Premier Inn and Beefeater Restaurant

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Innovate UK project number	450084
Project lead and author	Rickaby Thompson Associates for Whitbread Group Plc
Report date	2014
InnovateUK Evaluator	Tom Kordel (Contact via www.bpe-specialists.org.uk)

Building sector	**Location**	**Form of contract**	**Opened**
Hotel and food	Burgess Hill	Traditional	2009

Floor area	**Storeys**	**EPC / DEC**	**BREEAM rating**
2799 m^2	Hotel: 3, restaurant: 2	B (30) / N/A	Excellent

Purpose of evaluation

Analysis of heating provided by a combination of heat recovery from extracted air and ground source heat pump (GSHP), and rainwater harvesting and low flow devices. The integration of the design and construction process lacked cohesion. It became apparent that members of the design team didn't work together particularly well. The GSHP ground pipes were designed to a depth of 150 m but on construction it was not possible to drill below 90 m. The result of this was that 17 boreholes were required rather than the planned 11, which significantly increased the cost of the build.

Design energy assessment	**In-use energy assessment**	**Electrical sub-meter breakdown**
No	Partial	No

No energy breakdown reported (although a TM22 model was created, reporting electricity consumption at 169.2 kWh/m^2 per annum, and thermal via the heat pump at 70 kWh/m^2 per annum. These figures possess a high degree of variance). No individual floor areas reported nor energy consumption by floor areas. The energy monitoring suggests that the hotel and restaurant used significantly more energy than the model predicted, up to 100% more. The energy use within the restaurant was high, however comparable to other sites. Although significant metering was present much of it included mixed end-uses. Insufficient metering was present on the GSHP system which limited the team's ability to split cooling and heating.

Occupant survey (staff)	**Survey sample**	**Response rate**
BUS, paper	10 of 25	40%

The comments from the staff, including cleaning staff who work mainly in bedroom areas, are that the hotel can be hot and stuffy, with poor air quality in summer. The hotel's lack of controls meant that staff could not make modifications to the system. The BMS was complicated and staff had no training. For hotel guests, the temperature appears to be appropriate. The low staff response rate may have contextual causes. A cleaner at Premier Inn has 22 minutes to clean a room so there isn't much time to complete a paper survey. This group of staff is also on minimum wage and perhaps couldn't be expected to stay onsite to complete the survey.

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About this document

This report template is to be used by BPE teams to draw together the findings of the entire BPE process and to record findings and conclusions, as specified in the 'Building Performance Evaluation, Non-Domestic Buildings – Guidance for Project Execution'. The template is designed to assist in prompting the project lead to cover certain minimum specific aspects of the reporting process. Referring to the document 'Building Performance Evaluation, Non-Domestic Buildings – Guidance for Project Execution will remind you of the elements that should be included in each section. The overall report structure should allow for detailed commentary on the research carried out; explanation of both the hard and soft monitoring undertaken, detailing and evaluation of the findings and rigorous explanation of the lessons learnt. Where further details are being recorded in other reports it is expected these will be referred to in this document. Where translating energy into carbon emissions, ensure common factors / units are used as elsewhere, such as in TM22, to enable common comparisons.

The compilation / authorship of this report is the responsibility of the project lead for BPE. It is not the responsibility of the Technology Strategy Board Evaluator or Monitoring Officer to assist with completing this document. The Technology Strategy Board recognises that the project lead may not have all the relevant information of the specific technical knowledge to complete all sections of the report. It is expected that parts of the report will need to be completed by other members of the project team, however, it is the responsibility of the project lead to manage this process and ensure that the report is robust, with all sections fully completed to a high standard. It is the project leads responsibility to ensure that the report is submitted in a timely manner. Submission of this final report is a mandatory element of the Building Performance Evaluation programme.

Use of illustrations. BPE teams are encouraged to include diagrams, photos and clear sketches where helpful in illustrating a certain point. This can either be in the main body of the report or as appendices. The aim of using various illustrations is to assist with the narrative of the project and give additional understanding to the relevant sections they relate to. Therefore please attribute a caption to all images and ensure that the captions are active and informative (e.g. 'the solar panel was orientated north-south instead of east-west as specified' rather than 'a solar PV panel'). You must ensure you have all the relevant permissions for using images and give the correct credit to the image owner if necessary.

Each section of this report allows for the addition of subheadings, however for consistency reasons do not modify this form without permission from the Technology Strategy Board.

File naming conventions: Please prefix your 6 digit project number [450xxx] to the beginning of the filename when saving and submitting this report. Please remember to update the table of contents [right mouse click > update field] before submitting this report.

All appendix documents should be included in the main report when possible. If formatting issues cause difficulty (e.g. for plans or schematics that are not suited to A4/A3) then they should be referenced in the document and included separately using the naming convention [TSB project number i.e. 450xxx] - [project name] Final Report - appendix [x] (where items in [ ] are project specific).

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1 Introduction and overview

Technology Strategy Board guidance on section requirements:	This section of the report should be an introduction to the scope of the BPE and will include a summary of the key facts, figures and findings. Only the basic facts etc should be included here – most detailed information will be contained in the body of this report and stored in other documents/data storage areas.

This report forms the final report of the results of this project as part of the TSB study. The study has been conducted on a 60 bed premier inn adjacent to a 220 cover Beefeater restaurant. The building was opened in 2009 and the TSB study was undertaken for 2 years post occupation. There are a number of key observations which the monitoring team have made.

The comments from the staff, including cleaning staff who are mainly in the bedroom areas, are that the hotel can be hot and stuffy. The temperature monitoring suggests that, compared to recommended standards such as CIBSE, the hotel bedrooms are not particularly hot or 'stuffy'. The monitoring team have observed that, unlike in an office environment, the staff are active, and therefore the temperatures that are comfortable would generally be lower. For hotel guests, the temperature appears to be appropriate. The reason for the inconsistency could be due to the level of control that the hotel guests have over the cleaning staff.

There are a number of innovative features within the design, but the integration of the design and construction process lacked cohesion. This was evidenced through the design team meeting where it became apparent that members of the design team didn't work together particularly well.

The close monitoring of the hotel has highlighted that staff do not follow Whitbread processes when reporting a fault. There is a perception that it is quicker to speak directly to the relevant sub-contractor. This has meant that it is difficult to track on-going issues such as the call outs to ISO Energy for the Ground Source Heat Pump.

The energy monitoring suggests that the hotel and restaurant use significantly more energy than the model predicted, up to 100% more, however, comparing Burgess Hill to other, similar hotels, indicates that the total carbon dioxide emissions are comparable if not lower. This indicates that the issues may not necessarily be with the technology itself but due to a more holistic issue with construction/fabric.

The energy use within the restaurant is high, however again this is comparable to other sites. Of particular interest is the impact of the move to electric induction equipment. This equipment is more efficient but produces more CO2 as grid electric is much higher than natural gas.

