on ensuring the building is set up correctly for the purpose of accurately reporting its ongoing performance. The second stage is a more detailed assessment of the overall building performance and allows annual energy/water consumption to be recorded based on actual figures.
- 2.1.1.5 The stages and activities used in the methodology are shown in the following table.

Table 1 : BPE stages and requirements

Stage	When undertaken	Activities	Information to be provided/Employers Requirements Deliverables
Stage 1 - Data collection setup	Commissioning	<ul style="list-style-type: none"> • Ensure data monitoring and sub-metering systems are correctly collecting data and automatically reporting 	<ul style="list-style-type: none"> • Results of 7 day monitoring during soak test (forms part of H&S file)
Stage 2 - Initial performance review	3-6 months post occupancy	<ul style="list-style-type: none"> • Site visit and walk round with school management team and contractors • Collect and review initial building performance iSERV data and BMS energy consumption data (electricity, gas, water, temperature, CO₂) and compare against design prediction • Conduct structured interview of facilities staff/questionnaire • Complete teaching staff questionnaires • Collate all information into the initial report template and provide commentary on the findings • Develop action plan to address any issues identified, e.g. further training, seasonal adjustments and fine tuning • Report findings back to the school 	<ul style="list-style-type: none"> • Initial BPE performance report showing top 5 issues and initial energy and water performance. • Action plan to resolve issues before the end of defect liabilities period and final BPE review
Stage 3 - Final performance review	9-12 months post occupancy	<ul style="list-style-type: none"> • Collect and review longer term building performance iSERV data and BMS energy consumption data (electricity, gas, water, temperature, CO₂ in classrooms). • Conduct structured analysis of data collected accounting for any unexpected results • Collate all information into the final report template and provide commentary on the findings • Develop any further action plan • Report findings back to the school 	<ul style="list-style-type: none"> • Final BPE report showing : confirmed performance and actual annual energy and water consumption figures achieved with a comparison against the design prediction and ESFA benchmarks Any further actions to improve performance

2.2 Stage 1 - Data collection setup (handover period - pre-occupancy)

- 2.2.1.1 The setup of the data collection systems is an important step to achieve building performance in use.
- 2.2.1.2 In line with the ESFA requirements the school will be provided with main metering for all the incoming utilities and sub-meters. As a minimum these will be supplied on each of the following:
- a. gas to boilers
 - b. gas to kitchen
 - c. water supply
 - d. main electrical intake
 - e. kitchen general power
 - f. external lighting and power
 - g. HVAC control panel for centralised mechanical ventilation systems
 - h. server room general power
 - i. plant room general power
 - j. each floor general power
 - k. each floor lighting
 - l. any low or zero carbon energy sources except biomass.
 - m. trend comparison between each day or week for all meters
 - n. local display on the sub-meters with centralised recording, monitoring and trend logging, with sampling at a minimum of every 15 mins
 - o. automatic monthly data upload from all sub meters to iSERV
- 2.2.1.3 These meters, along with any additional and specialist meters, are required to be logged at 15 minute intervals via an Automatic Meter Reading (AMR) system. During the commissioning stage the contractor will be responsible for ensuring all the sub-metered data is both collected by the AMR system, and that this data accurately represents the actual performance of the systems being monitored. The BPE will utilise the data collected from these metered systems and so it is important that they are correctly commissioned.
- 2.2.1.4 The data collected from the meters is not the only source of technical data on the performance of a school building and the data collected by the BMS can also provide useful feedback. Where room temperature and CO₂ data is

being sent to the BMS then this too should be logged to be drawn on during the BPE data analysis phase.

- 2.2.1.5 Upon completion of the setting to work and commissioning of the building services, the Contractor shall perform a “soak test” of the systems installed by running the systems continuously for a 7 day period as follows:
- a. continue plant operation until seven continuous days have occurred without fault or failure of any component or function
 - b. monitor all functions (pressures/temperatures/starts per hour, sub metering etc.) which shall be trend logged using the microprocessor controls equipment where installed
 - c. monitor each type of space served by the plant and equipment using temperature data loggers (supplied by the Mechanical or Electrical Contractor) or the BMS system to verify the performance
 - d. any specified noise performance surveys shall also be carried out during this period
 - e. all data shall be downloaded in Excel spreadsheet format (electronic and hard copy) and should be available during the BPE reviews
 - f. all data and monitoring results shall be reported to the Employer and included in the H&S file alongside the other commissioning and test certificates

2.3 Stage 2 - Initial performance review (3 to 6 months post occupancy)

- 2.3.1.1 The Contractor shall carry out an initial BPE review 3 to 6 months after handover. This shall comprise:
- a. analysis of information on the project before the visit, such as Contractors’ Proposals design information, as installed information, controls philosophy, M&E schematics, sub-metering schematic, building user guide
 - b. site visit and walk round/meeting with the school – generally the headteacher, school bursar, school site supervisor (caretaker/premises manager), the Contractor (including contract manager, M&E and controls specialist)
 - c. photos of the school and elements reviewed
 - d. completion of an FM questionnaire
 - e. completion of teaching staff questionnaires

- f. review of the BMS system and energy data, comparison against design predictions and ESFA benchmarks
- 2.3.1.2 Follow up actions after the initial meeting shall comprise:
- a. analysis of the data collected for each school
 - b. compilation of a report on all findings, energy trends and observations from each school – issued to ESFA and clear actions by Contractor
 - c. compilation of short summary report for the school
 - d. overall report on the batch of schools for ESFA, if part of a batch project
 - e. all reports to follow the standard ESFA format for BPE reviews
- 2.3.1.3 Seasonal commissioning adjustments shall be conducted throughout the first year of the buildings performance following handover by the Contractor.
- 2.3.1.4 The initial performance review will be performed within 3 to 6 months of the building being occupied, and the primary purpose is to identify any obvious gaps in the handover process and ensure that the schools data collection systems are providing useful information. It is a sense check that the building is performing within the expected range and to put in place any necessary corrective actions.

2.3.2 Desktop analysis

- 2.3.2.1 The desktop analysis identifies the areas of focus for the visit by BPE team, with knowledge on what to expect on the systems and components known to impact on the building performance. It involves a review of the design information available against what was finally constructed.

2.3.3 Site walk round

- 2.3.3.1 This is an invaluable exercise providing a quick and effective visit as:
- a. the school gets an early indication they are going to benefit from this process, which builds trust and engages the school to talk about how they use the building, which impacts on building performance.
 - b. It provides buy-in by the school to complete the supporting questionnaires. The one for technical staff is completed there and then, whilst teaching staff are left copies to complete in a staff meeting (10 mins long). Secondary

schools will find it easier to coordinate responses through heads of departments.

- c. It quickly gives a feel for the school's attention to managing their behaviour which impacts on building performance. Indication of a positive approach - they know their monthly spend on utilities; their technical staff demonstrate how they take records from the meters. Negative indicators – window cills loaded up with books so you can't reach to open the window (poor air quality in teaching spaces); poor use of the building, e.g. school has built new internal teaching rooms, which blocks out daylight into other teaching spaces, whilst other rooms such as dedicated IT support staff room, which are only used half a day per week sit empty; stuff piled up in corners of rooms, halls and under staircases (fire risks)
- d. the contractor sees the ability of the school to use, operate and manage components they have designed and built, and where the focus for effective training needs to be, e.g. school caretaker confident in heating, electrical controls, seasonal maintenance, however not confident in BMS

2.3.4 Facilities staff questionnaires/interview

- 2.3.4.1 An interview should be conducted with one or more members of the facilities staff. These interviews are based around a set of multiple choice questions, See Appendix A. There is an opportunity for the interviewee to provide additional information to support their answers. It is intended that the interviewer asks all the questions provided, but it is acknowledged that it might be necessary to ask further site specific questions to get to the root cause of certain issues. Where this occurs the additional questions and answers should be recorded at the end of the standard questions.
- 2.3.4.2 The questions themselves are based around the quality of the training provided during the handover process, and the ease of operation and maintenance of the main building services. Where any deficiencies or issues are found these should be reported clearly in the conclusions section of the report

2.3.5 Teaching staff questionnaires

- 2.3.5.1 This stage seeks feedback from building users on their experiences of working in the building. This is done via a questionnaire, which is primarily aimed at the teaching staff, but other staff can also be included. Students will not be directly asked about their experience of the building, but it is anticipated that teaching staff will reflect the experience of the students in

their answers. The aim should be to get as many survey responses as possible, to maximise the understanding of the building's operation.

2.3.5.2 The survey questions are focused on the following building conditions:

- a. winter temperature
- b. summer temperature
- c. ventilation and general air quality
- d. lighting, both from daylight and electric lights. Glare from the lights will also be considered
- e. noise levels

2.3.5.3 A copy of the questionnaire is included at Appendix B.

2.3.5.4 The survey questions have been devised to highlight specific areas for the contractor to investigate and action if there is an issue. Therefore collating the survey results will produce an action plan for the contractor to investigate. These actions should be prioritised in order of the issues that received the most negative feedback.

2.3.6 Energy data collection and review

2.3.6.1 As the building will only have been operational for a relatively short period of time care must be taken when attempting to interpret the metered data as it may not be providing an accurate picture of the energy consumption patterns. This is because there may not have been enough time for all the systems to run-in to their full operating state and the impact of any seasonal variations have not been experienced. In addition to this there may still be a contractor presence on site which could contribute to the energy consumption seen. Despite this, collecting and reporting this data is still a worthwhile exercise as problems with systems can be identified, especially if utilities are being used out of hours unnecessarily.

2.3.6.2 The data should be presented in a table showing at least the following information for each meter and sub-meter:

- a. utility being monitored (e.g. gas, electricity, etc.)
- b. meter ID
- c. consumption since start of building occupation
- d. average consumption per day
- e. average out of hours consumption per day

2.3.6.3 In addition it can be useful to report on daily peak demands as this may allow any anomalies to be spotted as well as confirming the correct operation of controls

2.3.6.4 The use of iSERV to continually monitor energy consumption is the required system for reporting the data. The web-based iSERV database should be reviewed to ensure the data is being reported correctly. The data reporting takes the form of an automated email sent to iSERV that contains the monitored energy consumption data in a CSV format. The database has been designed to aid in providing operational feedback of buildings, and to make energy analysis simple, unambiguous and robust. The reports produced by the iSERV system are to be used directly in the summary BPE reports. Further details of in use energy monitoring are given in Appendix E.

2.3.7 Analysis of the performance data and user feedback

2.3.7.1 It is important to consider the relationship between the findings of the survey questions, the interviews, and the performance data. For example a general response from building users of low internal temperatures may correspond with a low gas consumption compared to benchmarks, and increasing the temperature may take the gas consumption well above the benchmark. This would indicate that there is a technical issue with the building's heating that needs to be investigated fully in order to increase winter temperatures, without significantly increasing fuel consumption.

2.3.8 Reporting format for initial BPE review

2.3.8.1 The initial Performance Review Report template is provided in Appendix C.

2.3.9 Action plan for resolving issues identified

2.3.9.1 Investigating the issues highlighted by the analysis in the previous step should result in a list of actions for the contractor to take forward or potentially raise as an action in conjunction with the school. Any action that is required to bring the building in line with the contractor's original scope should be implemented as soon as possible, such as the provision of additional training or recalibration of controls and metering.

2.3.9.2 All actions identified should be presented as a plan that will allow further success to be achieved by the final BPE review date after 12 months of building occupation.

2.3.9.3 Once the action plan has been prioritised it should be presented to the school along with the rest of the findings of the BPE.

2.4 Stage 3 Final performance review (9-12 months post occupancy)

2.4.1.1 The Final Performance Review builds on the work undertaken in the initial performance review by reviewing additional energy data and following up on the initial BPE review outcomes and the results of the contractors' action plan. All conclusions are then presented in a final BPE report using the template provided in Appendix D.

2.4.1.2 The initial BPE review conducted after the school has been in use for 3-6 months gives schools a chance to settle into their new building and allow them an understanding of its day to day operation. It also allows a more measured approach to be taken to calibration and reporting from the sub metering and also identify any additional training requirements. Allowing these to be addressed early provides an opportunity to collect more relevant data about the building operation and success of the second BPE review held towards the end of the defect and liability period (DLP). The extent of this final BPE review will vary depending on the school – at best it will be further data collection around the energy performance of the building giving a full year of results and showing any results of seasonal adjustments; at worst it may involve a further site visit and analysis of data if this was unsuccessful following the first site visit.

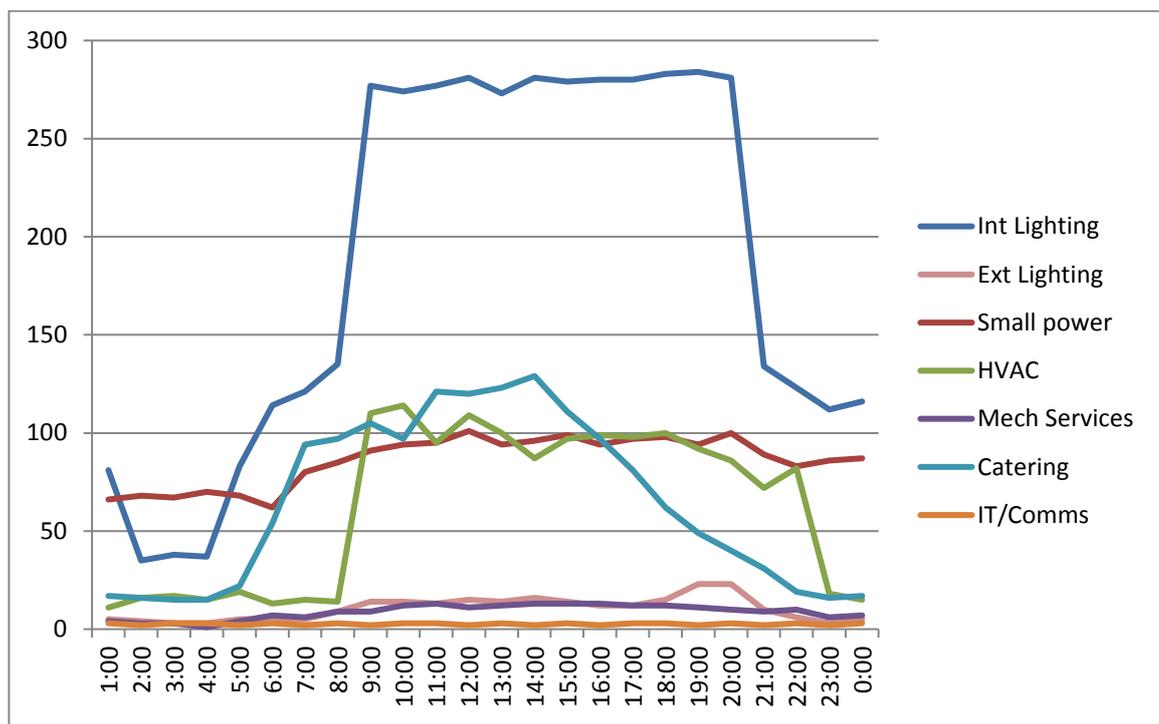
2.4.2 Energy data collection and review

The readings from the main meters and sub-meters should be collected for the entire period since the building was occupied. The trends should be shown as monthly summaries to allow seasonal variations to be easily seen. In addition to this the consumption for at least two different days should be shown graphically (as per the example in

Figure 1). The days chosen should be full school days, and ideally be from the winter and the summer to allow the full variation in consumption to be seen. These daily

profiles should provide clear visibility on how the building is performing on a more detailed level than is possible from simple daily meter readings.

Figure 1 – Example of a daily energy profile for a single day in a school



2.4.2.1 By examining the daily consumption profile in detail it should be possible to see when the main systems such as the heating, lighting and ventilation are switched on and off. Any systems that are operating out of hours unnecessarily can be clearly identified and rectified. An attempt should be made to reconcile the energy use pattern with the known activities taking place at the school. Any inconsistencies noted between energy use and the activities that drive it should be investigated further.

2.4.3 Energy data comparison against energy targets

2.4.3.1 Energy data comparison against energy targets can be made as follows :

2.4.3.2 For all New Buildings, whether a Partial or Whole School Project, the Contractor shall undertake an energy review against the energy targets as

described in the Generic Design Brief Technical Annex 2H : Energy and also against the contractors' design predictions.

2.4.3.3 Energy targets are expressed as electricity equivalent kWh_e. A kWh_e is calculated by multiplying the different fuel kWh consumptions by the relevant energy weighting factor.

Table 2 Energy Weighting Factors

Category	Description	Energy Weighting Factor*
Electricity	includes mains electricity, electricity from combined heat and power and renewable energy	1.0
All fuels	includes, gas, oil, and biofuels	0.4
All thermal energy	includes geothermal, district heat and heat from combined heat and power and solar thermal	0.5

* The energy targets are quoted based on the Operational Hours detailed in Section 4 **Error!**
reference source not found. of GDB Technical Annex 2H: Energy

Table 3 Annual Design Energy Targets - Primary

Type	Heating	Hot Water	Small Power	Lighting	Fans and Pumps	Cooling	Lifts	Total
Electrical equivalent (kWh/m ²)	21	4	10	13	7	1	1	57
Allow 4 kWh/m ² for building related services							Total	61

Table 4 Annual Design Energy Targets - Secondary

Type	Heating	Hot Water	Small Power	Lighting	Fans and Pumps	Cooling	Lifts	Total
Electrical equivalent (kWh/m ²)	20	4	25	13	7	1	1	71
Allow 4 kWh/m ² for building related services							Total	75

2.4.3.4 In addition to the metered data collected by the AMR, the additional data on temperature and CO₂ levels within classrooms available on the BMS should be reported. It provides confirmation of correct operation of controls and

allows fine tuning and seasonal adjustments to be made to minimise energy consumption.

2.4.4 Facility staff

2.4.4.1 The structured interviews with the facilities staff will ask the same questions that were asked during the initial performance review, thereby allowing progress on the issues previously identified to be fully tracked. It is also possible that new issues may have come to light in the intervening time, especially with regards to systems which are only required at certain times of the year such as heating or cooling. The issues raised by teaching staff in their responses to the questionnaires will be confirmed through the facilities team as having been suitably actioned since the initial BPE visit.

2.4.5 Teaching staff

2.4.5.1 Further teaching staff questionnaires are not required to be completed as resulting actions from the initial BPE review will have been completed through the initial review action plan. In the event of significant issues being identified at the initial BPE review in some circumstances it may be appropriate to re-survey the teaching staff so that these updated results can be included in the final BPE report.

2.4.6 Analysis of the performance data and user feedback

2.4.6.1 Overall analysis of the building performance, supported by actual annual energy consumption data and seasonal performance of the building should now be provided. A commentary against benchmarks and the design prediction can be made.

2.4.6.2 The results of the action plan undertaken as result of the initial BPE review can be recorded, along with any seasonal commissioning adjustments that resulted in improved building performance.

2.4.7 Reporting format for final BPE report

2.4.7.1 The final Performance Review Report template is provided in Appendix D.

2.4.8 Action plan for any outstanding items

2.4.8.1 Include details of any proposed further action that is required.

Appendix A - Facilities staff questionnaire

Appendix A – Building Performance Evaluation - Facilities staff questionnaire

This Facilities Staff Interview is a vital part in achieving better performing school buildings. It forms part of the building performance evaluation and provides the insight into the criteria which effect educational and operational performance. It will help the school users (staff and students) and the school's technical and operational team to get a clear understanding of how the building is performing in use in order to inform necessary action. It will also inform the design and operation of future educational buildings.

Completing the interview

- 1 If any question has a qualifying remark, note this in the box under the question.
- 2 Try to summaries any long answers into the key point(s) relating to the question.
- 3 If the interviewee does not have experience with the system in question, skip all questions on that system.

Do you have any responsibility for the operation or
1 maintenance of the building's heating systems? yes no

Additional comments

The training provided on the operation and maintainance of
2 the heating system was good inadequate too complex

Additional comments

3 The heating controls are simple to use moderately simple to use complex to use

Additional comments

10 The level of feedback on the cooling/ventilation systems provided by the control system is good inadequate too detailed

Additional comments

11 Issues with the cooling/ventilation systems are easy to identify slightly difficult to identify difficult to identify

Additional comments

12 Maintenance of the cooling.ventilation systems are easy moderately difficult difficult

Additional comments

13 Do you have any responsibility for the operation and/or maintenance of the building's lighting? yes no

Additional comments

14 The training provided on the operation or maintainance of the lighting systems was good inadequate too complex

Additional comments

15 The lighting controls are simple to use moderately simple to use complex to use

Additional comments

16 Access to the light fittings for cleaning, replacement and maintenance is

easy moderately difficult difficult

Additional comments

17 Using the metering system to compare energy consumption over the weekend the weekday consumption is

easy difficult not possible

Additional comments

18 Comparing the energy consumption of this week with last week with the metering system is

easy difficult not possible

Additional comments

19 The training provided for monitoring and reporting the school's water and energy use was

good inadequate too complex

Additional comments

20 In terms of helping to understand, operate and manage the school, the contractor's Aftercare Service was

full and complete partly complete inadequate

Additional comments

21 Cleaning the school building is

completely
straightforward

partly
straightforward

difficult

Additional comments

Please add any further comments and expand on any answers where improvement measures are required.

Comments

Appendix B - Teaching staff interview questionnaire

Appendix B – Building Performance Evaluation - Teaching staff interview questionnaire

This Teaching Staff Survey is a vital part in achieving better performing school buildings. It forms part of the building performance evaluation and provides insight into the criteria which effect educational and operational performance. It will help the staff and students, and the school's technical and operational team to get a clear understanding of how the building is performing in order to inform necessary action. It will also inform the design and operation of future educational buildings.

Completing the survey

About you

Female

Male

Classroom name / number

Your answers should refer to the room you spend the most amount of time in.

Place a tick or a cross in the box with is the most relevant answer for you.

1 In **winter** the temperature in my classroom in the morning is

too hot

too cold

comfortable

2 In **winter** the temperature in my classroom at the end of the day is

too hot

too cold

comfortable

3 In **winter** my classroom's temperature is suitable for different teaching scenarios (lecturing, group work, practical work, etc.)

for all scenarios

for some scenarios

for no scenarios

Provide further details if heating is not suitable for some/no teaching scenarios

4 The **winter** air quality in the in the classrooms is best described as

stuffy

dry

good

drafty

humid

5 The heating controls for the classroom provide

poor temperature control	<input type="checkbox"/>	good temperature control	<input type="checkbox"/>	N/A (No controls)	<input type="checkbox"/>
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Provide further details if temperature control is poor

6 The heating controls (thermostats, radiators, etc.) in the classroom are

Difficult to use	<input type="checkbox"/>	Easy to use	<input type="checkbox"/>	N/A	<input type="checkbox"/>
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Provide further details if controls are difficult to use

7 The level of training given on how to regulate the **winter** temperature for your classroom was

missing	<input type="checkbox"/>	inadequate	<input type="checkbox"/>	good	<input type="checkbox"/>
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8 In **winter** the temperature in the corridors is

too hot	<input type="checkbox"/>	too cold	<input type="checkbox"/>	comfortable	<input type="checkbox"/>
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9 In **winter** the temperature in the gym/assembly hall/cafeteria /toilets is

too hot	<input type="checkbox"/>	too cold	<input type="checkbox"/>	comfortable	<input type="checkbox"/>
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Provide further details if too hot or cold

10 In **summer** the temperature in my classroom in the morning is

too hot	<input type="checkbox"/>	too cold	<input type="checkbox"/>	comfortable	<input type="checkbox"/>
---------	--------------------------	----------	--------------------------	-------------	--------------------------

11 In **summer** the temperature in my classroom at the end of the day is

too hot	<input type="checkbox"/>	too cold	<input type="checkbox"/>	comfortable	<input type="checkbox"/>
---------	--------------------------	----------	--------------------------	-------------	--------------------------

12 In **summer** my classroom's temperature is suitable for different teaching scenarios (lecturing, group work, practical work, etc.)

for all scenarios	<input type="checkbox"/>	for some scenarios	<input type="checkbox"/>	for no scenarios	<input type="checkbox"/>
-------------------	--------------------------	--------------------	--------------------------	------------------	--------------------------

Provide further details if summer temperature is not suitable for some/no teaching scenarios

13 The **summer** air quality in the classrooms is best described as

stuffy	<input type="checkbox"/>	dry	<input type="checkbox"/>	good	<input type="checkbox"/>
drafty	<input type="checkbox"/>	humid	<input type="checkbox"/>		

14 The **summer** ventilation controls for the classroom provide

poor temperature control	<input type="checkbox"/>	good temperature control	<input type="checkbox"/>	N/A	<input type="checkbox"/>
--------------------------	--------------------------	--------------------------	--------------------------	-----	--------------------------

Provide further details if ventilation control is poor

15 The **summer** ventilation controls in the classroom are (give details in the comments section below)

Difficult to use	<input type="checkbox"/>	Easy to use	<input type="checkbox"/>	N/A	<input type="checkbox"/>
------------------	--------------------------	-------------	--------------------------	-----	--------------------------

Provide further details if ventilation controls difficult to use

16 The level of training given on how to regulate the **summer** temperature for your classroom was

missing	<input type="checkbox"/>	inadequate	<input type="checkbox"/>	good	<input type="checkbox"/>
---------	--------------------------	------------	--------------------------	------	--------------------------

17 In **summer** the temperature in the corridors is

too hot	<input type="checkbox"/>	too cold	<input type="checkbox"/>	comfortable	<input type="checkbox"/>
---------	--------------------------	----------	--------------------------	-------------	--------------------------

18 In **summer** the temperature in the gym/assembly hall/cafeteria /toilets is

too hot	<input type="checkbox"/>	too cold	<input type="checkbox"/>	comfortable	<input type="checkbox"/>
---------	--------------------------	----------	--------------------------	-------------	--------------------------

Provide further details if too hot or cold

19 Do you always turn the lights on when you enter the classroom?

no	<input type="checkbox"/>	yes	<input type="checkbox"/>	Automatic lights	<input type="checkbox"/>
----	--------------------------	-----	--------------------------	------------------	--------------------------

20 During the day can you teach successfully under solely daylight conditions?

no	<input type="checkbox"/>	yes	<input type="checkbox"/>		
----	--------------------------	-----	--------------------------	--	--

21 The lighting in the classroom is

too bright	<input type="checkbox"/>	too dim	<input type="checkbox"/>	appropriate	<input type="checkbox"/>
------------	--------------------------	---------	--------------------------	-------------	--------------------------

22 Are there any issues with light quality? light colour issues light flicker issues none

23 Are there any issues with glare from sunlight in the classrooms? no yes

24 Is it difficult to read from display screens due to glare from sunlight electric lights neither
Both N/A

25 Are there areas within the classroom which are under or over lit? under lit over lit even light throughout

26 Do the lighting controls allow sufficient adjustments in the lighting to meet changing teaching scenarios? no yes No controls (automatic)

Provide further details if not

27 Teaching is sometimes interrupted by noise from outside noise from other rooms neither
Both

Please add any further comments and expand on any answers where improvement measures are required.

Comments

Appendix C
Initial Building Performance Evaluation report template

Initial Performance Review (Name of School)

1. Introduction

The introduction should include a description of the school covering the following information as a minimum:

- a. Brief description of the building (location, floor area, layout, storeys, special facilities, etc.)
- b. Date the school was opened.
- c. Number of students
- d. Name of contractor
- e. Name of architect
- f. Name of M&E designer
- g. Facilities management arrangements (in-house or out sourced)
- h. Date of the initial performance review
- i. Name of individual who conducted the review
- j. Name of facilities staff interviewed

2. Overview of the design

This section should include an overview of the school's design with sufficient detail to allow the reader to understand the main operating principles of the main building services as well as the overall design strategy for energy management. Much of this information is often located in the building log book. Each building service should be provided with its own sub-heading. Any design targets for the systems should be stated.

Heating

Details of the heating system should include the operating hours, and temperature set points, fuel types, an overview of the local controls, and distribution method for the heat, i.e. hot water or warm air. Where there are multiple heating systems, such as a biomass boiler and supplementary gas boiler, the interaction between these systems should be described.

Lighting

Details of the lighting should cover the type of lamps used, whether they have automatic controls and the level of controls available to teachers in the individual classrooms. Details should also be provided regarding how the rooms have been designed to utilise daylight.

Ventilation

Details of the type of ventilation and the controls available to teachers should be described. Areas with specific ventilation needs such as kitchen, changing rooms and sports halls should be noted. The design maximum CO₂ levels should also be stated.

Cooling

If cooling is provided, the reason for its use should be explained. The details of the controls should include information on whether it is possible for the heating and cooling systems to be operating at the same time.

BMS Controls

A list of all the systems that are connected to the BMS should be provided, along with the level of control provided over them. For example the BMS may only provide information on whether plant is running or not for some systems, whereas for others it may provide full control including changing of set-points.

Other major systems (including renewables).

Any system which has a significant impact on the building's performance should be noted.

3. Issues with the Building

This section should be used to provide information on any issues with the building performance that affect energy consumption, facilities management and building user comfort. The walk-around tour of the building should be undertaken with a member of the facilities staff in order to view all the systems in operation. It should be illustrated with photographs taken during the site visit walk round.

Wherever possible the root cause of the issues should be described.

4. Initial Energy and Utility consumption

A brief overview should be provided of the energy monitoring systems in place and the process required to extract the data from them. For example is it possible to download the meter readings in an easily readable format. The ease of investigating energy consumption trends over time should be stated. For example is there a computer

interface that displays energy consumption in a graphical format on the BMS that the school uses regularly.

The initial energy and utility data should be recorded here. As a minimum the following information should be presented.

- a. Utility being monitored (e.g. gas, electricity, etc.)
- b. Meter ID
- c. Consumption since start of building occupation until present day.
- d. Average consumption per day
- e. Average out of hours consumption per day

A brief description of the energy monitoring process used by the school should be provided. It should provide details on who has overall responsibility for monitoring and managing the energy consumption.

The energy total consumptions since the start of the occupation, as recorded on the BMS system , should be extracted and the results are shown by completing the table below.

Utility	Total consumption since start of occupation as recorded by the BMS on date of initial BPE review	Av daily consumption based on No. of days since opening	Energy used /m2/day based on GIFA m2	Typical benchmark, Kwhr/m2/annum, from CIBSE TM46 2008	Design energy target from ESFA energy efficiency guide 2014	Contractors proposals as shown in BRUKL, KWhr/m2/annum	Actual energy used, Kwhr/m2/annum
Electricity	kwhr	Kwhr	Kwhr/m2/day	40	32		
Gas	m3	m3	Kwhr/m2/day	150 (fossil fuel)	62		
Water	m3	m3	N/A	not shown	2.3l/person/day	N/A	

5. Facilities staff interview results

The facilities staff interview is based on a multiple choice format and as such the responses can be presented in the format shown in the following table. There should also be a written summary of the main findings from the interview.

Questions	Multiple choice answers		
	1	2	3
1 Do you have any responsibility for the operation or maintenance of the building's heating systems?	yes	no	
2 The training provided on the operation and maintenance of the heating system was	good	inadequate	too complex
3 The heating controls are	simple to use	moderately simple to use	complex to use
4 The level of feedback on the heating system provided by the control system is	good	inadequate	too detailed
5 Issues with the heating systems are	easy to identify	slightly difficult to identify	difficult to identify
6 Maintenance of the heating system is	easy	moderately difficult	difficult
7 Do you have any responsibility for the operation or maintenance of the building's cooling and/or ventilation systems?	yes	no	
8 The training provided on the operation and maintenance of the cooling and ventilation systems was	good	inadequate	too complex
9 The cooling/ventilation controls are	simple to use	moderately simple to use	complex to use
10 The level of feedback on the cooling/ventilation systems provided by the control system is	good	inadequate	too detailed
11 Issues with the cooling/ventilation systems are	easy to identify	slightly difficult to identify	difficult to identify
12 Maintenance of the cooling, Ventilation systems are	easy	moderately difficult	difficult
13 Do you have any responsibility for the operation and/or maintenance of the building's lighting?	yes	no	
14 The training provided on the operation or maintenance of the lighting/shading/blinds systems was	good	inadequate	too complex
15 The lighting/shading/blind controls are	simple to use	moderately simple to use	complex to use
16 Access to the light fittings for cleaning, replacement and maintenance is	easy	moderately difficult	difficult
17 Using the metering system to compare energy consumption over the weekend the weekday consumption is	easy	difficult	not possible
18 Comparing the energy consumption of this week with last week with the metering system is	easy	difficult	not possible
19 The training provided for monitoring and reporting the school's water and energy use was	good	inadequate	too complex
20 In terms of helping to understand, operate and manage the school, the contractor's Aftercare Service was	full and complete	partly complete	inadequate
21 Cleaning the school building is	completely straightforward	partly straightforward	difficult

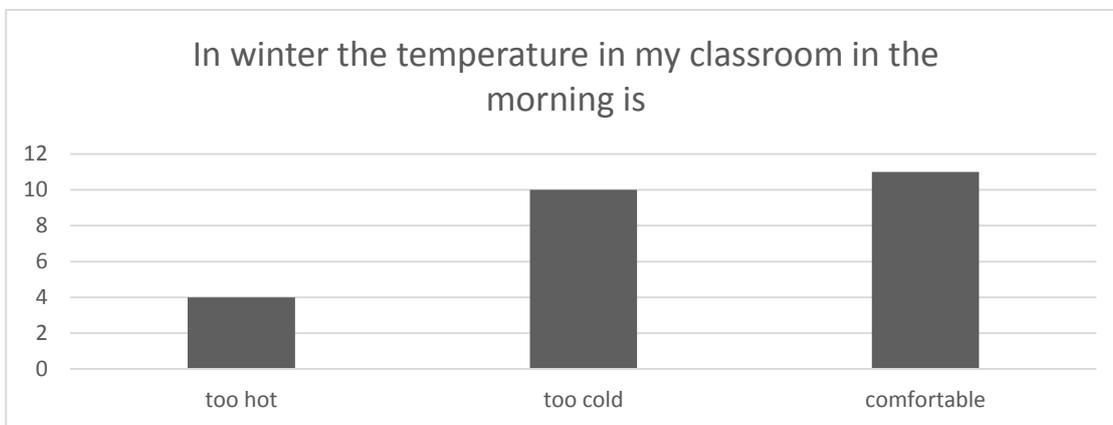
If any additional questions are asked in order to obtain a more detailed understanding of the issues raised they should be noted along with the corresponding response.