At first glance it seems that there is little which can be done to further reduce energy use within the restaurant. Typically, user behaviour is a large impact in restaurants with practices such as leaving gas rings and ovens on when not in use wasting large amounts of energy. With induction equipment this aspect was expected to be removed. However, through the monitoring equipment it can be seen that there have been occasions where the equipment has been left on overnight. This is due to an empty tray being left in the oven. These occasions appear to be early on in the buildings use which is probably down to site getting used to the new equipment

The gas use from the flame grill contributes significantly to the gas consumption of the site. Typically this around 75% of the sites total gas use, some months closer to 100%. The flame grill used at Burgess Hill is

more efficient than standard and is one of the innovative features incorporated. Whitbread are looking at more efficient flame grills as a result of this project. A comparison has been made with a similar use hotel which shows that, whilst the flame grill at Burgess Hill utilises a significant proportion of gas used on site, it utilises less gas than a site of similar usage.

2 Details of the building, its design, and its delivery

Technology Strategy Board guidance on section requirements:	This section of the report should provide comments on the design intent (conclusions of the design review), information provided and the product delivered (including references to drawings, specifications, commissioning records, log book and building user guide). This section should summarise the building type, form, daylighting strategy, main structure/ materials, surrounding environment and orientation, how the building is accessed i.e. transport links, cycling facilities, etc – where possible these descriptions should be copied over (screen grabs - with captions) from other BPE documents such as the PVQ. This section should also outline the construction and construction management processes adopted, construction phase influences i.e. builder went out of business, form of contract issues i.e. novation of design team, programme issues etc. If a Soft Landings process was adopted this could be referenced here but the phases during which it was adopted would be recorded in detail elsewhere. If a Soft Landings process was adopted this can be referenced here but the phases during which it was adopted would be recorded in detail elsewhere in this report and in the template *TSB BPE Non Dom Soft Landings report.doc*.

2.1 Building Description

The Premier Inn, Burgess Hill is a new 60 bedroom hotel with a 220 cover Beefeater bar and restaurant adjacent. The Burgess Hill development represents a continuation of Whitbread's sustainability policy to take forward the development of energy efficient, low carbon budget hotels, and the introduction of a first low-carbon restaurant. Challenging targets of a 70% reduction in carbon emissions and a 60% reduction in water use are set over a standard Premier Inn of a similar age.

The site was previously developed as an industrial/business use and is located on the Victoria Industrial Estate on the south-west edge of Burgess Hill. The site is approximately 0.72 hectares and lies just north of the A273, and is accessed via Charles Avenue. The development is located on a wider business park, which is urban in nature with only limited soft landscaping.

The hotel building is a 3 storey high structure with a mixture of render and timber cladding finishes. The restaurant building is a 2 storey building with similar external treatments. The buildings are linked by a short, single storey access corridor that is predominately glazed. The buildings are arranged in an L-shape in the north-east corner of the site, fronting on to Charles Avenue with car parking to the rear.

The hotel building is on a West – East axis which means that the south side bedrooms would be expected to face higher degrees of solar gain.

A Building User Guide was produced as part of the BREEAM assessment. As part of the TSB project, the Building User Guide has been reviewed. A number of areas are outlined in the Building User Guide are no longer applicable, such as the use of pre-heat from the waste water. The thermostat (A Siemens unit) originally fitted has been replaced by a Honeywell unit. The Building User Guide outlines the use of a BMS which is not used.

Another interesting point to note regarding the BUS was that it was not available on site and no member of staff even knew that there should be one available, including the senior Cluster and Regional Managers.

2.2 Design Philosophy

Whitbread were very ambitious with this project and their design target was to reduce the energy consumption by 70%. Whitbread already had a reasonable specification, but this was enhanced for the Burgess Hill project.

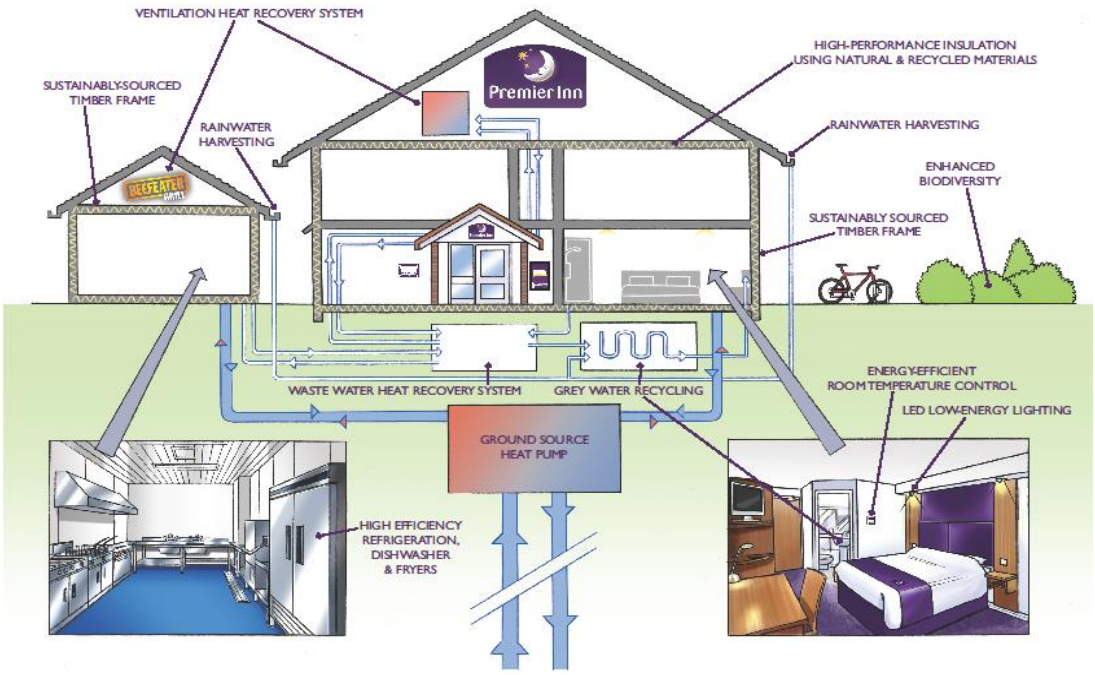


Figure 1: Diagram showing design intent.

The buildings are constructed from a 140mm timber frame system to achieve significantly better thermal performance than required by the then current Building Regulations, Part L 2006. Triple glazing is used throughout to reduce heat losses and improve acoustic performance. Attention was paid by the architects (Axiom Achitects) to reducing the effects of thermal bridging and improving airtightness. Through the TSB study it is clear that the efforts at improving air tightness have not been successful. The air tightness result of around 8 clearly shows that there are still considerable improvements to be made but thermal imaging shows that there is actually minimal heat loss.

The services design for the development has been structured to obtain the best energy performance within the constraints of the site and budget. The performance of the building thermal envelope is of paramount importance to ensuring that energy demands are reduced for thermal conditioning for the customers and staff.

In addition it was recognised that the energy profile of the building showed that there would be high peaks in demand for domestic hot water during two short periods of the day – early evening and morning. It also indicated that there was a simultaneous demand for heating and cooling during most of the year.