6. Teaching staff survey results

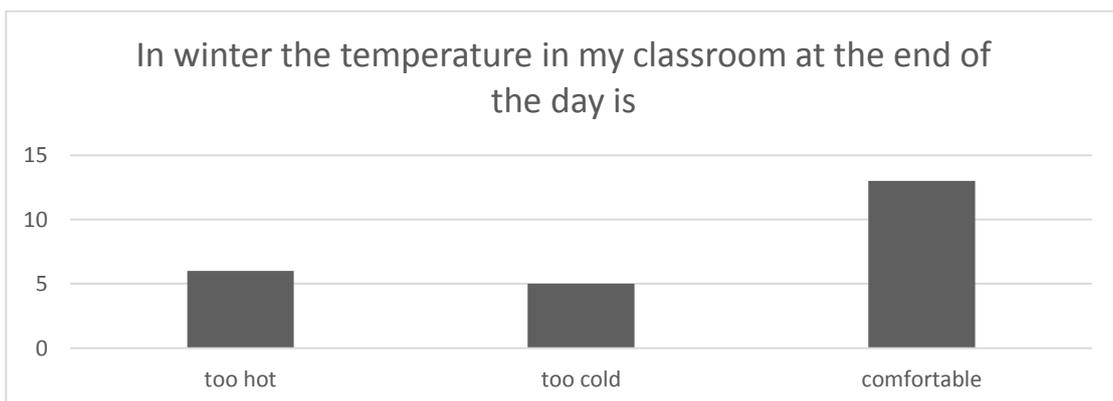
A summary of the main findings in all areas should be provided and any trends in poor building performance should be highlighted. It is important when interpreting the staff survey results to look at the broad trends in the opinions rather than focusing on single points from individuals.

In addition to the summary, the responses to the individual questions should be presented in a graphical format. A spreadsheet answer template is available to assist with this process. Although the questions are multiple choice there are spaces on the answer sheet for the respondents to provide further details if required. These additional responses should be reported below the graphs. As shown in the following examples.

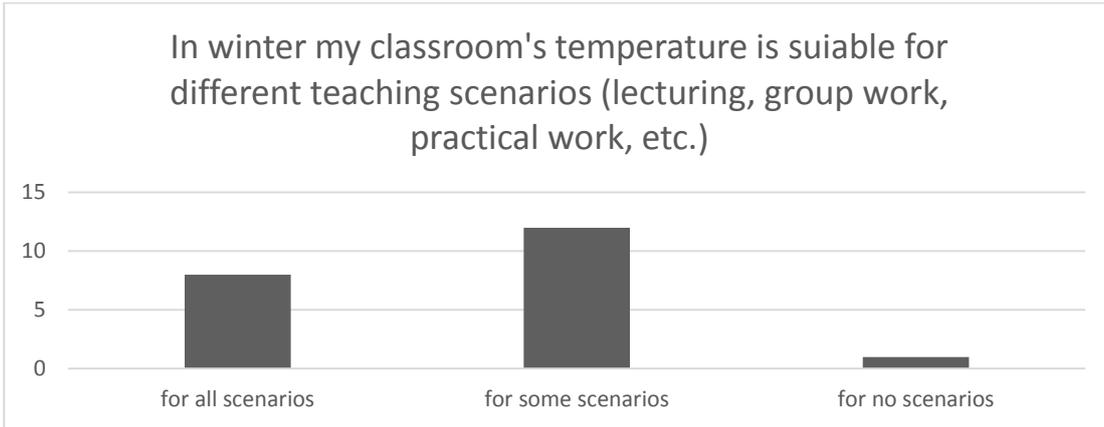
Question 1



Question 2



Question 3

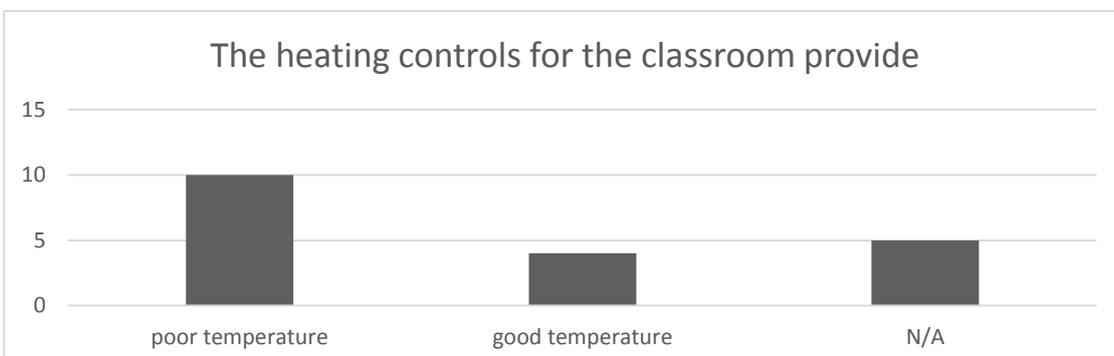


- “Towards the end of the day students are drained, and lack energy and motivation”
- “The room is hot and stuffy”

Question 4

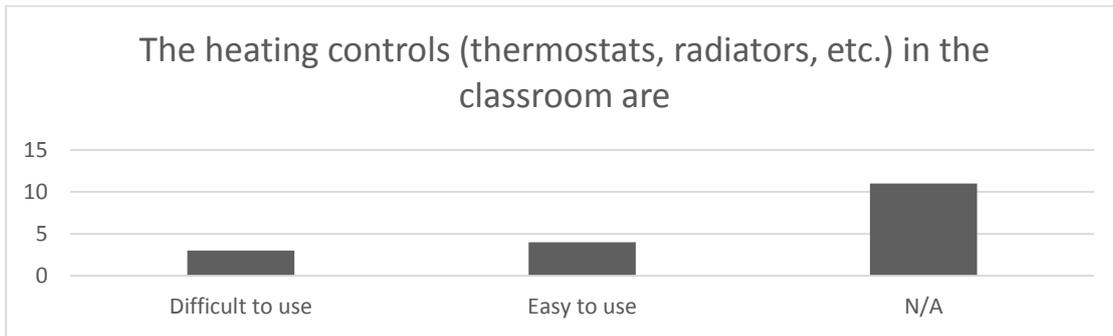


Question 5



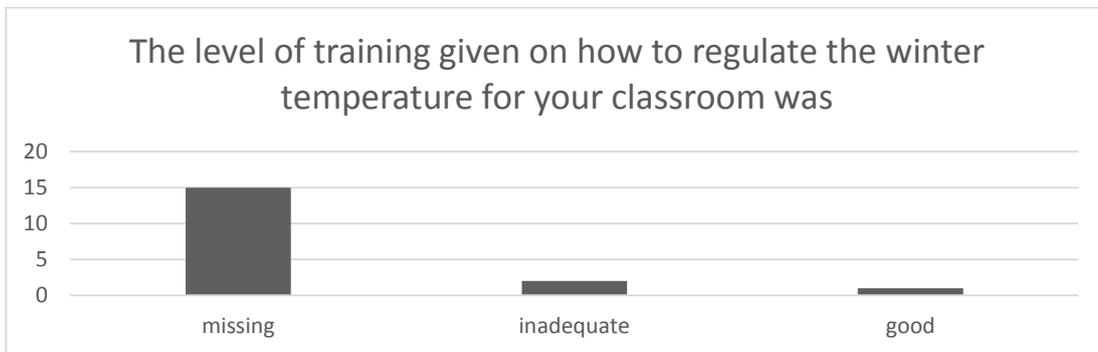
- “The temperature stays the same even is the controls are adjusted”
- “The thermostat has no effect”

Question 6

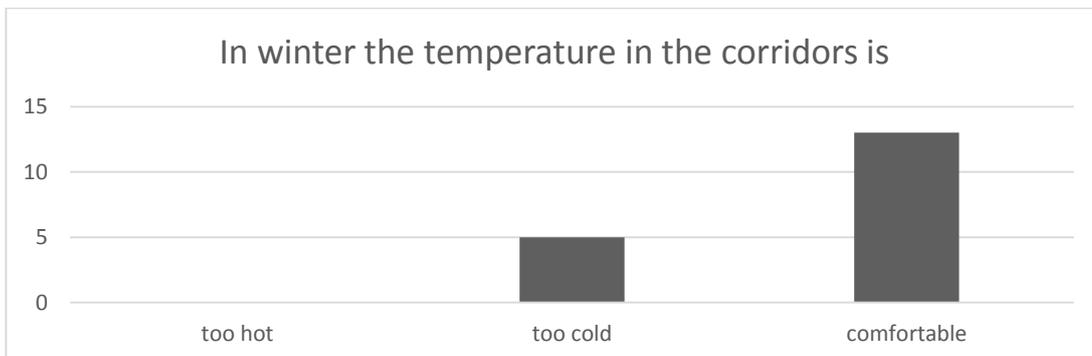


- “The controls make no difference to the temperature”

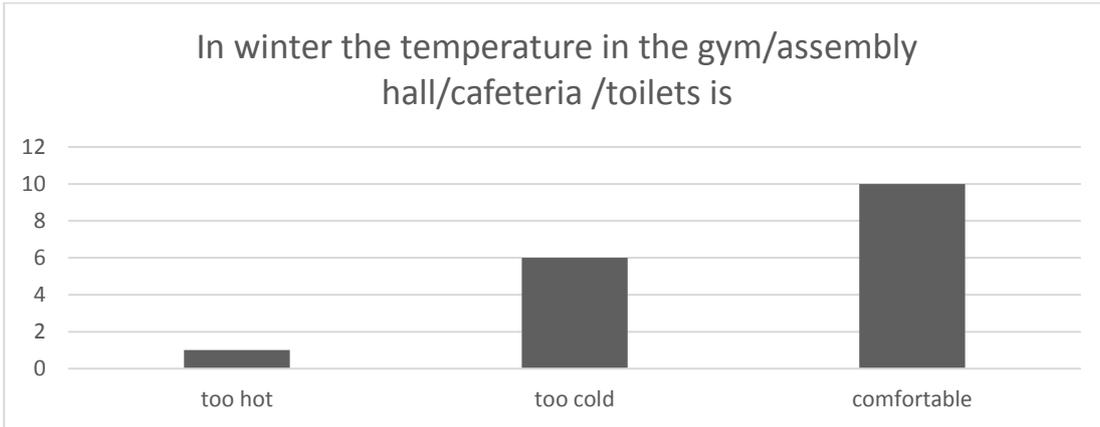
Question 7



Question 8

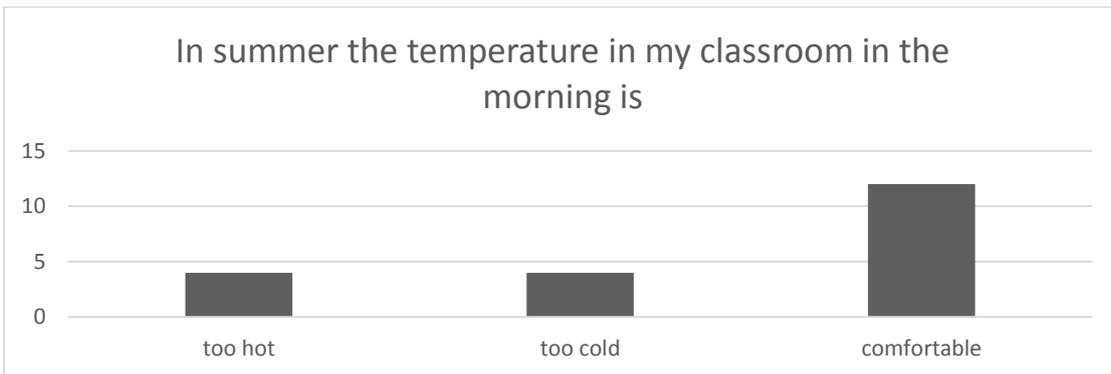


Question 9

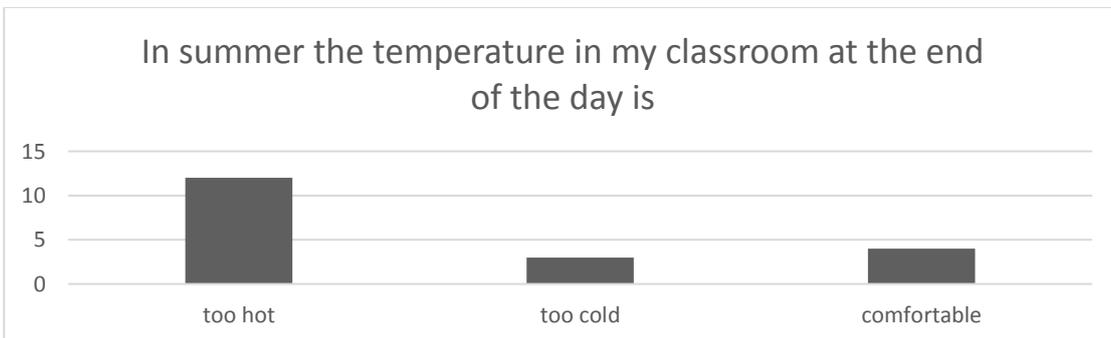


- “Always very warm”
- “The sports hall is very warm”

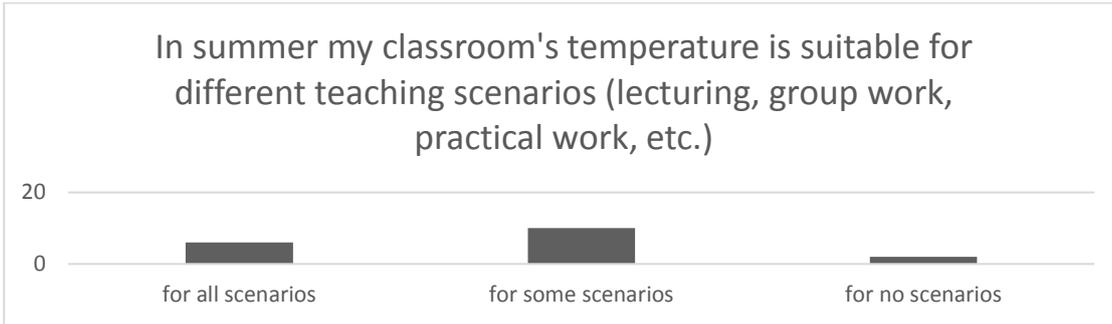
Question 10



Question 11

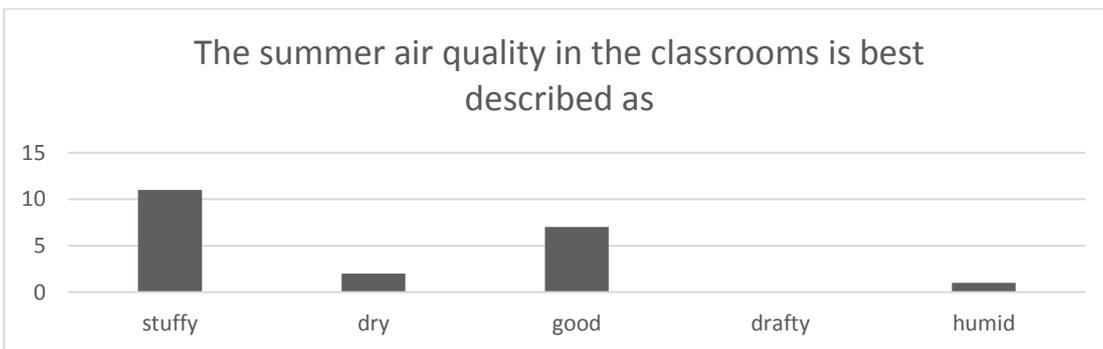


Question 12

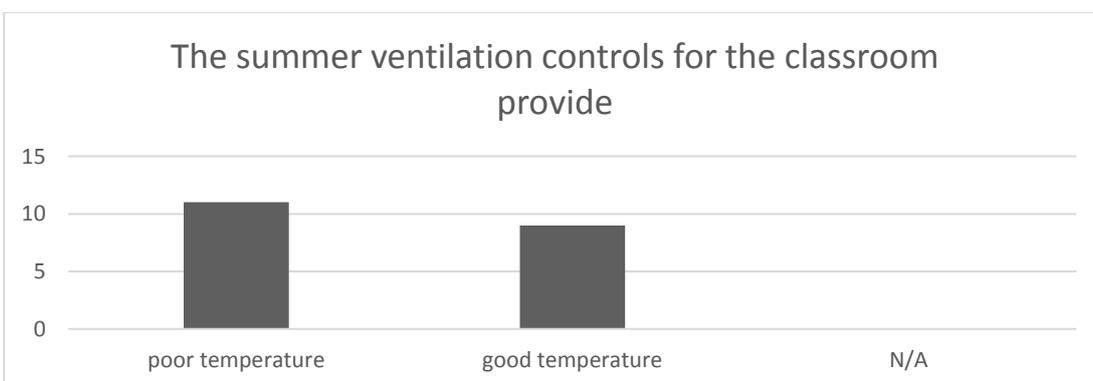


- “We carry out daily duties, however temperature and environment make these difficult and exhausting”
- “Leave the unit feeling tired and unwell during the summer months”
- “No fresh air circulation”
- “Room is very warm and stuffy”

Question 13

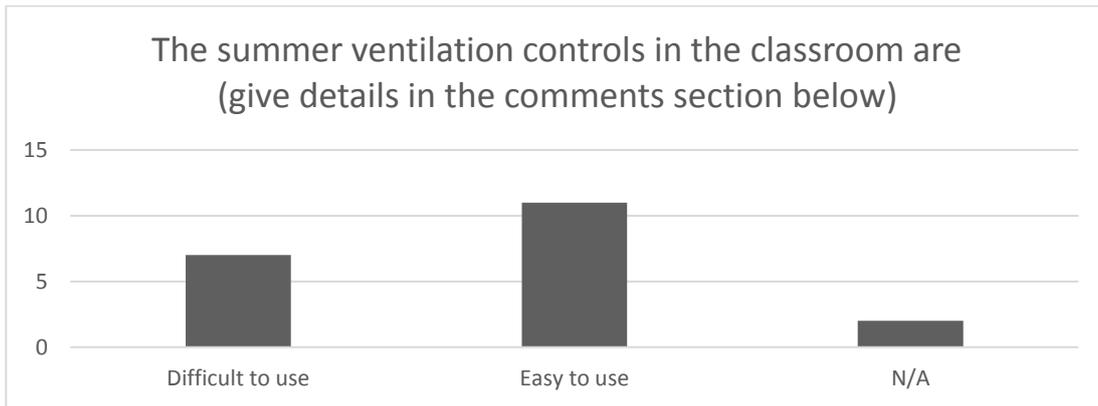


Question 14



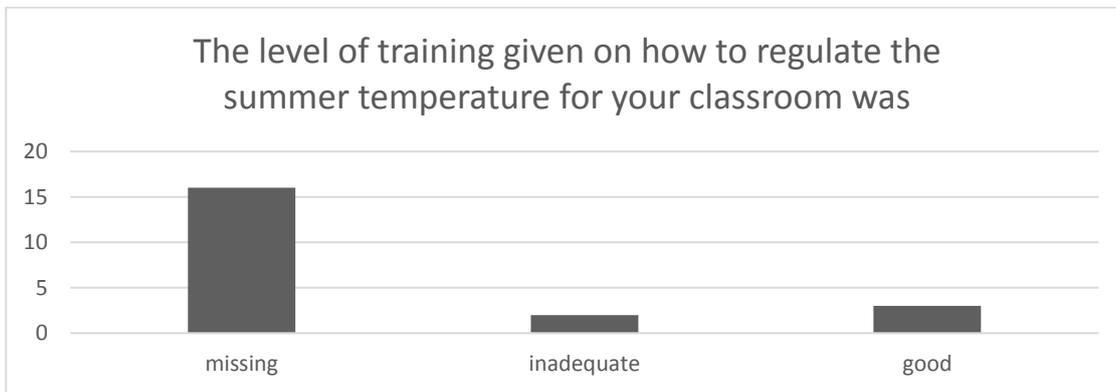
- “The air conditioning is set as low as possible”

Question 15

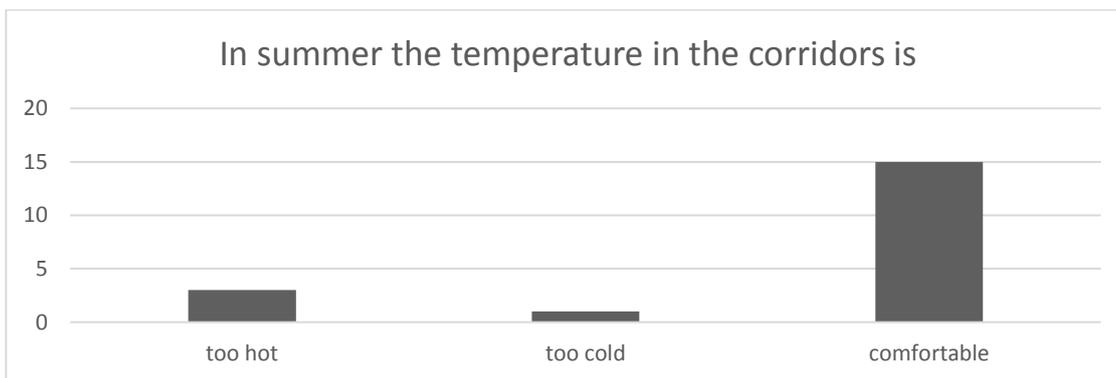


- “The controls make no difference”

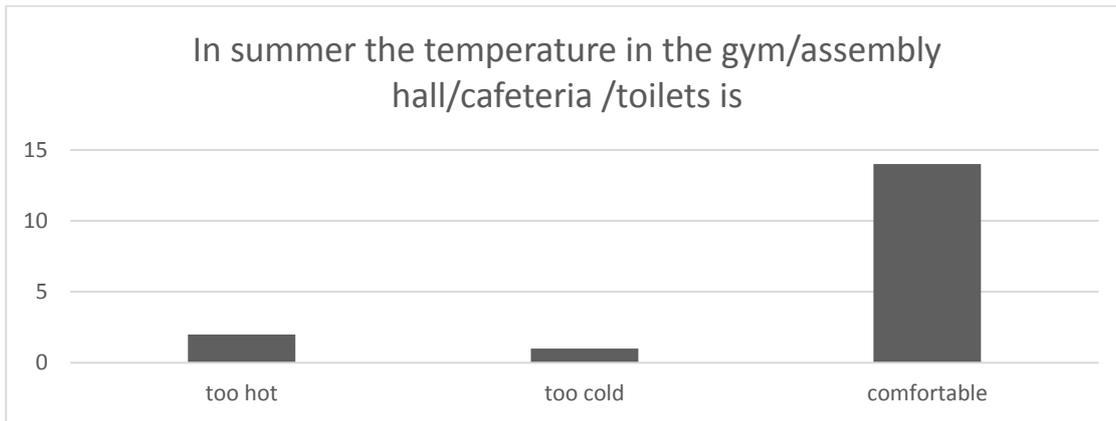
Question 16



Question 17

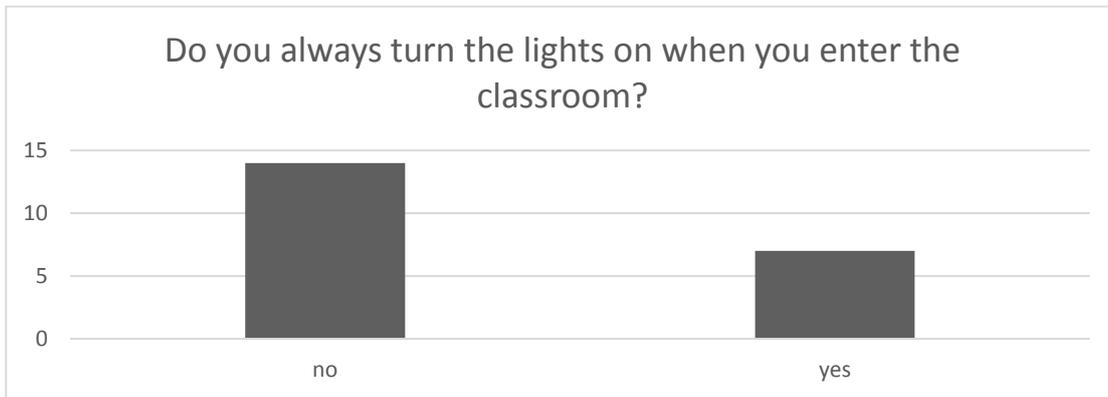


Question 18

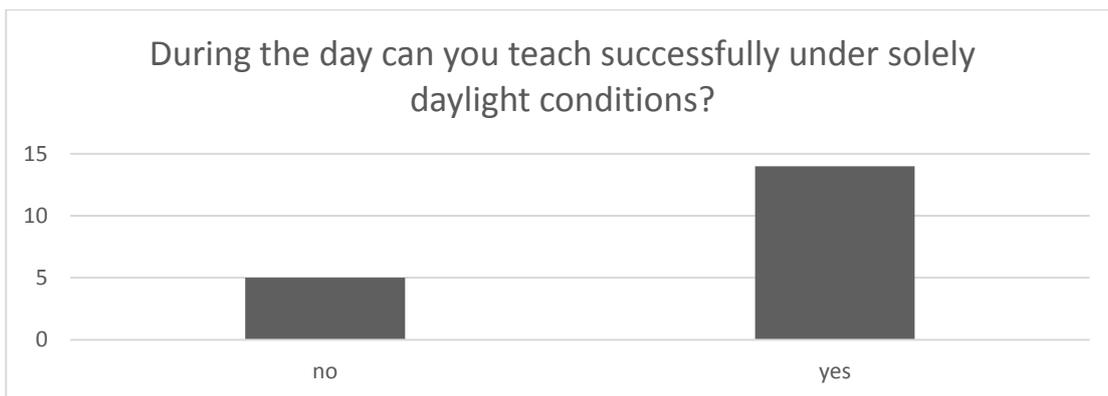


- “The temperature varies from 25.4 °C to 28.1 °C in the summer”

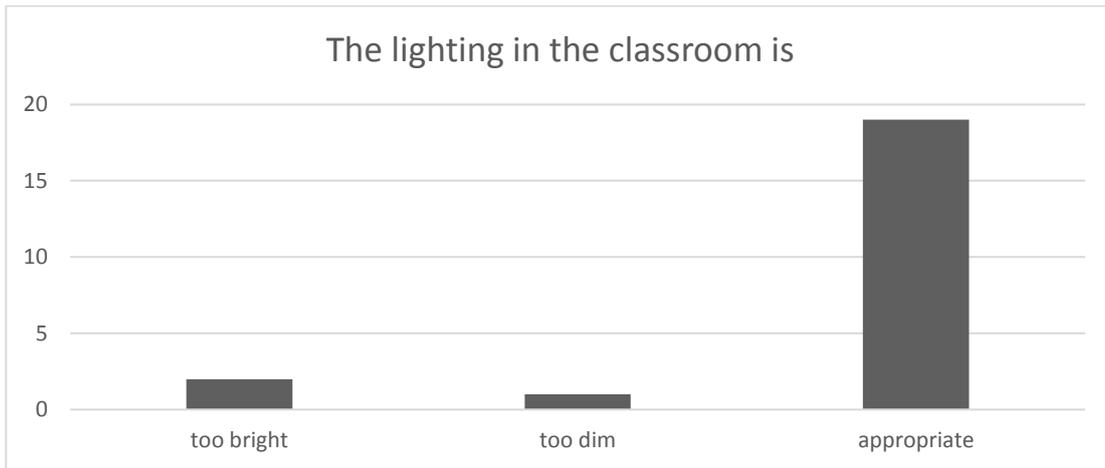
Question 19



Question 20

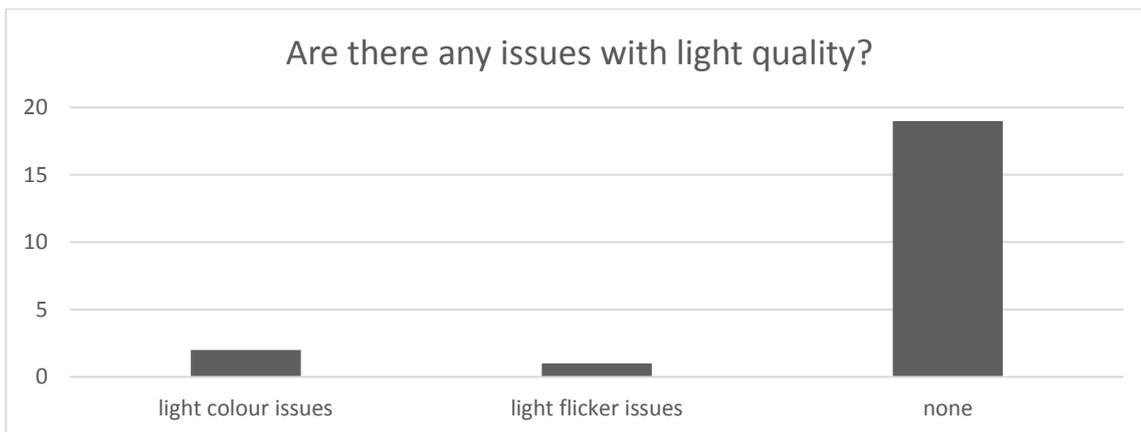


Question 21

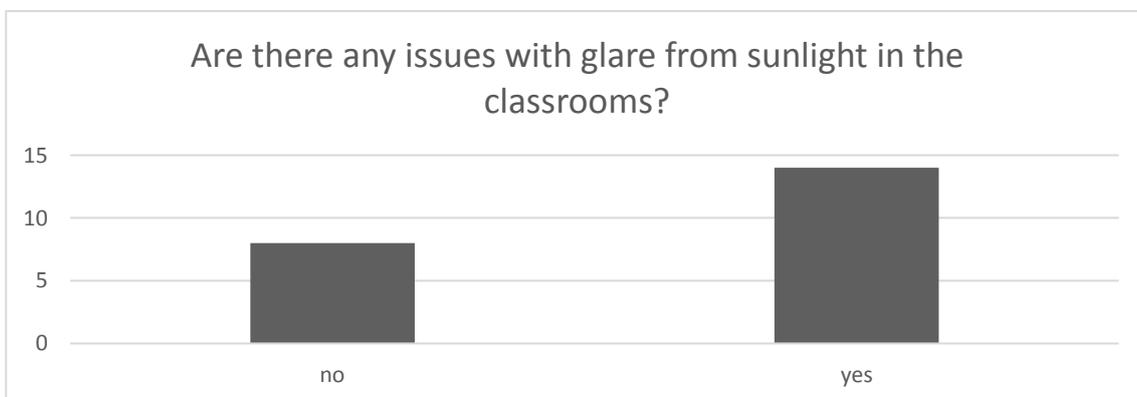


- "The lights are ill placed"

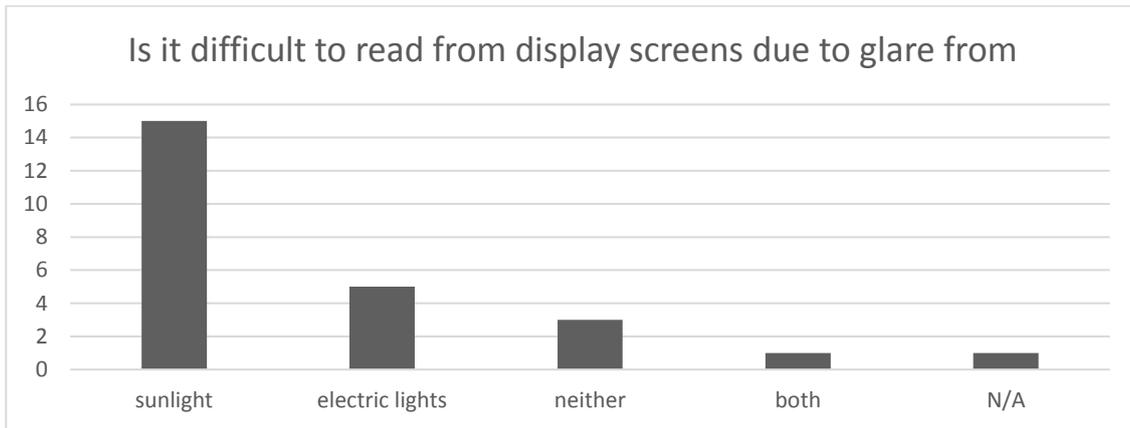
Question 22



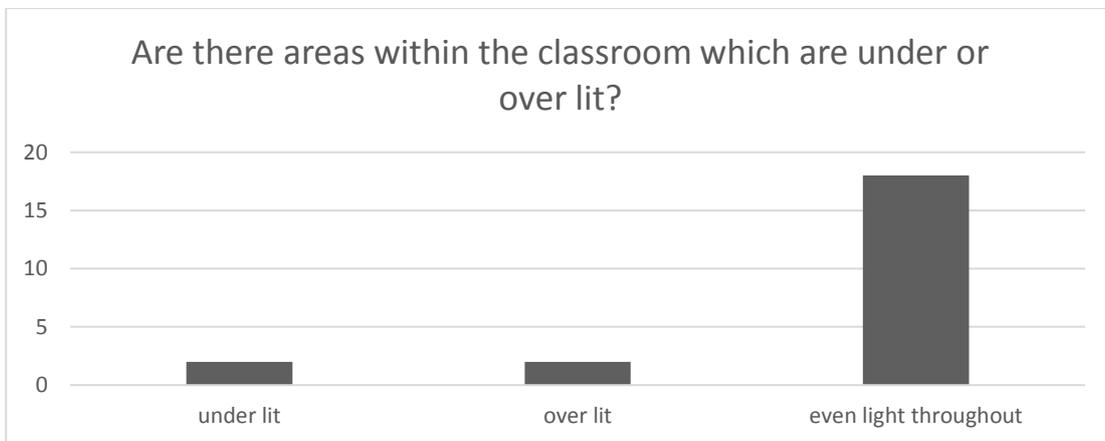
Question 23



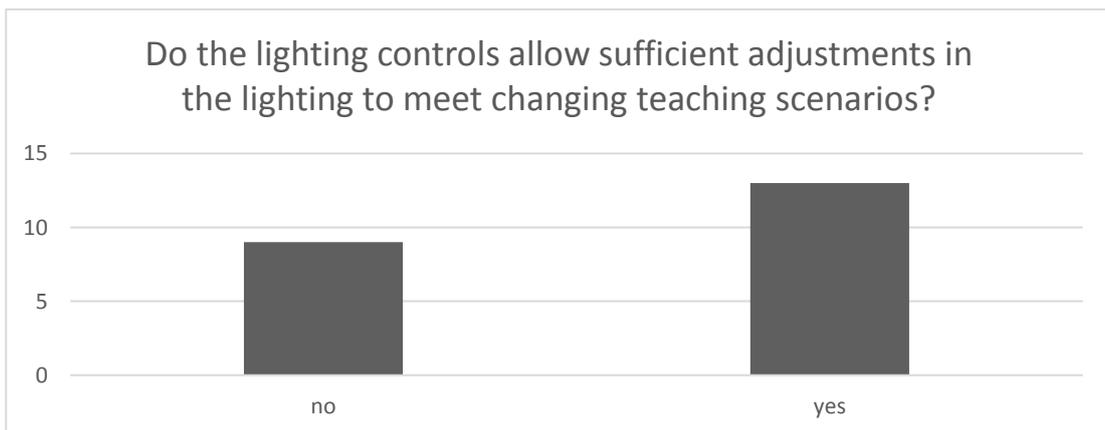
Question 24



Question 25

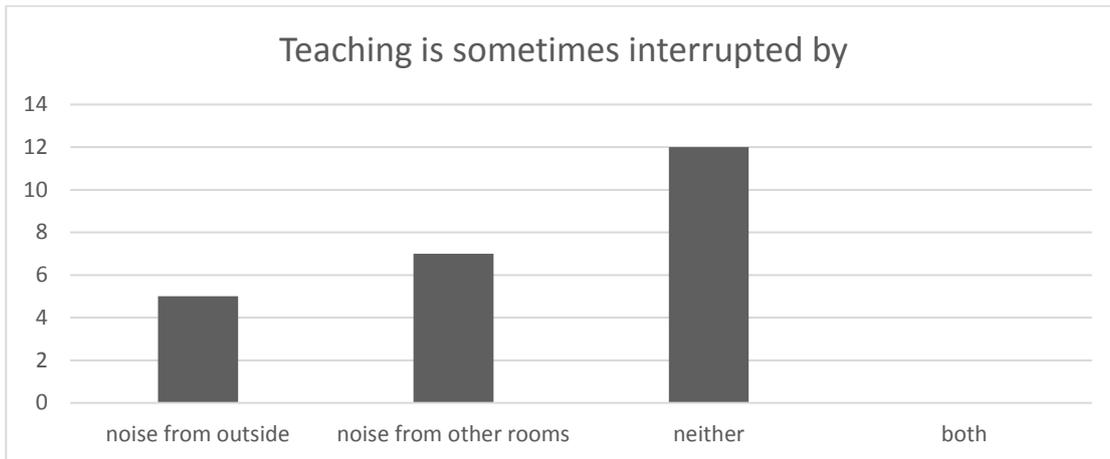


Question 26



- “There are light and dark areas within the room”