Space heating within the hotel is provided by a combination of heat recovery from extracted air with the balance met from a ground source heat pump installation. The initial plan was for further heat recovery from the grey water system as well but during the build it was considered that this heat would not be of a suitable grade for the increased cost and was omitted. The Nilan heat recovery unit in the kitchen also provides pre heat to the buffer vessels. High efficiency direct gas-fired hot water systems are installed.

Improvements in water use efficiency have been achieved by the use of low volume flush WCs and water efficient taps and showers. A grey-water system is installed with sufficient capacity to meet 100% of the WC flushing requirements.

Other energy efficiency measures included: the extensive use of energy efficient lighting, including LEDs with automated control systems; an energy efficient lift; a building management system to control the various items of plant and log data from the extensive sub-metering installation; full monitoring and control of the cook line; induction hobs; high efficiency refrigeration, dishwashers (with heat recovery) and fryers; small compact beer cellar; the use of some recycled materials in construction and landscaping to improve the ecological value of the development. These later issues were included to help achieve the desired BREEAM rating of *Excellent*.

2.3 Whitbread Comments

A design review meeting was held with representatives from Whitbread to better understand the design intent and strategy for the site. Present were:

Alex Flak	Construction Director
Chris George	Head of Energy and Environment
Simon Lancaster	Senior Project Manager
Ben Brakes	Energy and Environmental Manager
Catherine Arotsky	Rickaby Thompson Associates Ltd
Tom Kordel	XCO_2 (representing TSB)

2.4 Whitbread Design Philosophy

Whitbread outlined that the project was their idea. They had already undertaken a smaller pilot project at Tamworth which did not include a restaurant and had fewer bedrooms. They were looking to construct a hotel and restaurant that could then be replicated to reduce the impact of their substantial growth programme.

Whitbread set a target of 70% reduction in energy use compared to a ‘standard’ project. They made an additional budget allowance of 10% as opposed to Tamworth which was 40% more expensive. The idea was that with the reduced energy demands, the additional 10% build cost would be make the business case for improving the standard build design.

The project comes from a recognition by Whitbread that utility bills represent a significant proportion of their costs and it is an area that they can influence and thereby reduce. Whitbread are also concerned about rising energy prices.

Tamworth has been a success in terms of performance, ease of use and customer satisfactory. Tamworth has a 70% reduction in energy use and a 40% reduction in water use against a similar size Premier Inn in actual performance.

The Whitbread team did highlight that there are differences between Tamworth and Burgess Hill. In particular, Tamworth has a centralized ventilation system whereas Burgess Hill has room per room. The objective for Burgess Hill, however, was to look at more ‘off the shelf’ solutions to reduce costs.

Whitbread previously do not typically utilize a BMS in their properties due to their complexity, but a BMS was specified for Burgess Hill.

Whitbread's hotels use large amounts of water so they had started trialling greywater collection in a number of sites and this was included at Burgess Hill.

Whitbread also recognized that the restaurant kitchen uses significant energy so they proposed a fundamental change in strategy for catering. The following are key features at Burgess Hill:

- Heat recovery dishwasher
- More efficient char grill
- Induction hob and grill with pan sensors
- More efficient refrigeration

Other targets set by Whitbread was an air tightness target of 5; all equipment as efficient as possible; and zero construction waste – zero to landfill.

Whitbread noted that the project was not ideal as the design (i.e. orientation and form) were fixed prior to the energy strategy being introduced which is typical for Whitbread sites.

2.5 Construction issues

Whitbread highlighted a number of construction issues.

The first issue they encountered that the Ground Source Heat Pump ground pipes were designed to a depth of 150m but on construction it was not possible to drill below 90m.The result of this was that 17 boreholes were required rather than the planned 11 which in turn dramatically increased the cost of the build by around £60k.

Whitbread suggested that the air tightness details produced by the architects were not quite right. The architects did not have a lot of experience of producing air tightness details and they should have been provided with additional assistance in meeting the stringent targets set.

Whitbread were concerned from an early stage that there was conflict in the design team which caused a lot of issues. Of particular note was that the process for approval of change notifications was not fully structured and agreed at the outset. This may have been part of the cause of the conflict. In addition it was difficult getting different products from different manufacturers to work together such as the Nilan Unit and the Ground Source Heat Pump. Commissioning was going to be a big issue as the systems weren't designed to work together. It would appear that there was no specific member of the design team who took responsibility for ensuring that the commissioning took place and that all products worked together. The specification did require that a member of the design team should have been appointed to manage commissioning but this requirement may have been overlooked. All independent pieces of equipment were commissioned independently by either the manufacturer or installer.

Whitbread were disappointed with some of the manufacturers, in particular the aftercare offered For example Whitbread were unable to reach an agreement for an ongoing maintenance agreement with ISO Energy who installed the Ground Source Heat Pump (see Section 5). Whitbread are a potentially big client, but some of the manufacturers were not interested in working together to ensure the systems worked effectively.

Originally the restaurant and hotel had separate plantrooms, but these were integrated during the design process. The reason for this could be that additional bedrooms in the Premier Inn provide a better return on investment. This has resulted in some minor complications discovered by this study, in particular the monitoring of the build was very difficult from the start as the sub metering was incorrectly labelled.

GSHP's were also included in the detailed design in order to provide an element of heating and cooling to the hotel rooms and restaurant. In theory, GSHP should lend itself very well to the hotel model. However, on investigation into the actual COP of the heat pump system, during the heating season, it became clear that the actual COP is around 2.5 rather than the anticipated 4.2 which was predicted from the manufacturer.

The heat recovery from the restaurant extract system also appears to be ineffective. The system was designed to take waste heat from restaurant and use this as a pre-heat for the heating in the restaurant. Whitbread have theorised that particulates in the air make the system inefficient as a lot of filtering is required. In some cases it appears to be fighting with the GSHP by providing heating when not required and therefore actually lowering the efficiency of the GSHP.

The concept design made use of heat recovery from the grey water recovery however during the build it was decided that the heat exchanger would not be utilized as the heat would have been at too low a grade to be cost effective.

Whitbread have highlighted that whilst the fabric measures are effective, there was insufficient supervision of the contractor to ensure all of the detailing, in particular relating to thermal bridging was correctly installed. Subsequently Whitbread have proposed the use of a Clerk of Works to manage the construction and ensure thermal bridging details are adhered to.

2.6 Restaurant

The strategy for the restaurant is to decarbonise the kitchen by switching to electricity where possible and sourcing the electricity via a "green tariff". Some features of the restaurant product require gas use, such as the use of a char grill to produce the signature "flame grilled steaks", but a more efficient char grill was included. This strategy has since been rolled out across Whitbread to all new Hotels and Restaurants who now do not utilise gas in the kitchens. Following the work on the TSB project, Whitbread have sourced more efficient char grills offering a further 30% saving over the unit installed at Burgess Hill and these are now to be the Whitbread standard.

The restaurant utilises underfloor heating which is heated via the Ground Source Heat Pump. The hot water for the restaurant is the same system as the hotel. The underfloor heating fires in the morning and gets the room up to temperature. Once up to temperature the NILAN unit should maintain the temperature for rest of the day.

In use, the NILAN unit was constantly at fault and froze when the external temperature was below zero. The cause of this fault has not been identified. As a strategy for the restaurant, Whitbread would not use the NILAN unit again.

2.7 Whitbread Conclusions

As a result of the monitoring, many stand alone hotels (Solus) no longer serve lunches as it was found that the energy used was disproportionate to the usage. Fryers and flame grills have to stay on throughout lunch to be ready for any customers.

Whitbread determined that cleaners were flushing toilets multiple times when cleaning a room, the average was 7 times. Whitbread introduced 'Project Flush' to train cleaners to only flush once. This resulted in significant water savings.

Whitbread have learned a number of lessons. They would ensure that the specified systems work together and that a member of the design team is responsible for ensuring this and that they are commissioned together. This has already been trialled at another project in Cambourne. This included:

- Redefined roles of each person within the design team
- Designed the units in the bedrooms with GSHP in mind.
- No further changes were made to the restaurant.

2.8 Design Team Comments

Due to the conflicts in the design team it was not possible to meet with the design team, so each design team member was interviewed separately. Some design team members opted to provide written responses.

The design team members interviewed were:

Brett Smith	Jenks Associates	Design Engineers
Jim O'Brien	Fletcher McNeill	Project Managers
Martin Evans		Sustainability Consultant
	Hopkins	Contractor's services engineers
Richard Hollis	Axiom	Architect

The design team comments are generally consistent. There is a recognition that the system proposed was overly complicated, did not operate effectively together and was not commissioned correctly.

The design team noted a number of issues, in particular the system is complex. A generic solution was proposed for the BMS, but the system was not appropriate. An alternate was proposed, but this was a generic system. The design team recognised that a full bespoke system would have been more appropriate.

The design team agreed that there were a number of issues within the design team and that no one person was responsible for ensuring the services worked well together. Each team within the build were very protective over their particular section of the build and there wasn't a lot of cross over in implementation.

The design team noted that the controls were very complicated and there was insufficient training for the staff. There were comments that the staff are transient so difficult to ensure adequate training, however the BPE study has noted a number of staff who have been present throughout the monitoring period. The monitoring team would also note that one of the issues identified during the monitoring period were staff who developed personal contacts at the installer's companies and therefore contacted them directly without going through Whitbread's maintenance team.

Axiom architects commented that the design was fixed before they were commissioned. They struggled to incorporate some of the innovative technologies into the existing design. In particular they commented that the services required more space than originally designed. The hotel rooms are to a fixed design as

researched by Whitbread so these could not be changed. The Ground source heat pumps in the restaurants also presented difficulties.

2.9 Conclusions

Whilst not the only problem encountered, there were some clashes within the design team. Without a designated single point of M&E, there were multiple consultants and advisors providing conflicting information and sometimes a lack of communication to the client. This meant that Whitbread, on occasion, had to make informed decisions as to the most appropriate strategy with inconsistent information. With that being said, the team worked well enough together to achieve Whitbreads first BREEAM excellent rating on the build.

3 Review of building services and energy systems.

Technology Strategy Board guidance on section requirements:	This section should provide a basic review of the building services and energy related systems. This should include any non-services loads – which would therefore provide a comprehensive review of all energy consuming equipment serving the building or its processes. The key here is to enable the reader to understand the basic approach to conditioning spaces, ventilation strategies, basic explanation of control systems, lighting, metering, special systems etc. Avoid detailed explanations of systems and their precise routines etc., which will be captured elsewhere. The review of these systems is central to understanding why the building consumes energy, how often and when.

3.1 Building summary information

Building fabric	
Frame and Walls	The building is a 'super' insulated timber frame construction. External walls are finished in a mixture of render and timber cladding.
Roof	The roof to the restaurant is generally a pitched roof made of timber frame panels, and the roof to the hotel is flat.
Floor	Intermediate floors are timber frame and the ground floor is a reinforced concrete raft slab.
Glazing and Shading	The windows are triple glazed in softwood timber frames. There are no deliberate fixed shading devices, however the roof overhang provides a small degree of protection.
Building Services	
Heating	Heating, cooling and ventilation are provided using a combination of mechanical ventilation with heat recovery and a ground source heat pump (GSHP). Each guests bedroom is provided with a ceiling mounted fan-coil unit to provide tempered air. Local control is provided within each room. The restaurant is provided with mechanical ventilation and an underfloor heating system.
Ventilation	
Cooling	
Hot water generation	Hot water is provided by a combination of high efficiency, gas-fired calorifiers and the GSHP.
Lighting	The building incorporates various types of lighting. General lighting is provided by high efficiency fluorescent luminaires (both tubes and compact fluorescents) with high frequency ballasts. The bar area utilises new LED technology. Lighting is well controlled with extensive manual control including dimming and some automatic control (such as time switches on external lighting).

3.2 Building Services Information

The heating cooling and hot water systems for the Beefeater Restaurant and Premier Inn are designed to recover waste heat, generate heating and cooling using renewable technologies and use as little water, gas and electric as possible when running this size of business.

Each bedroom within the Premier Inn contains a fan and heat exchanger located above the suspended ceiling just within the bedroom to provide fresh air for the guest and vent moist air to the outside. The exhaust air is used, through a heat exchanger to heat the incoming fresh air and so save energy in heating the room. The fan incorporates a boost setting that automatically activates when the bathroom light is on.

The restaurant air has a much larger unit but follows the principle of the bedroom fan by using waste heat being exhausted with the stale air to heat the incoming fresh air and so retain the energy within the building as far as is possible. The original strategy stated that when cooling is required, the same unit will cool the warm outside air when entering the building and use that heat to pre-heat some of the hot water used for basins, showers and baths within the hotel and restaurant. Unfortunately this system has been ineffective. The 'back of house areas' and toilets within the restaurant also have air conditioned by the air handling unit for the restaurant.

Waste water from the guest bedrooms on the first and second floor is passed through a filtration system and tank to not only 'recover' this water for re-use in flushing toilets. The original design incorporated a heat exchanger to pre-heat some of the hot water used in the hotel but it was determined that the heat was not sufficient to pre-heat the hot water.

Most of the taps within public areas are operated by infrared beams as are the basins with kitchen and grill to ensure that taps aren't left running.

The incoming water main has a leak monitor on it that will inform the Building Management System of a leak on the main that will in turn indicate an alarm on the user panel.

All of the above systems are automatic and under the control of the Building Management System.

The main source of heating and cooling to both buildings is the Nibe Ground Source Heat Pump that is located in the ground floor plant room. This unit draws heating or cooling energy from 17 x 100m deep boreholes underneath the car park and stores it in two buffer vessels located alongside the heat pump within the plant room. A four pipe system emanates from the plant room taking a flow and return circuit of hot and cold water around all of the bedrooms in the hotel to respond to guest heating and cooling needs and also provides heating to an under floor heating system in the guest areas of the restaurant.