Question 27



General comments

“Gets too hot in the office and doors have to be propped open”

“The office gets hot and stuffy. When the sun shines on the side of the building it gets very hot”

“Door is always open to get air circulating. Staff room is noisy”

“Fire door needs to be open to cool the office”

“Nothing ever changes despite contractors trying”

“Room is always warm and stuffy. We only have half the lights on and need to keep the student access hatch open all day which is noisy”

7. Conclusion

The main areas of both good and bad performance for the building are to be summarised in this section. If there are any definite actions which need to be taken they should also be listed.

A simple table showing the outcome of the review, ranking the issues raised in order of significance along with proposed action plan to rectify any issues :

Issue number	School or general	Issue	Explanation	Issue owner	Lead action required by:
1	general	Training	Reinforcing training on ventilation controls will assist in reducing overheating	Contractor/school	contractor
2	school	Teaching staff questionnaires	<ul style="list-style-type: none"> • 17 returned from school : Winter temperature – generally good, some draught issues main entrance doors • Noise/acoustics generally good but some reports of noise transmission from adjacent rooms and ventilation units noise (rooms 2027, 2026) • Summer temperature – generally good but some rooms too hot (textiles room, general office). All would benefit from training on what controls are available within classrooms. • Air quality – Generally good, some reports of stuffy/some draughts, some Bunsen burner issues (Rm 2026) • Lighting – generally considered satisfactory 	contractor	contractor
3	general	Energy consumption is good	Sub meter calibration against utility billing data and ensuring that all sub meters are recording data would help the school in managing their energy consumption.	contractor	contractor
4					
5 etc					

Develop the action plan from the initial BPE review showing the proposed programme for all items and implement in preparation for the final BPE review at 12 months after occupation.

Appendix D
Final Building Performance Evaluation report template

Final Building Performance Review (Name of School)

1. Introduction

This section should be an update of the equivalent section in the initial performance review document. The introduction should include a description of the school which covers at least the following information:

- Brief description of the building (location, floor area, layout, storeys, special facilities, etc.)
- Date the school was opened.
- Number of students
- Name of contractor
- Name of architect
- Name of M&E designer
- Facilities management arrangements (in house or out sourced)
- Date of the initial performance review
- Name of individual who conducted the review
- Name of facilities staff interviewed
- Number of teaching staff who completed the questionnaire

2. Overview of the design

As with the “Introduction” this section can be drawn from the work done from the initial building performance review document, with any changes specifically highlighted. This section should include an overview of the school’s design with sufficient detail to allow the reader to understand the main operating principles of the main building services as well as the overall design strategy for energy management. Much of this information is often located in the building log book. Each building service should be provided with its own sub-heading. Any design targets for the systems should be stated.

Heating

Details of the heating system should include the operating hours, and temperature set points, fuel types, an overview of the local controls, and distribution method for the heat, i.e. hot water or warm air. Where there are multiple heating systems, such as a biomass boiler and supplementary gas boiler, the interaction between these systems should be described.

Lighting

Details of the lighting should cover the type of lamps used, whether they have automatic controls and the level of controls available to teachers in the individual classrooms. Details should also be provided regarding how the rooms have been designed to utilise daylight.

Ventilation

Details of the type of ventilation and the controls available to teachers should be described. Areas with specific ventilation needs such as kitchen, changing rooms and sports halls should be noted. The design maximum CO₂ levels should also be stated.

Cooling

If cooling is provided, the reason for its use should be explained. The details of the controls should include information on whether it is possible for the heating and cooling systems to be operating at the same time.

BMS Controls

A list of all the systems that are connected to the BMS should be provided, along with the level of control provided over them. For example the BMS may only provide information on whether plant is running or not for some systems, whereas for others it may provide full control including changing of set-points.

Other major systems (including renewables).

Any system which has a significant impact on the building's performance should be noted.

3. Issues with the Building

This section should focus on the issues with the building performance that affect energy consumption, facilities management and building user comfort. It should be supported by the photographs taken on the site visit.

Wherever possible the root cause of the issues should be described. As the building will have been occupied for some months a greater number of issues may have emerged. Issues with the ease of maintaining and cleaning the building should be noted.

4. Energy and Utility consumption

4.1 Description of the energy monitoring systems

A brief overview should be provided of the energy monitoring systems in place and the process required to extract the data from them. The ease of investigating energy

consumption trends over time should be stated. For example is there a computer interface that displays energy consumption in a graphical format; do the school utilise the iSERV energy reports in managing the building?

4.2 Overview of energy consumption

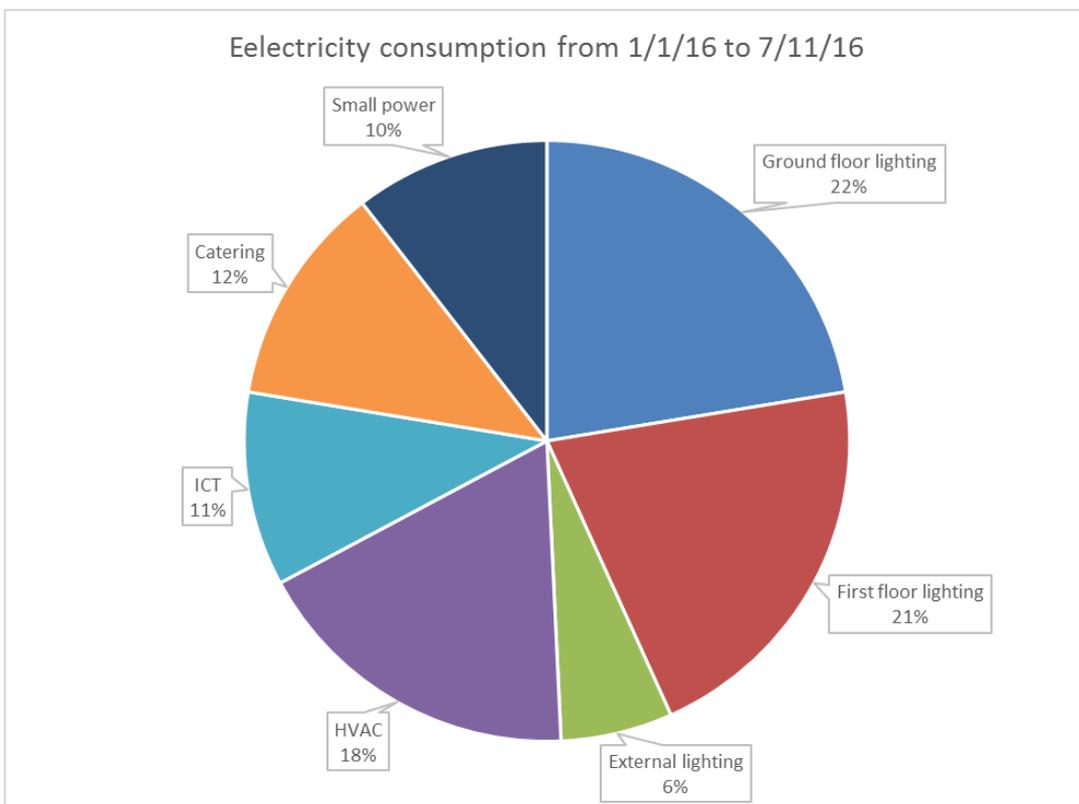
The first year annual energy and utility data should be recorded here. As a minimum the following information should be presented.

- Utility being monitored (e.g. gas, electricity, etc.)
- Meter ID
- Consumption since the start of building occupation until the present time
- Average consumption per day
- Average out of hours consumption per day

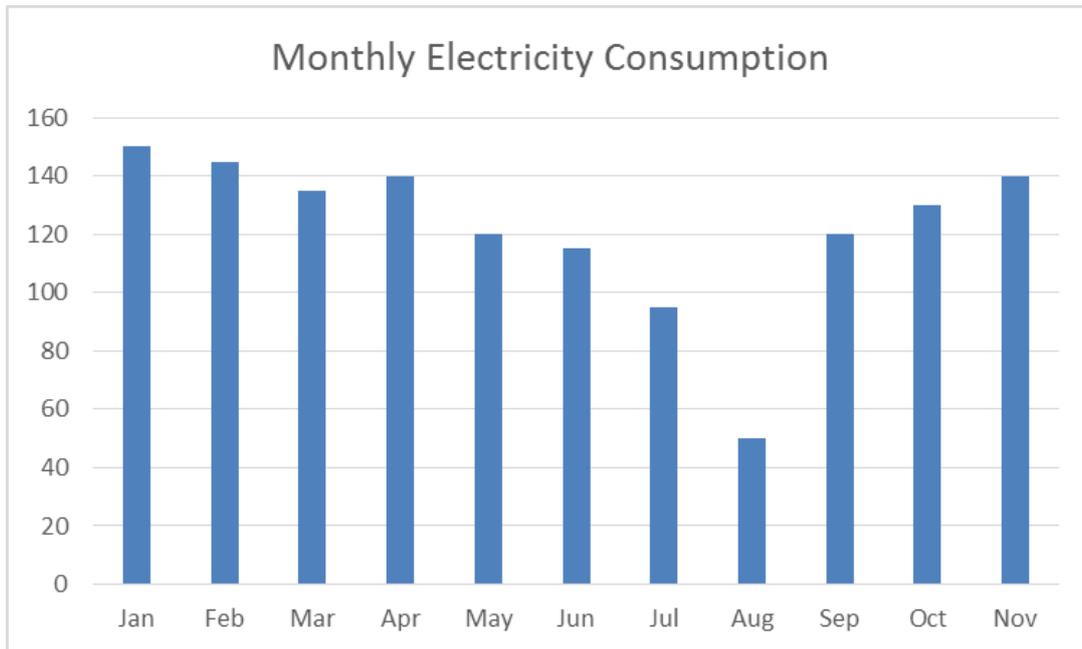
A brief description of the energy monitoring process used by the school should be provided that provides details on who has overall responsibility for monitoring and managing the energy consumption.

4.3 Breakdown of consumption

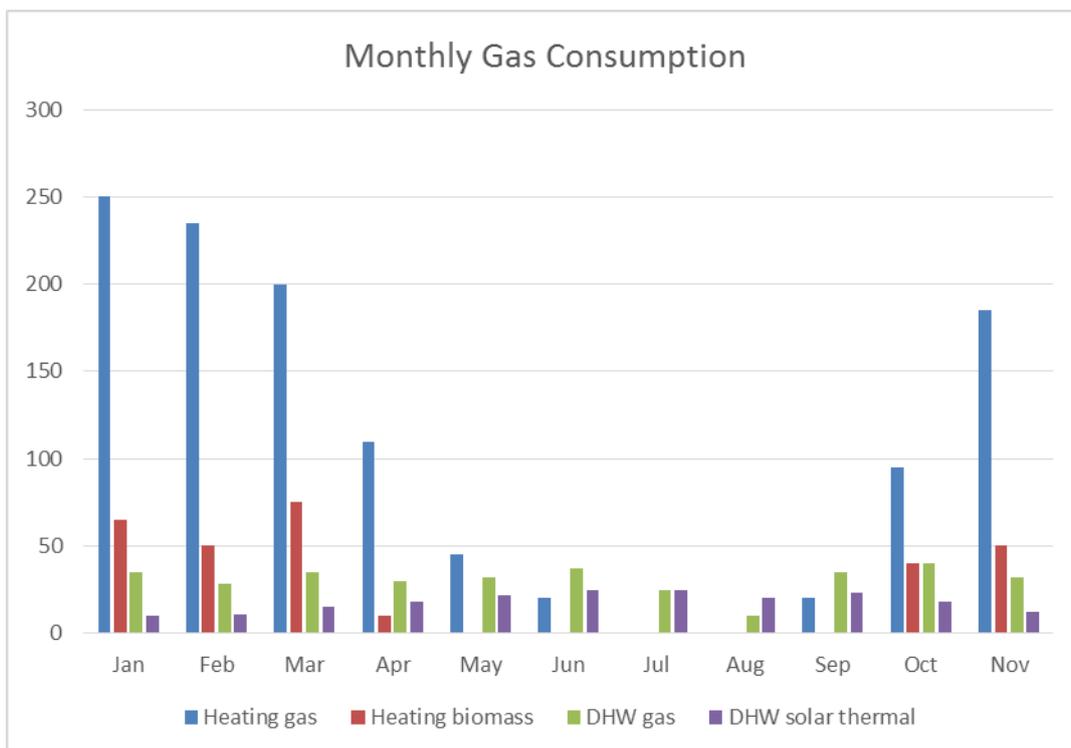
The electricity consumption should be grouped into use type and presented to demonstrate how the energy is consumed as shown in the following chart.



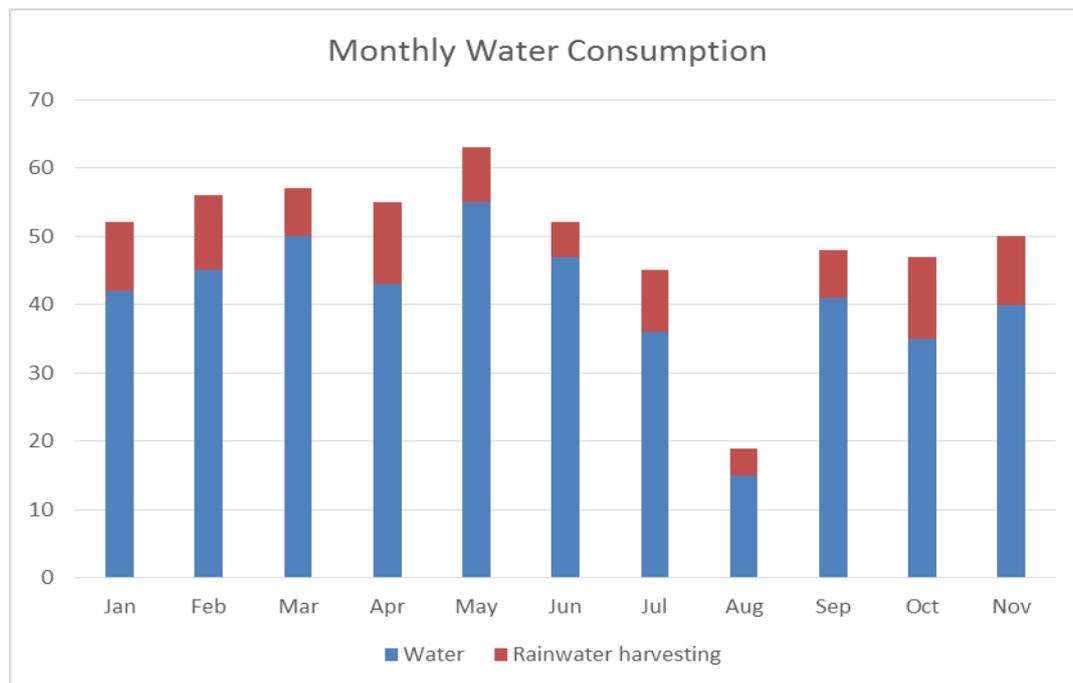
The monthly totals for the various sub-meters and main meters should also be shown. Where there are trends observed in the energy consumption, a commentary should be provided describing the likely drivers behind them.