The original hot water strategy stated is outlined in Figure 2. The incoming mains water first passes through a heat exchanger where the recovered heat from the waste water is used to increase temperatures, followed by the recovered heat from the restaurant air and then heat energy from the Ground Source Heat Pump. The final stage and minimal top up to ensure the hot water is perfect for the guest is through two high efficiency gas water heaters although it is envisaged that these will not generally being carrying much of the heating load. These boilers are located in the main ground floor plant room.

All of the plant for heating, cooling and hot water is automated and managed through the Building Management System.

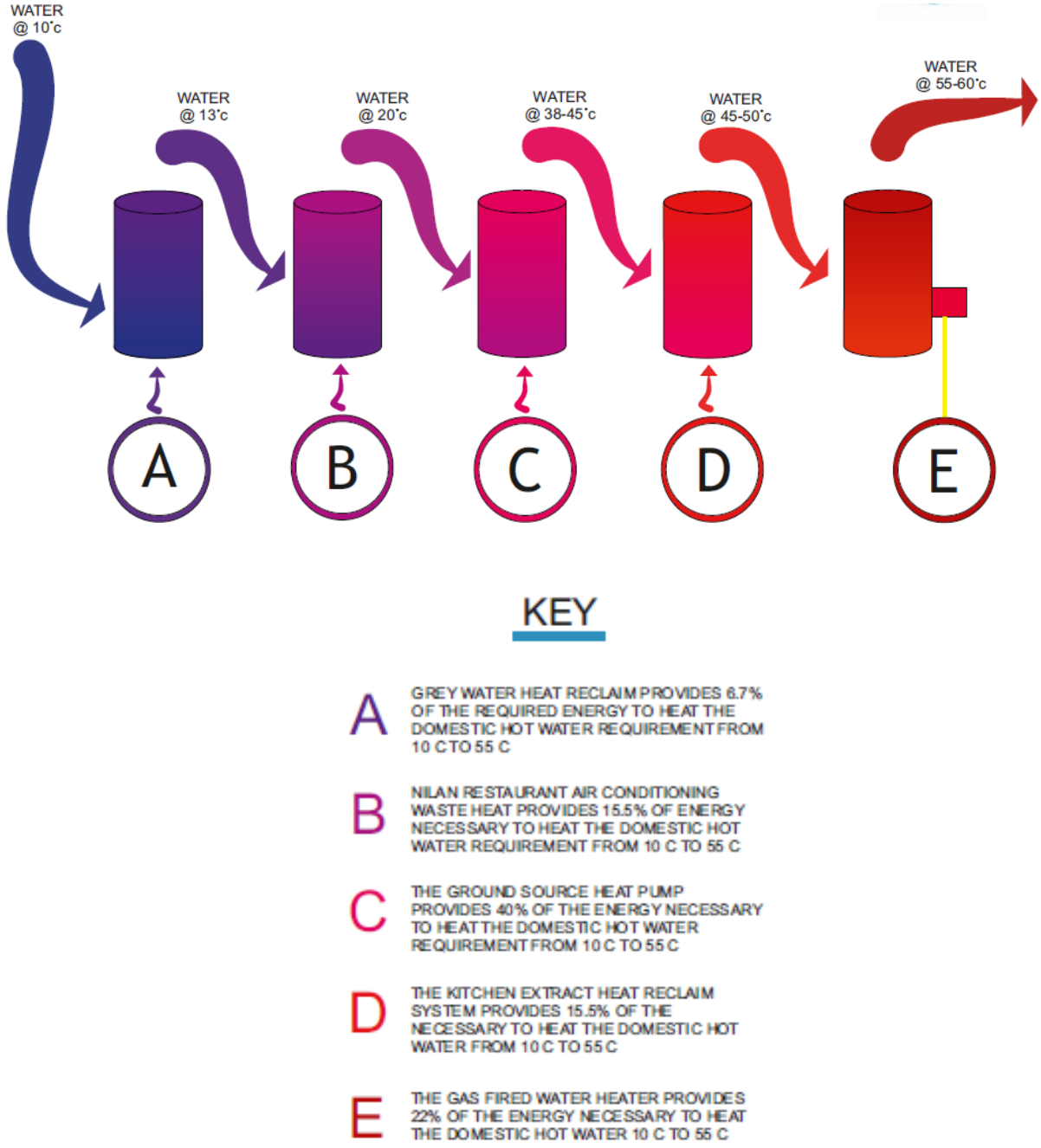


Figure 2: Schematic of hot water strategy

Waste water from the baths on the 1st and 2nd floor is filtered and stored in an underground tank to provide recycled water to flush all of the toilets. In addition to the waste water, some rain water is also collected.

The heating, cooling and hot water systems are so designed to firstly recover waste heat being exhausted or drained from the building and use it to pre-heat air and water coming into the building. The second stage is to use a renewable source (GSHP) to take that recovered heat and boost it at a high efficiency rating to service the needs of the guest in their bedroom and in the restaurant. The Ground Source Heat Pump will also provide comfort cooling to the bedrooms and restaurant. Then and only then, will gas be used to raise the hot water for basins, showers and baths to the statutory level of temperature. IT is anticipated that sufficient renewable and recovered energy will be available to minimise the gas usage.

Water Storage
The hotel water supply utilises a water tank located in the 3rd floor tank room. The incoming water is conditioned by a Kalguard Water Conditioner. A packaged water booster set is fed from the storage tank and feeds boosted water Premier Inn cold water taps, public toilets and to the ground floor plant room.

Grey Water Control
The controller for the grey water recycling system is located within the ground floor plant room and manages the flow of the filtered grey water to the toilets. This system has a final filter located on the outlet side of the main unit housing. The system is automated and should there be insufficient grey water, it will automatically switch to mains water.

General Temperature Control
The restaurant contains many different temperature sensors and also there are externally located sensors that monitor internal and external air temperature. In addition, located on the plant and specific pipe work, many further sensors monitor the operating temperature of the system and feed this back to the Building Management System to allow automated operation of the complex system within the design parameters. The operating system is held on a computer located within the main office for the Premier Inn. No manual adjustment should be made by persons other than qualifies engineers or design consultants.

Premier Inn Room Control
The temperature in each room is controlled by a Siemens RGD160 thermostat controller that operates motorized valves letting either hot water or chilled water into the fan coil unit located at the entrance to the bedroom to either heat or chill the room. The fan coil unit operate within parameters of 18°C and 23°C that are controlled by the guest by adjusting the thermostat.

Ground Floor Plant Room
The plant room should only be accessed for required maintenance and in the case of an emergency. The louvered doors to the plant room must be kept clear and not covered over as they provide ‘free air ‘for combustion by the gas boilers when in operation. The plant room does contain schematics of the system and each pump, valve and item of plant is labelled for reference. As mentioned previously, the plant room contains a large amount of sensors and data wiring. No aspect or item of this must be disturbed without explicit approval of the designer or installation engineers.

First Floor Plant Room
As the ground floor plant room.

General ventilation grilles and flues
All ventilation grilles through walls and roof areas must be kept clear and in good order. Externally, no plants or foliage must be allowed to get within 1m of an air input or outlet grille.

Plant located on the flat roof at the rear of the Beefeater
No access should be given to this area other than to qualified engineers, system designers or approved maintenance engineers. It is accessed through the 1st floor plant room but contains complex and inter-related systems. Only in emergency should this area be accessed by those other than mentioned above.

Building Services Information (Electrical)

Electric Mains Distribution

The main incoming electric supply can be found in the ground floor electric switch room and this is also where your main electric meter can be found (should you ever be required to give meter readings, serial numbers etc.)

From this position all other electrical services are supplied. Please refer to 'as installed drawings for exact locations of all of the distribution boards.

The installation has been sub-divided with smaller distribution boards catering for different aspects of the installation (you will find distribution boards dedicated to areas such as the kitchen, Beefeater front of house lighting, external lighting, mechanical services etc.).

From each of these sub distribution boards, individual circuits are energised via miniature circuit breakers (mcb's). The function of a particular mcb can be identified from the circuit charts installed in each distribution board and this is the first place you should look if there is a problem with any of the electrical installation. Should there be a fault, please check the mcb in the appropriate distribution board and ensure that the mcb to that particular circuit is switch "ON". Should the mcb be "OFF", it should be switched back on. If after switching back on the mcb trips off again, then there is a problem on that particular circuit and a call should be made through the 'help desk' to get that fault checked and rectified.

Premier Inn Corridor LED lighting

The Premier Inn corridor lighting is controlled via automatic presence detectors and time clocks to energise the lighting as required at different intervals in the day and night. During the hours of 6am and 8pm, the system has been designed to allow only 50% of the corridor lights to be switched on. After 8pm, and up until 6am the following day, all of the corridor lights will be switched on (50% will be permanently on, and the other 50% will come on via the automatic presence detector in each compartment of the corridor).

Premier Inn Bedrooms

In each of the Premier Inn bedrooms, you will find a dedicated consumer unit which services all of the electrics in that particular room. The room is divided into three sub circuits: power sockets, lighting and ventilation.

Should there be a fault on any of the electric services in any of the rooms, please check the mcb's are switched on (as described in the "mains distribution" section of this guide).

The ceiling and bed head lighting to the bedroom is controlled via the energy saving outlet at the entrance to each bedroom (please note this does not include the table lamp on the desk). To activate the lighting, the customer must insert their bedroom key card into the energy saving outlet located to the left hand side of the bedroom door. The card MUST be left in the outlet at all times for the lights to work.

Beefeater front of house lighting

The entire front of house decorative lighting has been designed to automatically switch on at 6am and off at 1am. A managers over-ride switch has been installed adjacent to the main lighting switch bank, should the staff be required to operate the lights outside of the pre-determined times.

External Lighting

The Beefeater building mounted signage and building mounted decorative lighting has been designed to automatically switch on via a light sensitive switch. The lights will then switch off at 1am via a time clock.

The Premier Inn building mounted signage and building mounted decorative lighting has been designed to switch on via a light sensitive switch. The lights will stay on until the light sensitive switch deems there is sufficient daylight. Likewise the car park column lighting has been designed to switch on via a light sensitive switch. The lights will also stay on until the light sensitive switch deems there is sufficient daylight.

A managers over-ride switch has been installed adjacent to the main lighting switch bank, should the staff be required to operate the lights outside of the pre-determined times.

Lift

The lift in this hotel to move guests between the ground and second floor is a high efficiency unit operating from re-chargeable batteries that store the electricity generated when the lift descends due to gravity. Additional mains electricity is then added to this 'free' source to ensure sufficient charge to raise the lift when next called on.

3.3 Comparison with other 'Green' Whitbread sites

A preliminary comparison has been undertaken of the Burgess Hill development with other sites which have utilised 'green' strategies. The following summarises the key technologies incorporated within the comparison hotels.

Hotel	Features
Burgess Hill	Ground source heat pumps, heat recovery, air source heat pumps, improved building fabric,
Three Fish Newport, Telford & Wrekin	Ground source heat pumps,
Trevithick Inn, Cambourne, Cornwall	Ground source heat pumps, small scale solar (PV) and air source heat pumps
Barry, Wales	Air source heat pumps, low occupancy
The Colliers, Rugely, Derbyshire	Ground source heat pumps
Oakley Hay Corby, Northamptonshire	Good thermal insulation, good air tightness, air source heat pumps with underfloor heating in the restaurant.

Table 1: Table summarising key 'green' features

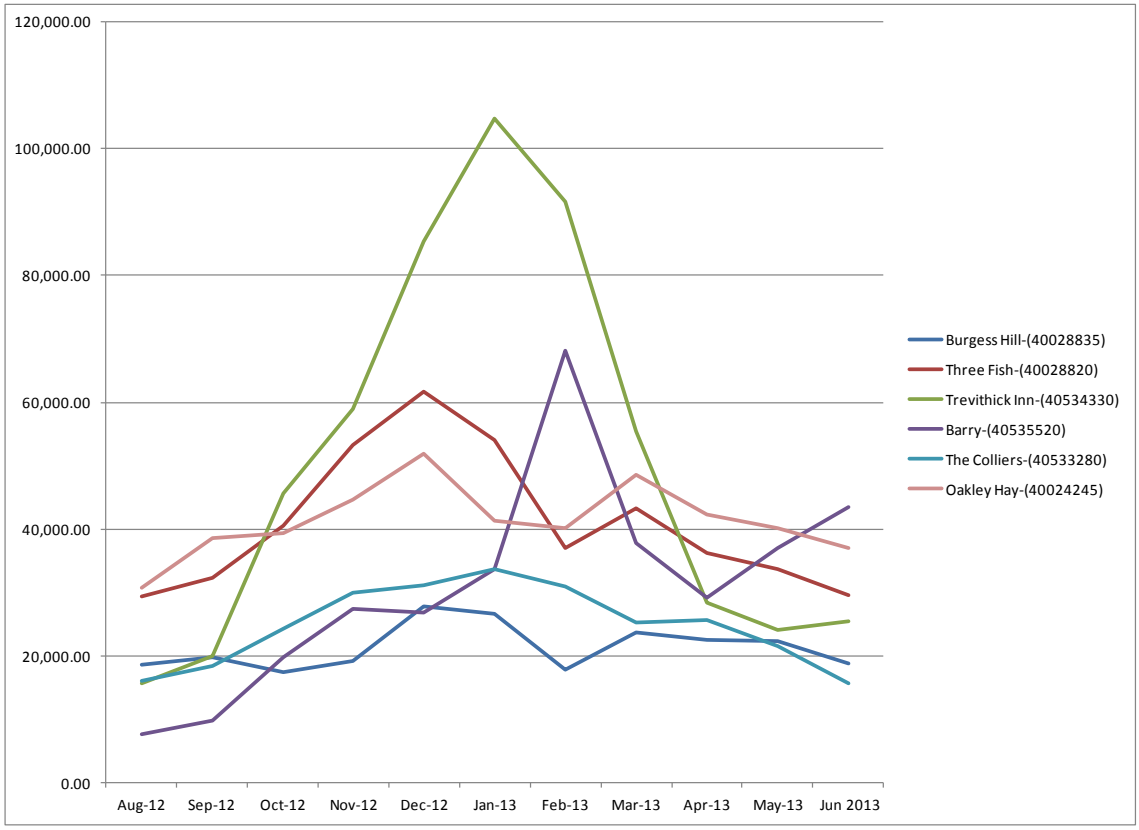


Figure 3: Graph comparing gas use against other Whitbread sites

The graph above highlights the different energy profiles of several Whitbread sites with differing types of equipment but all are 60 bed hotels with 220 cover restaurants so perfect for comparison. Burgess Hill performs consistently through the year and has a lower profile than most of the other sites with the exception of the Colliery in Rugely.