The gas should also be presented in a similar manner as the electricity. If possible the hot water should be shown separately from the heating use. Also renewable heat is used alongside the gas, this should also be presented. As with the electricity consumption a commentary should be provide to explain the driving factors behind the patterns in consumption.



The water consumption should also be shown with any contribution from rainwater harvesting or greywater recovery shown separately.



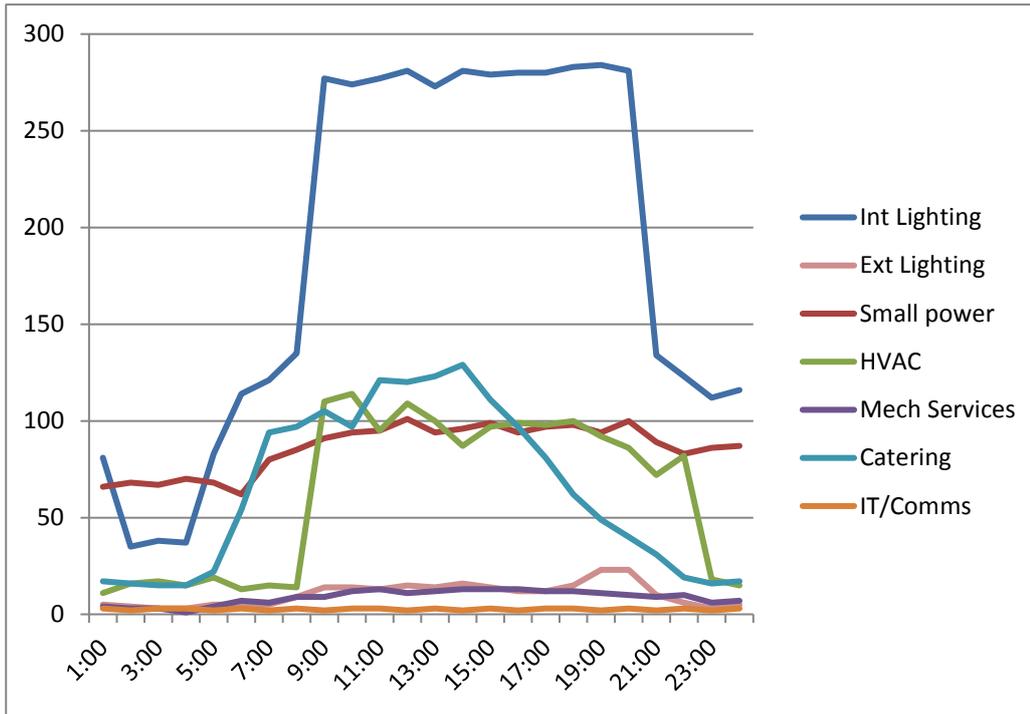
4.4 iSERV Analysis and reporting

The energy data that is uploaded to the iSERV or similar monitoring system should be analysed to highlight areas of good and bad energy performance. The iSERV system will produce a report showing different areas of the building's energy performance measured against industry benchmarks. The main findings from this report should be summarised here, paying particular attention to any areas that significantly exceed the benchmark consumption figures.

4.5 Daily profiles

The energy consumptions for a summer day and a winter day should be presented as shown in the following chart.

Figure 2 – Example of a daily energy profile for a school building



A commentary should be provided which shows how the activities taking place within the school are mirrored by the energy consumption. For example it is expected that the power consumption of the lighting will peak based on the amount of day light and the school operational hours, and this should be reflected by annotation of a separate graph of the internal lighting metered data.

A table showing the comparison of the actual annual energy and water consumptions against the contractors design proposals and also the ESFA energy benchmarks should be included. A commentary explaining what actions have been taken through items such as seasonal commissioning adjustments, fine tuning and training to reduce energy consumptions and achieve design performance should be included.

Where it is not clear what is driving any aspect of the energy consumption, this should be clearly noted as an area for further investigation.

If the temperature and CO₂ levels are being monitored within the rooms then these too should be recorded on a separate daily profiles. If either the CO₂ or the temperature levels are found to be outside the design limits this should be highlighted along with details of the potential causes.

Internal temperature is linked to the heating and ventilation systems and it can be useful to produce daily profiles showing the gas consumption and internal temperature in the winter, and the ventilation consumption and internal temperature in the summer.

5. Facilities Staff interview results

The facilities staff interview is structured based on a multiple choice format and as such the responses can be presented in the format shown in the following table. In addition to the table any specific details and issues raised during the interview should be described in this section of the report.

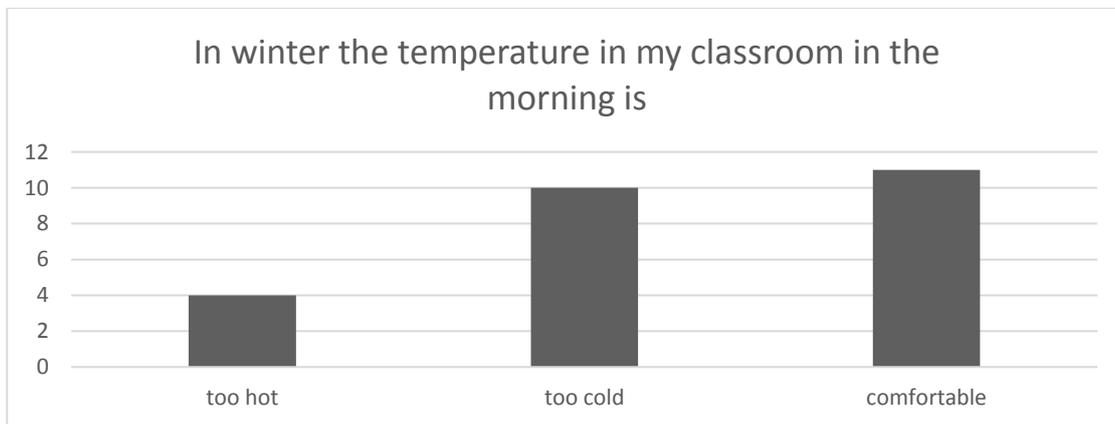
Questions	Multiple choice answers		
	1	2	3
1 Do you have any responsibility for the operation or maintenance of the building's heating systems?	yes	no	
2 The training provided on the operation and maintenance of the heating system was	good	inadequate	too complex
3 The heating controls are	simple to use	moderately simple to use	complex to use
4 The level of feedback on the heating system provided by the control system is	good	inadequate	too detailed
5 Issues with the heating systems are	easy to identify	slightly difficult to identify	difficult to identify
6 Maintenance of the heating system is	easy	moderately difficult	difficult
7 Do you have any responsibility for the operation or maintenance of the building's cooling and/or ventilation systems?	yes	no	
8 The training provided on the operation and maintenance of the cooling and ventilation systems was	good	inadequate	too complex
9 The cooling/ventilation controls are	simple to use	moderately simple to use	complex to use
10 The level of feedback on the cooling/ventilation systems provided by the control system is	good	inadequate	too detailed
11 Issues with the cooling/ventilation systems are	easy to identify	slightly difficult to identify	difficult to identify
12 Maintenance of the cooling, Ventilation systems are	easy	moderately difficult	difficult
13 Do you have any responsibility for the operation and/or maintenance of the building's lighting?	yes	no	
14 The training provided on the operation or maintenance of the lighting/shading/blinds systems was	good	inadequate	too complex
15 The lighting/shading/blind controls are	simple to use	moderately simple to use	complex to use
16 Access to the light fittings for cleaning, replacement and maintenance is	easy	moderately difficult	difficult
17 Using the metering system to compare energy consumption over the weekend the weekday consumption is	easy	difficult	not possible
18 Comparing the energy consumption of this week with last week with the metering system is	easy	difficult	not possible
19 The training provided for monitoring and reporting the school's water and energy use was	good	inadequate	too complex
20 In terms of helping to understand, operate and manage the school, the contractor's Aftercare Service was	full and complete	partly complete	inadequate
21 Cleaning the school building is	completely straightforward	partly straightforward	difficult

6. Teaching staff survey results

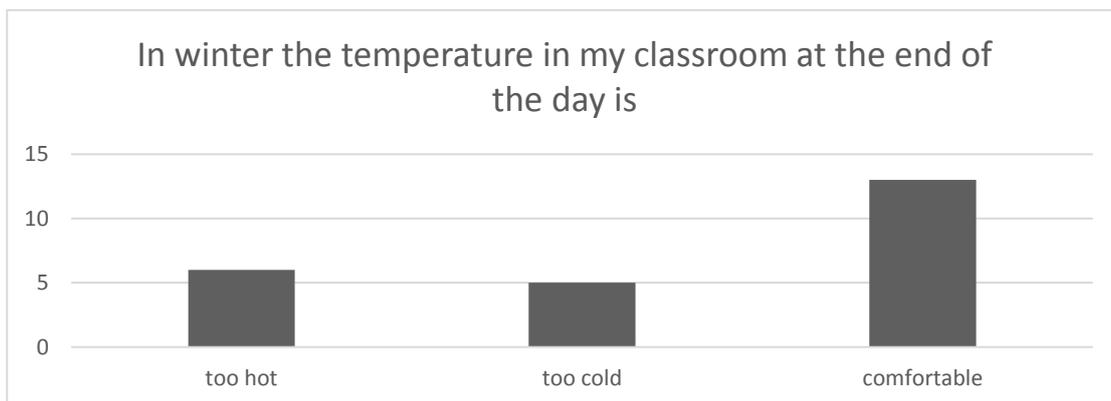
A summary of the main findings in all areas should be provided and any trends in poor building performance should be highlighted. It is important when interpreting the staff survey results to look at the broad trends in the opinions rather than focusing on single points from individuals.

In addition to the summary, the responses to the individual questions should be presented in a graphical format. A spreadsheet answer template is available to assist with this process. Although the questions are multiple choice there are spaces on the answer sheet for the respondents to provide further details if required. These additional responses should be reported below the graphs. As shown in the following examples.

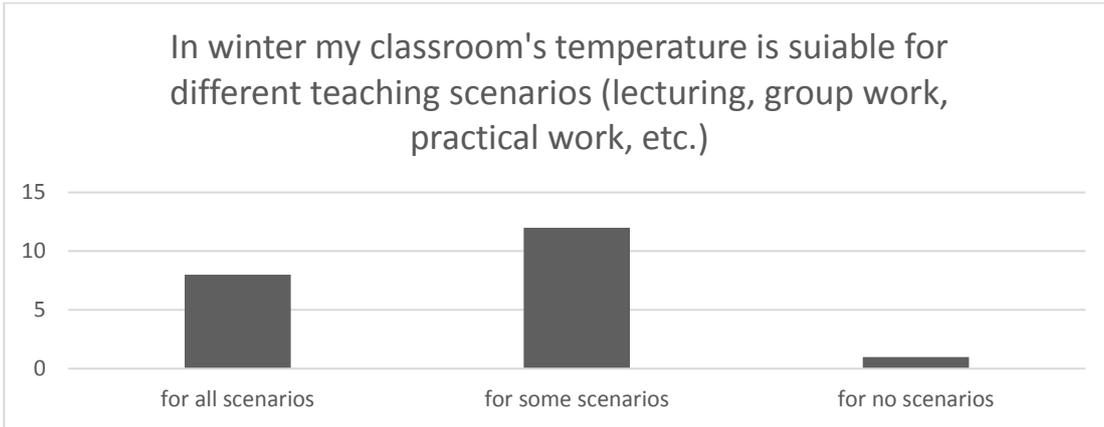
Question 1



Question 2



Question 3

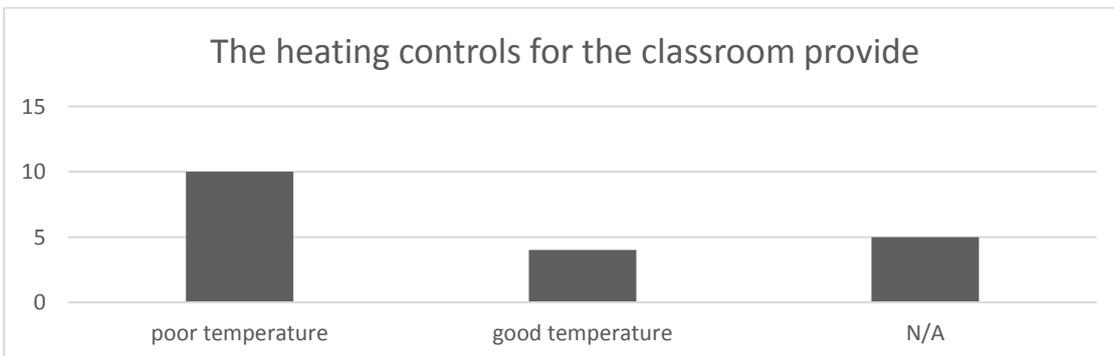


- “Towards the end of the day students are drained, and lack energy and motivation”
- “The room is hot and stuffy”

Question 4

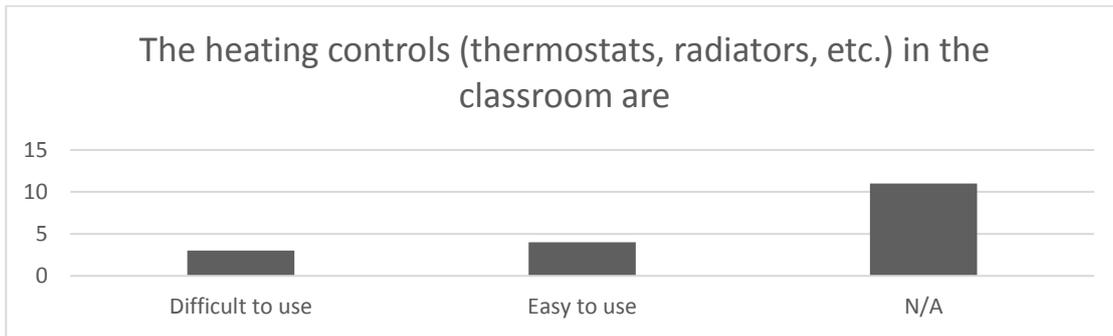


Question 5



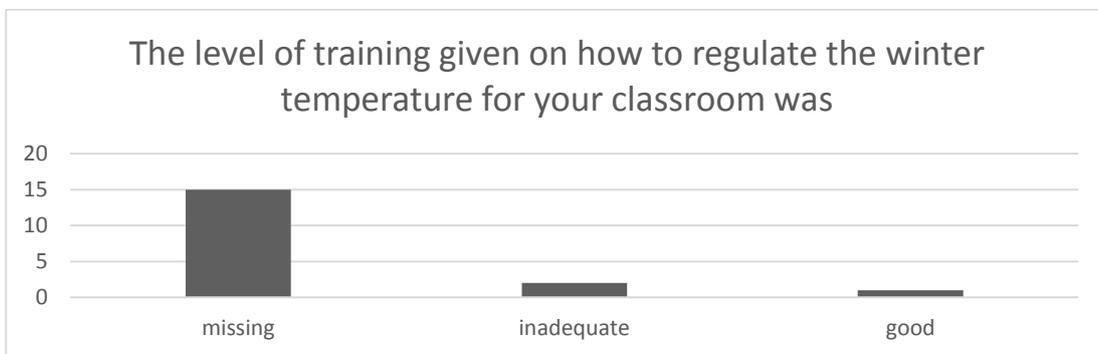
- “The temperature stays the same even is the controls are adjusted”
- “The thermostat has no effect”

Question 6

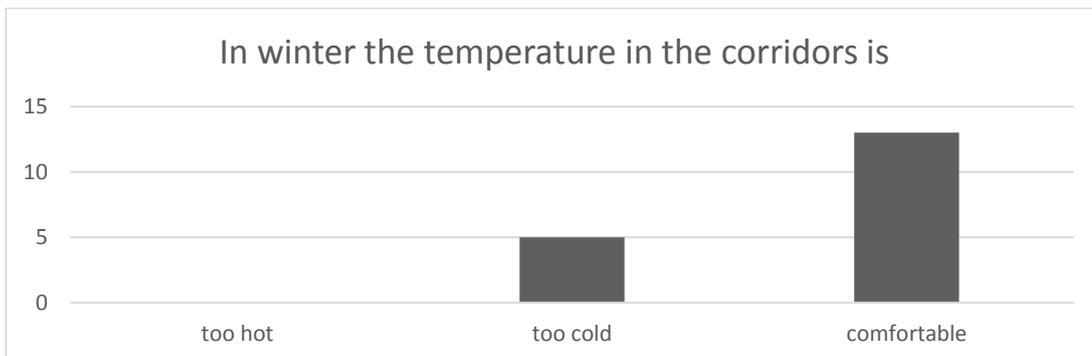


- “The controls make no difference to the temperature”

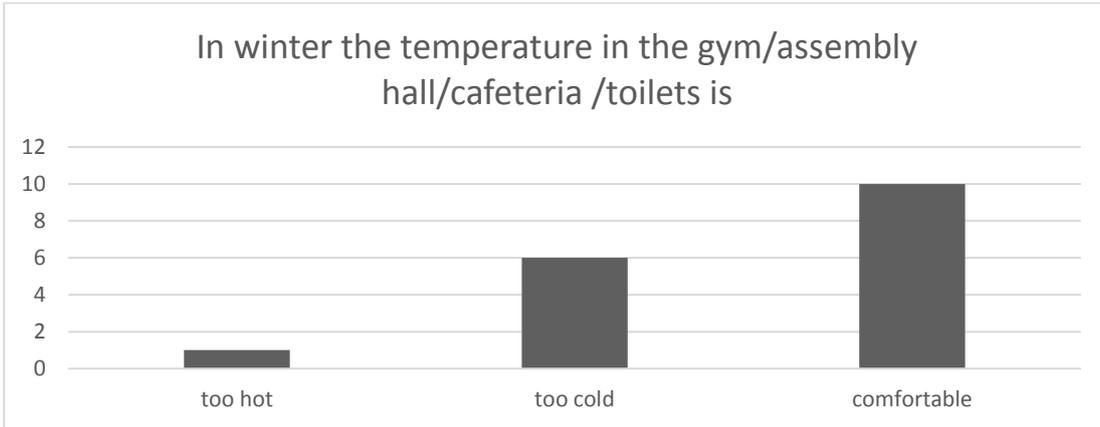
Question 7



Question 8

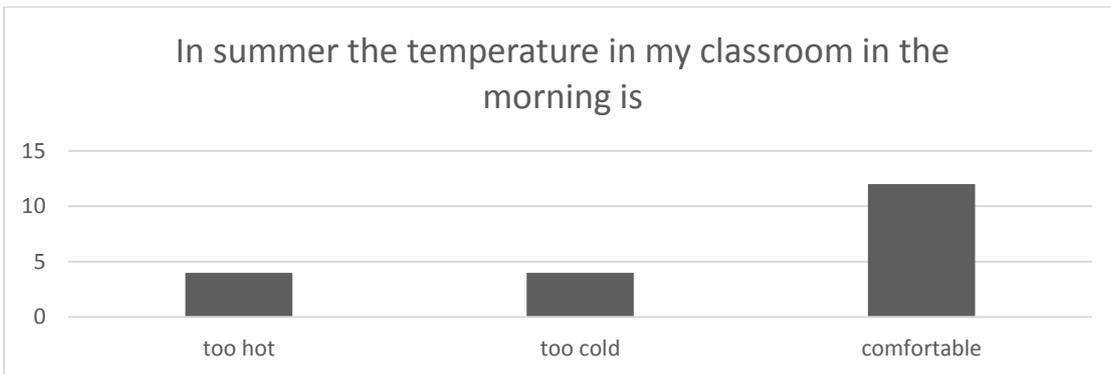


Question 9

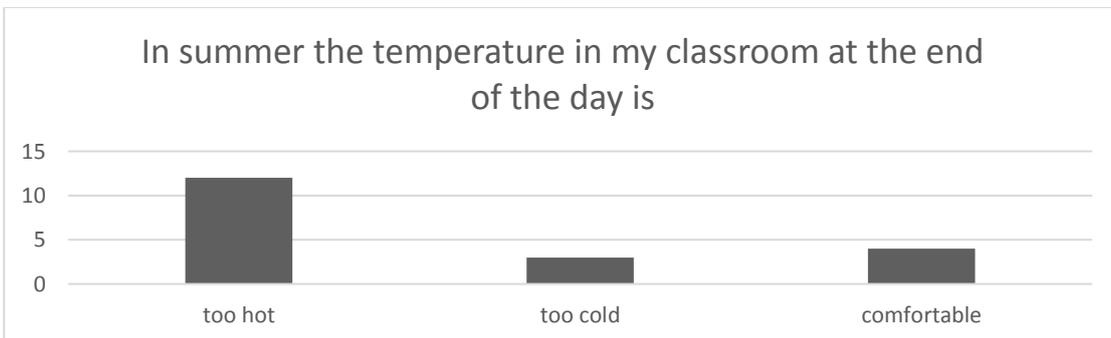


- “Always very warm”
- “The sports hall is very warm”

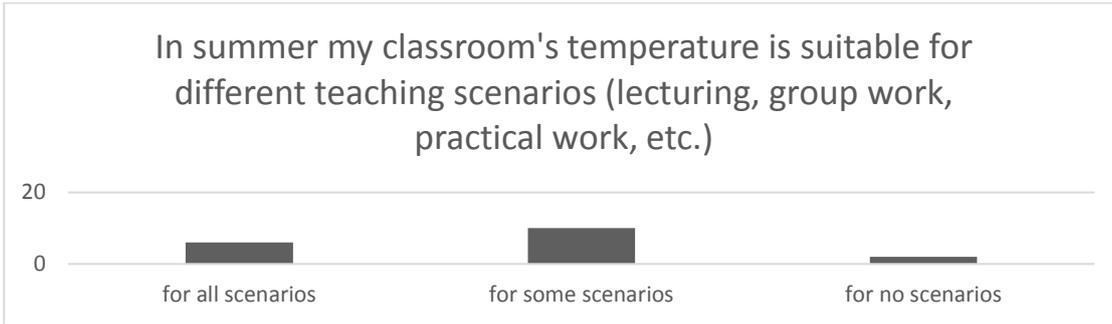
Question 10



Question 11

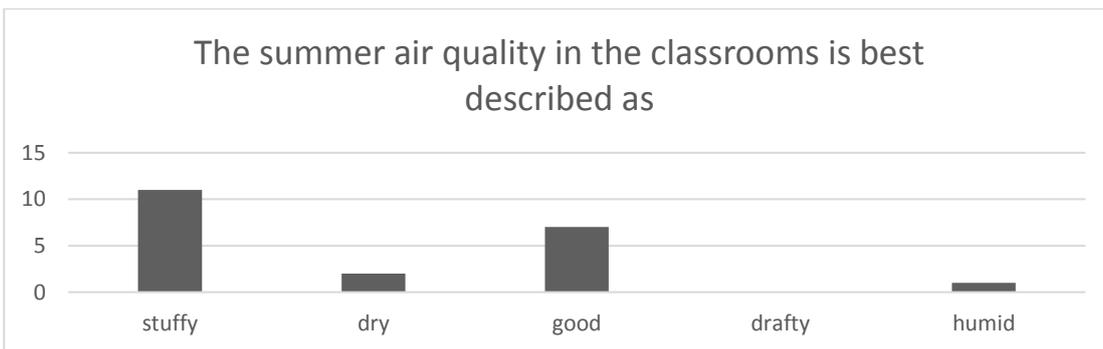


Question 12

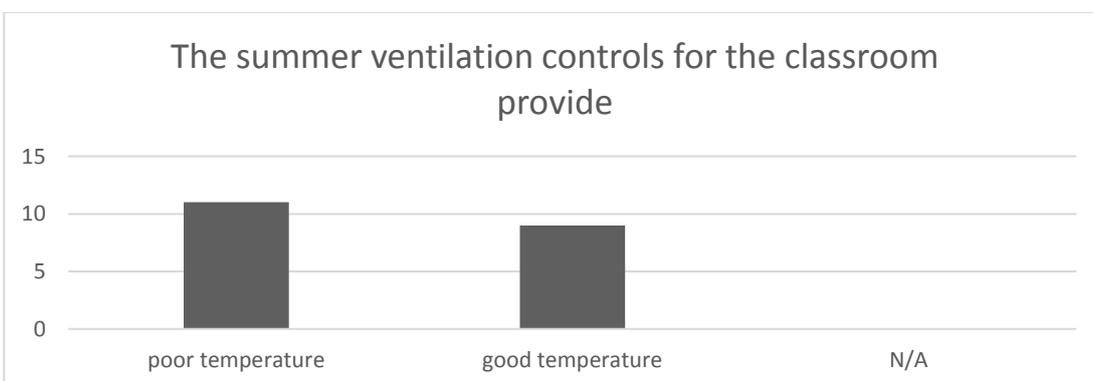


- “We carry out daily duties, however temperature and environment make these difficult and exhausting”
- “Leave the unit feeling tired and unwell during the summer months”
- “No fresh air circulation”
- “Room is very warm and stuffy”

Question 13

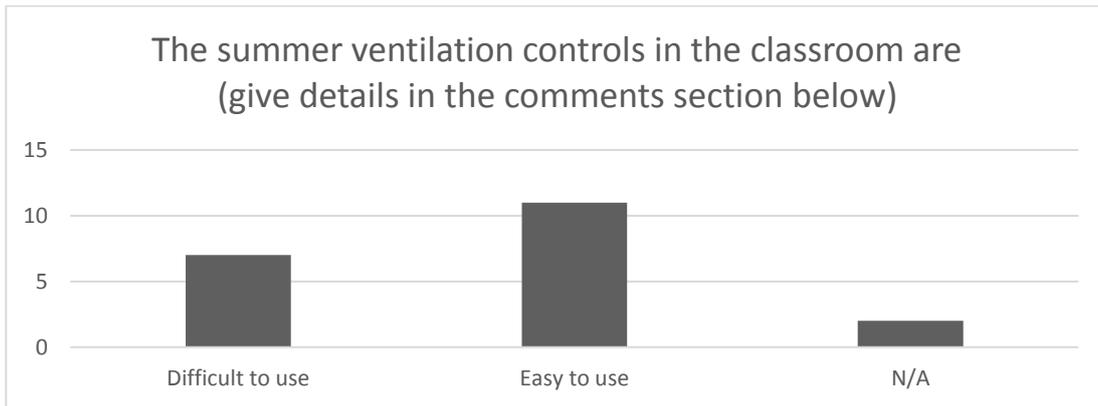


Question 14



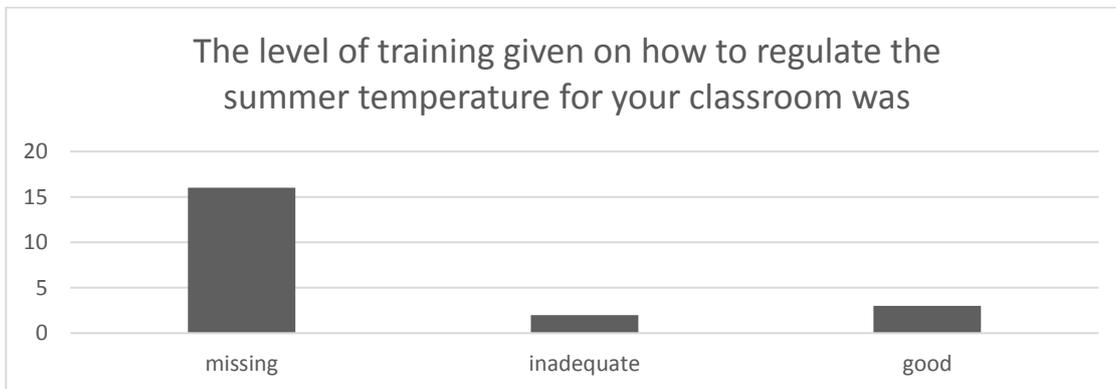
- “The air conditioning is set as low as possible”

Question 15

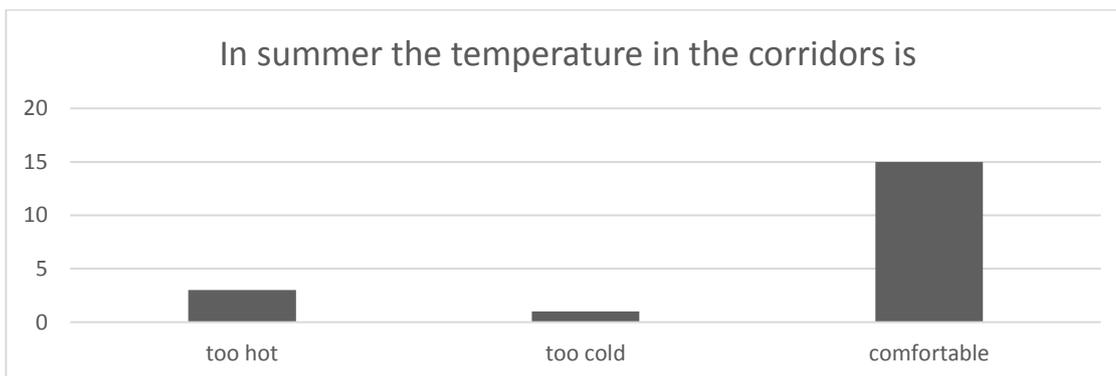


- “The controls make no difference”

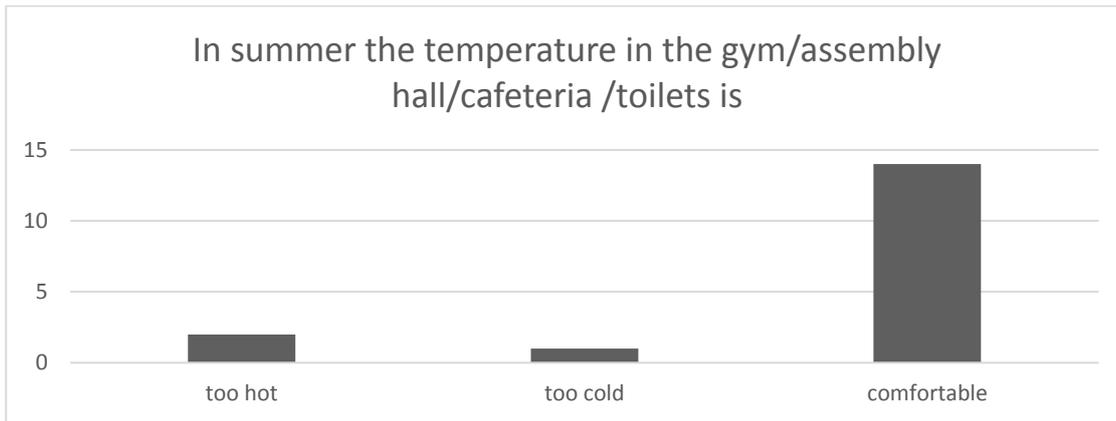
Question 16



Question 17

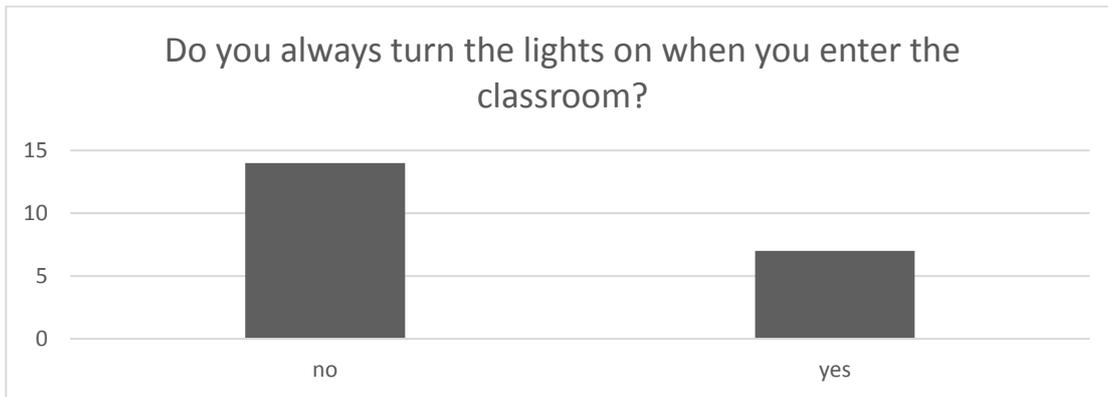


Question 18

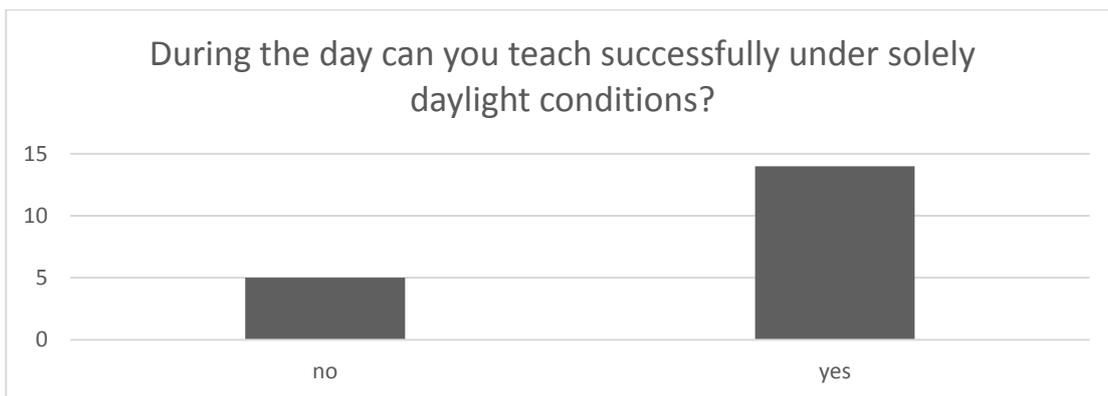


- “The temperature varies from 25.4 °C to 28.1 °C in the summer”