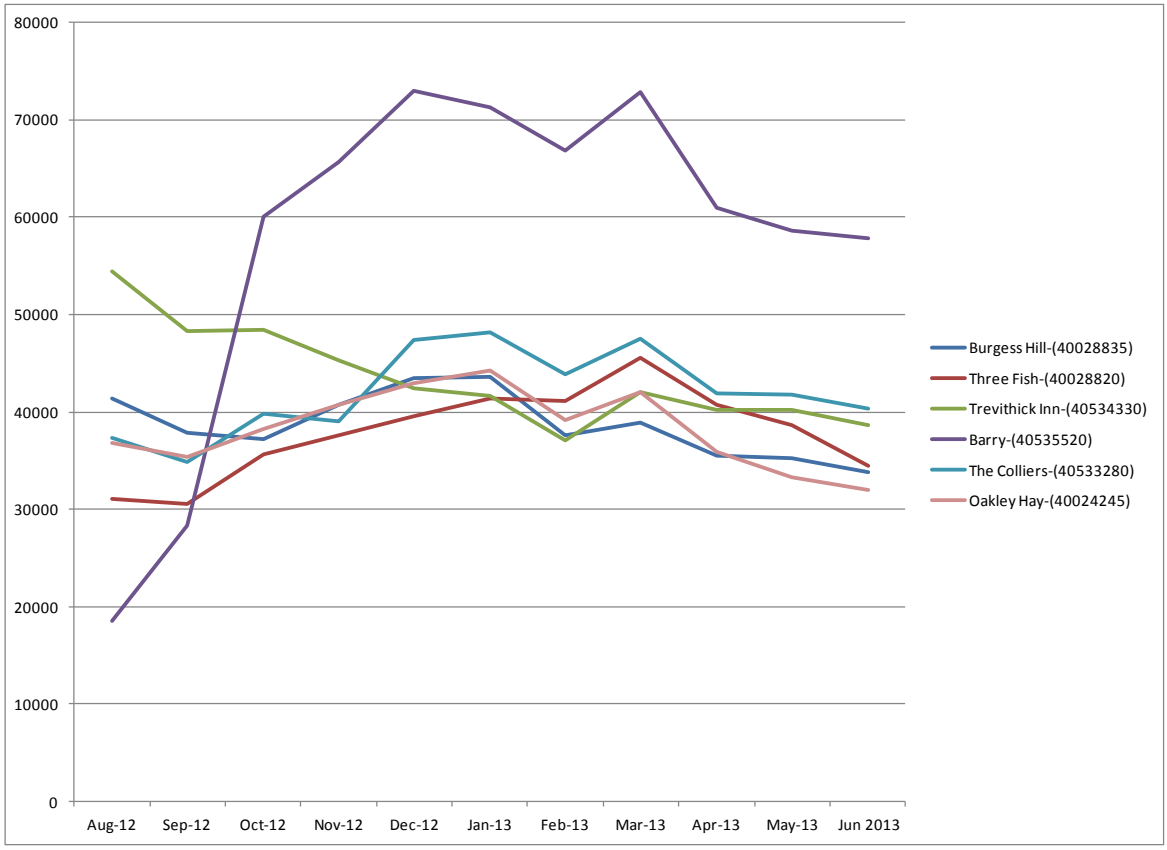


Figure 4: Graph comparing electricity use against other Whitbread sites

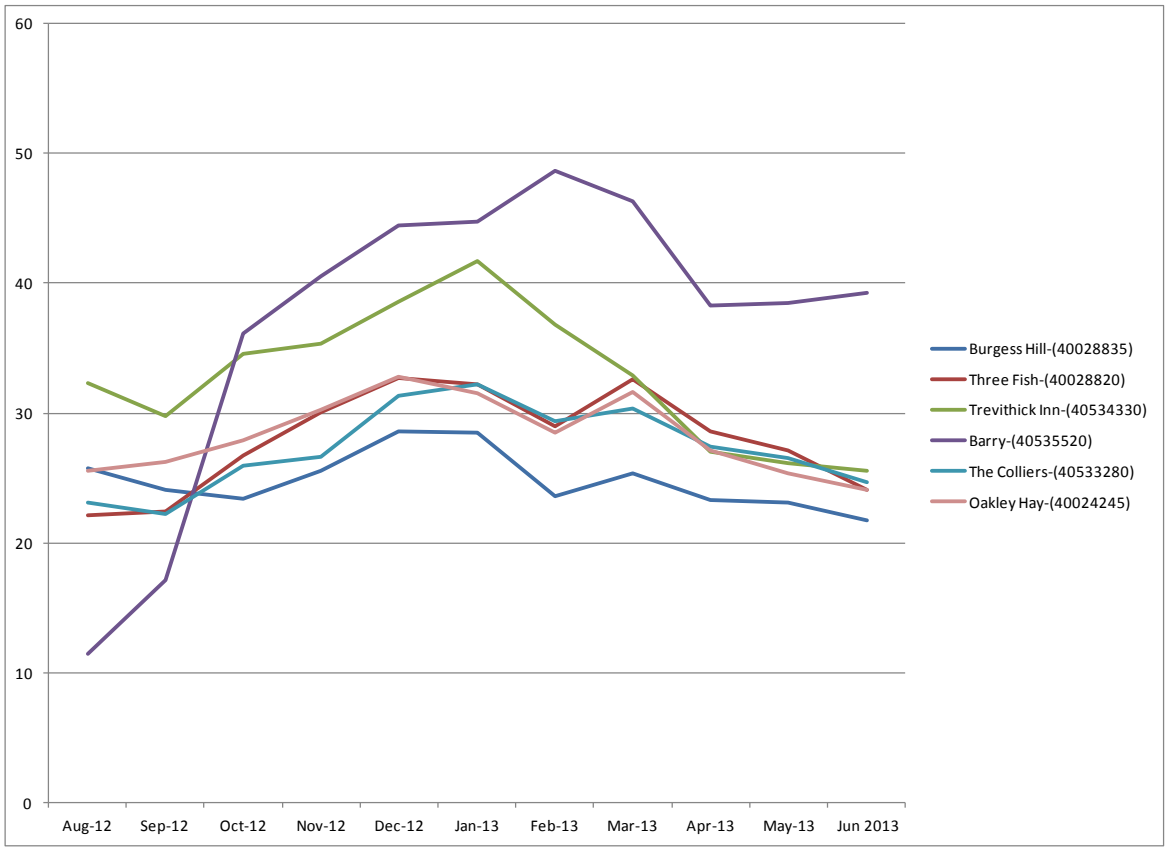


Figure 5: Graph comparing CO_2 emissions against other Whitbread Sites

3.4 Conclusions and key findings for this section

The study has shown that the strategy has not met all expectations. The energy use is not 70% less than a standard Premier Inn/restaurant. The energy use is higher than predicted although it is theorised that the model does not take into account the high occupancy of this type of hotel. In Burgess Hill the hotel is typically 100% occupied whereas the average occupancy in the Premier Inn estate is 86%. There have been a number of practical issues which have been highlighted. In particular, it has been concluded that the design is unnecessarily complicated and simpler strategies can give similar energy use without the complexity. This is illustrated by the comparison with The Coliers, Rugeley which is a simpler servicing strategy but has similar or lower energy use than Burgess Hill. An example of this complexity is the Ground Source Heat Pump and the kitchen extract system both providing heat to the buffer vessel. The installation of the BMS suggests that it was expected to manage the system but staff on-site and at head office have no access to the system. Whitbread do not routinely install BMS as they have been found to be too complicated to manage due to staff turnover, however we are looking at alternative models such as centrally controlled by Whitbread head office.

From the design review, there were some communication issues within the design team, with no one taking true responsibility for ensuring all of the equipment would or does operate well together. The design team did present some interesting ideas and clever strategies, such as heat recovery from the grey water. In theory this is a win win strategy, as waste heat is beneficially utilised and, by extracting the heat from the grey water recycling system, there are fewer risks (associated with storing warm water such as Legionella and Pseudomonas). Unfortunately, whilst theoretically useful, the system was never fully operational as it was deemed that the heat recovered would in-fact be minimal as the temperature of the waste water would be less than 40°C.

Due to the communication issues within the design team, the project highlighted an issue which arose with the units in the bedrooms. The original units in the bedrooms had to be changed as they were too noisy for guests as the design did not fully take into account Whitbread's stringent acoustic criteria within the bedrooms. The substitute units were incorrectly installed as the installer tried to adapt them to the original space and pipework. This resulted in leaks and these units were also ultimately replaced.