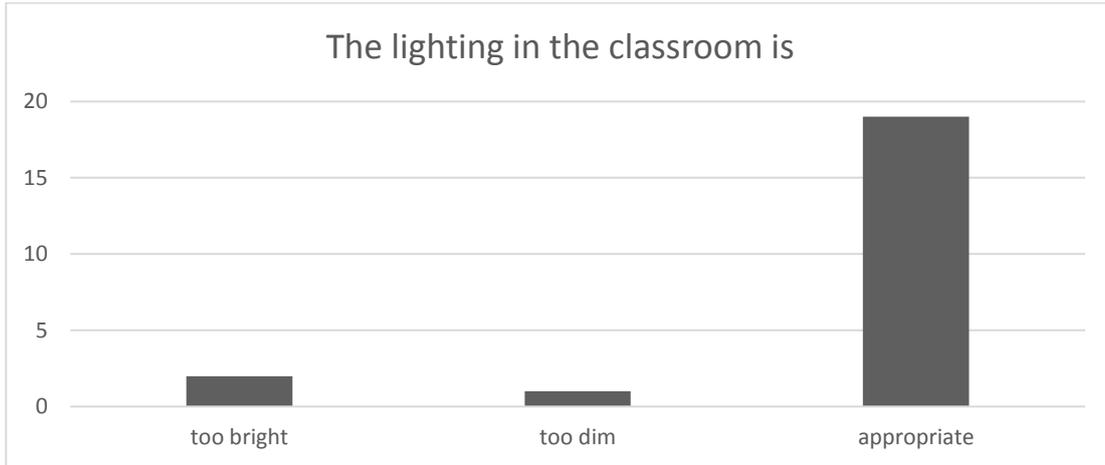
Question 19



Question 20

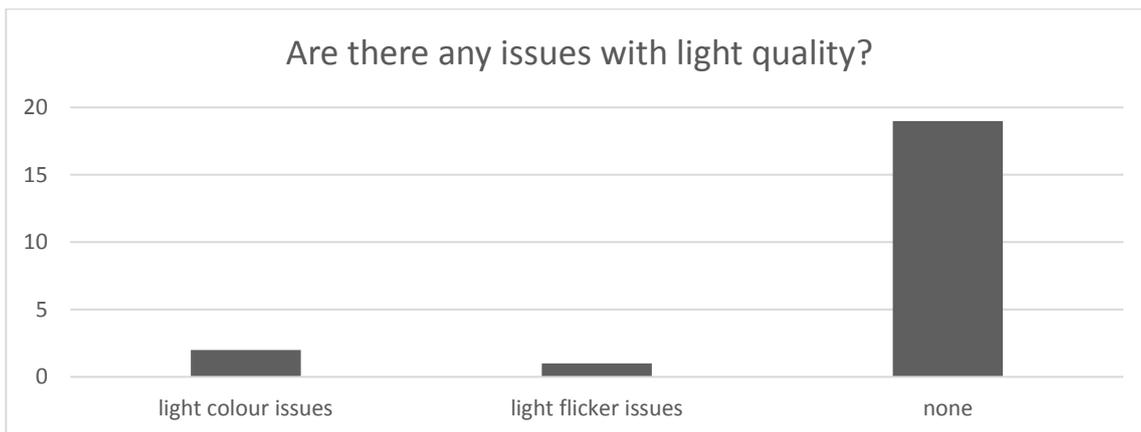


Question 21

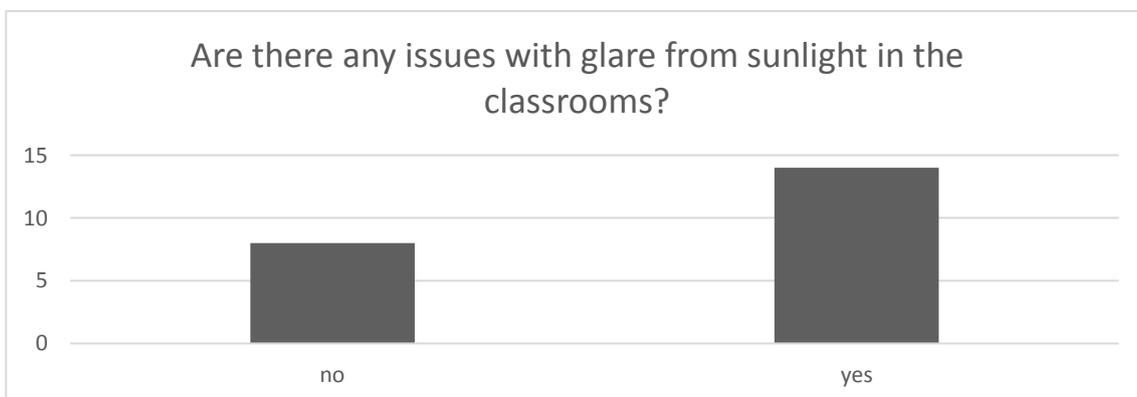


- "The lights are ill placed"

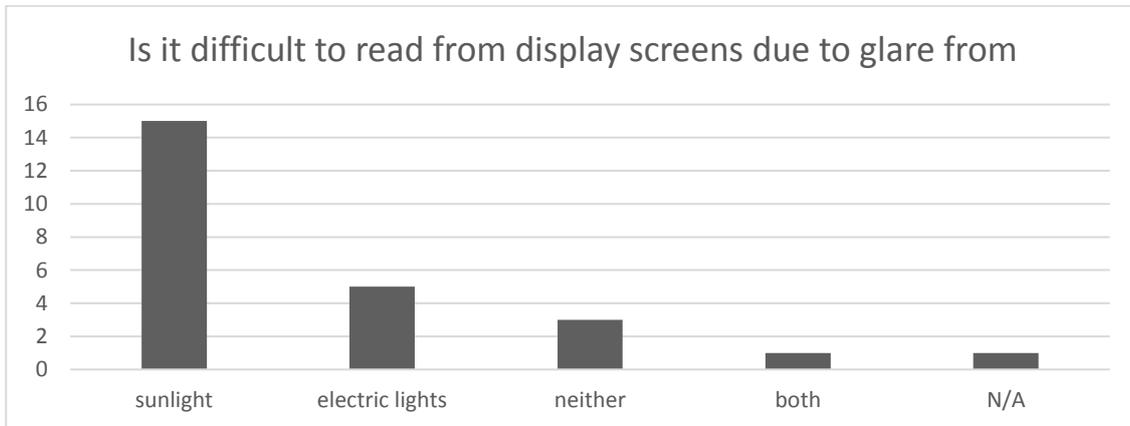
Question 22



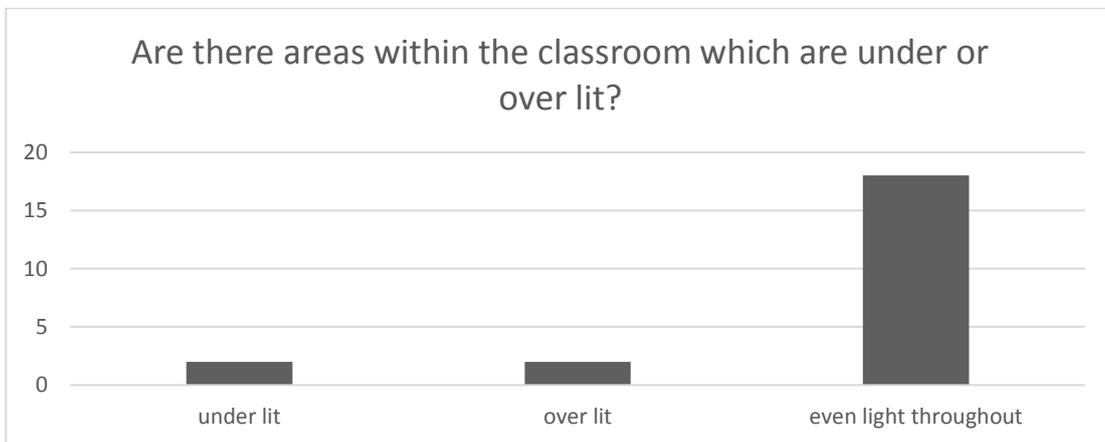
Question 23



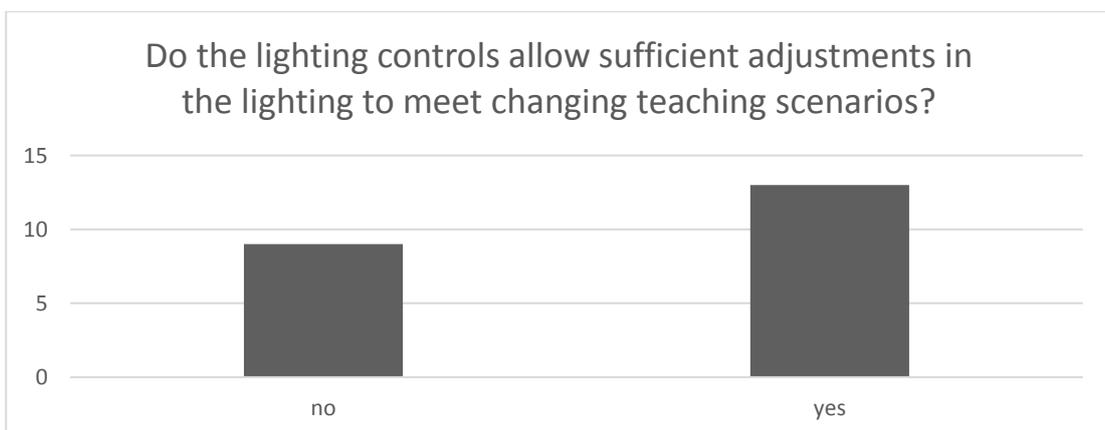
Question 24



Question 25

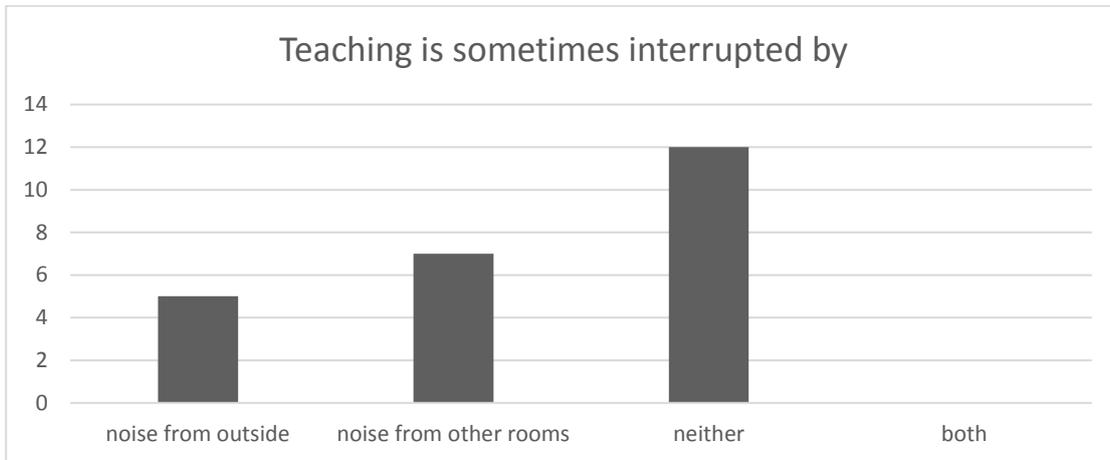


Question 26



- “There are light and dark areas within the room”

Question 27



General comments

"Gets too hot in the office and doors have to be propped open"

"The office gets hot and stuffy. When the sun shines on the side of the building it gets very hot"

"Door is always open to get air circulating. Staff room is noisy"

"Fire door needs to be open to cool the office"

"Nothing ever changes despite contractors trying"

"Room is always warm and stuffy. We only have half the lights on and need to keep the student access hatch open all day which is noisy"

7. Conclusion

The conclusion should bring together all the information from the energy data analysis alongside the responses from the facilities staff interviews and staff questionnaire. It is important to look at all the information together to draw any links between the monitored energy consumption data and the experiences of the building users. Any notable trends or patterns in the findings should be highlighted

An action plan of issues to resolve any areas for further investigation should be put together along with a recommendation for the priority they should be given.

Once completed the report should be reported back to the school for them to consider for further action.

Appendix E

In-use energy monitoring using ISERV reporting methodology

A well designed and commissioned and fully functioning metering and monitoring system as described in the Generic Design Brief is an Employer's Requirement Deliverable. It is fundamental to the monitoring and targeting process that is, in turn, an essential part of energy management. The Contractor is required to establish feedback mechanisms which enable monitoring of the energy status and operation of the School. These mechanisms should be used to inform building managers whether the energy consumption is greater than expected.

Metering and monitoring are used to obtain robust, error free insights into the operation and energy consumption of a system. Metering, monitoring and reporting in a clear readily understandable format is a requirement to improve operational energy, water efficiency and building performance.

Metering enables the building operator to measure and verify the energy and water consumption of the Building and identify areas where irregular energy consumption occurs. The information collated from the energy meters should allow continuous monitoring, benchmarking and post occupancy Building Performance Evaluation against operational targets.

The metering and monitoring strategy should reflect the size, complexity and facilities management approach of the School. The more complex the services solution, the more sub-metering will be required. End use data should always be able to be presented as simply as possible to aid understanding.

The Contractor shall ensure that the systems are metered according to the requirements detailed in the GDB and Annex 2I: Controls.

Continuous Monitoring

Continuous monitoring of the energy end uses shall be used to compare consumption to benchmark end use loads. The data will allow the School's facility managers to identify and remedy problems such as inadequate system control or incorrect default settings.

Contractors shall use the iSERV methodology to automatically monitor and report on the energy and water use of the School, or Buildings in the case of a project involving part of the school. This requirement applies for any building of over 500m². The reporting of consumption and performance in use of the Buildings, shall be carried out using the K2n system or similar system approved by the Employer.

iSERV enables continuous improvement in schools energy and water performance based on potential savings identified by the collection and analysis of real time energy and water end use data. It monitors plant performance related to different activity areas and compares performance to existing benchmark data. It can be used to identify Energy Conservation Opportunities (ECOs).

The Contractor shall complete the K2n building assets description spreadsheet, ensuring all component, system, sensor and meter names relate to physical items or spaces where possible. The Contractor will be required to provide the initial first year 15 month subscription and set up this service for the School or Buildings and help the School to use the system to benchmark the performance of the School or Buildings during the 12 months post handover. The Contractor will use the system to prove that all connected meters are calibrated correctly and will remedy any faults in the metering system during the defects period. Further information can be found at www.k2nenergy.com.

Requirement

Contractors shall supply 15 minute interval continuous monitoring and benchmarking data to the K2n National Database (or similar system approved by the Employer) on at least a monthly basis, and preferably on a daily basis, to enable automated reporting against ESFA targets on a monthly basis and quarterly feedback from the Contractor to the School during the 12 months defect period.

ESFA and K2n have set up and developed K2n National Database, based on the iSERV methodology, to establish realistic benchmarks and feedback in use for school buildings and have developed reporting formats for monthly reports to schools and Contractors. These reports will help schools to manage their energy consumption and identify avoidable waste.

Monthly reports of achieved performance

The K2n monthly reports should be used to provide the feedback interface for the School users by means of the agreed monthly reporting templates. Providing these monthly reports to the Schools will enable them to provide appropriate control over those energy consumers which they influence, helping the overall School energy targets to be achieved. Alternatively, with the Employers' approval, Contractors can choose to use other energy management reporting software to produce similar feedback reports for the School provided the report formats have been approved by the ESFA.

Monthly reports can be set to report progress against any designated end of year month. For the first year this will be based on sector average consumption profiles, for year two onwards this will be profiled against the previous twelve months for the School. This enables tracking of consumption over the year, prediction of progress against contractual targets to be assessed as part of BPE, and allows early corrective action to be taken if needed. See Section 2.15 of GDB.

Data required

To participate in the wider community of Building Owners/Operators/energy Managers providing data to K2n and the ESFA, which enables up-to-date national benchmarks to be produced and maintained for ESFA funded schools and their systems, the ESFA requires the Contractor to comply with the K2n data reporting standards. To enable this to happen the data from schools must be submitted in the agreed format. If the Contractor chooses to use a similar system to K2n to record and analyse data and to produce reports, the system still needs to upload monthly 15 minute data as required by the Project Agreement to the K2n National Database for ESFA benchmarking purposes. The data format will need to be compatible with the K2n National Database. Approval will depend on demonstration of regular successful transfer of the data.

This requires the Contractor to fully describe each School with the data requested in the fields in the K2n building assets spreadsheet. The Contractor shall request the latest ESFA spreadsheet from K2n. The latest version can be obtained on request from info@k2nenergy.com. A completed spreadsheet for an example school will also be provided.

The operational data required for the meters and sensors described in the K2n building assets spreadsheet can usually be exported via a BEMS system, or directly from meters and sensors with the appropriate data collection and transmission facilities.

Alternatively, manual transmission of the data to a dedicated email address can also be used to transmit the data to K2n. This will need to be sent by midnight on the 1st of each month, including all data for the previous month, to enable inclusion in the automated reports which will be sent to the Contractor and the Employer (and School if required).

The minimum level of sensor data required is zone space temperature sensor data for each heating zone and data from an outside air temperature sensor. This allows energy performance and building systems performance to be evaluated. The Contractor may choose to include additional sensor data, e.g. room temperature and CO₂ sensor data for each room, in order that further insights into the effectiveness of the building services HVAC systems can be provided to the School and Contractor. The K2n National Database is capable of assessing energy use per space if appropriate sensors are in place.

Contractors can use this data to aid seasonal commissioning adjustments during the 12 month defect period. Correlating the internal conditions with energy consumption enables the identification of avoidable energy use, building performance issues and sensors or meters that are likely to be out of calibration. This is a powerful means of remote system diagnosis.

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