The Whitbread project team have recognised that the services may not have been fully commissioned to ensure that they operated together. The team estimate that less than 2 days were spent throughout the project on commissioning which, considering the complicated nature of the build compared to other Whitbread properties was too short. The commissioning plan that was in place at design was squeezed as the project was delayed due to the increased number of boreholes required. A copy of the commissioning strategy is appended to this report. From this project and other project reviews, it has become clear that commissioning is a key issue. A number of issues could have been addressed sooner, such as how the systems operated together, the noisy fans in the bedrooms and clearly identifying the sub-meters. .During the TSB study a week was spent relabeling and in some cases recalibrating the sub meters installed.

Whitbread are aware of these issues and are investigating how to implement better strategies in the future. Whitbread plan to implement some of the learning from this study at Burgess in a new build in Spalding, planned to start in 2015. In particular there will be more of an emphasis on air tightness, modelling and greater commissioning time built into the project time line.

4 Key findings from occupant survey

Technology Strategy Board guidance on section requirements:	This section should reveal the main findings learnt from the BPE process and in particular with cross-reference to the BUS surveys, semi-structured interviews and walkthrough surveys. This section should draw on the BPE team's forensic investigations to reveal the root causes and effects which are leading to certain results in the BUS survey; why are occupants uncomfortable; why isn't there adequate daylighting etc. Graphs, images and data could be included in this section where it supports the background to developing a view of causes and effects.

4.1 BUS Survey

The results of the BUS survey (as provided by ARUP) are attached to this report.

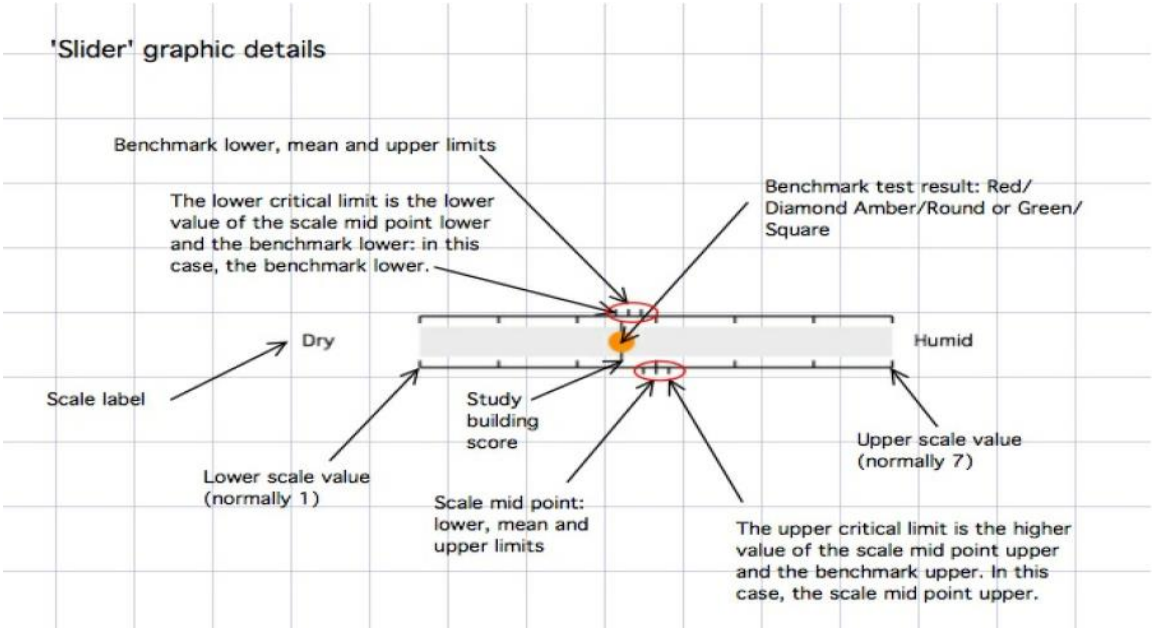
Being a hotel, the number of employees within the building is small. Most the building occupants are guests.

The staff are generally very busy and whilst all staff were given the survey, not all had time or the inclination to complete it. Those that did commented that, whilst there are some issues in the hotel and restaurant, there are many positives.

The survey was carried out on Monday 30th September. A total of 25 survey forms were given out to all staff on-site on that day and a total of 10 were returned. This is a response rate of 40% which is poor by Whitbread standards but not unexpected. For example, a total of 7 surveys were given to cleaning staff with only one returned. A cleaner at Premier Inn has a total of 22 minutes to clean a room so there isn't much time to complete a paper survey. This group of staff is also on minimum wage and shouldn't be expected to stay on-site to complete it after their shift has finished.

4.1.1 Results

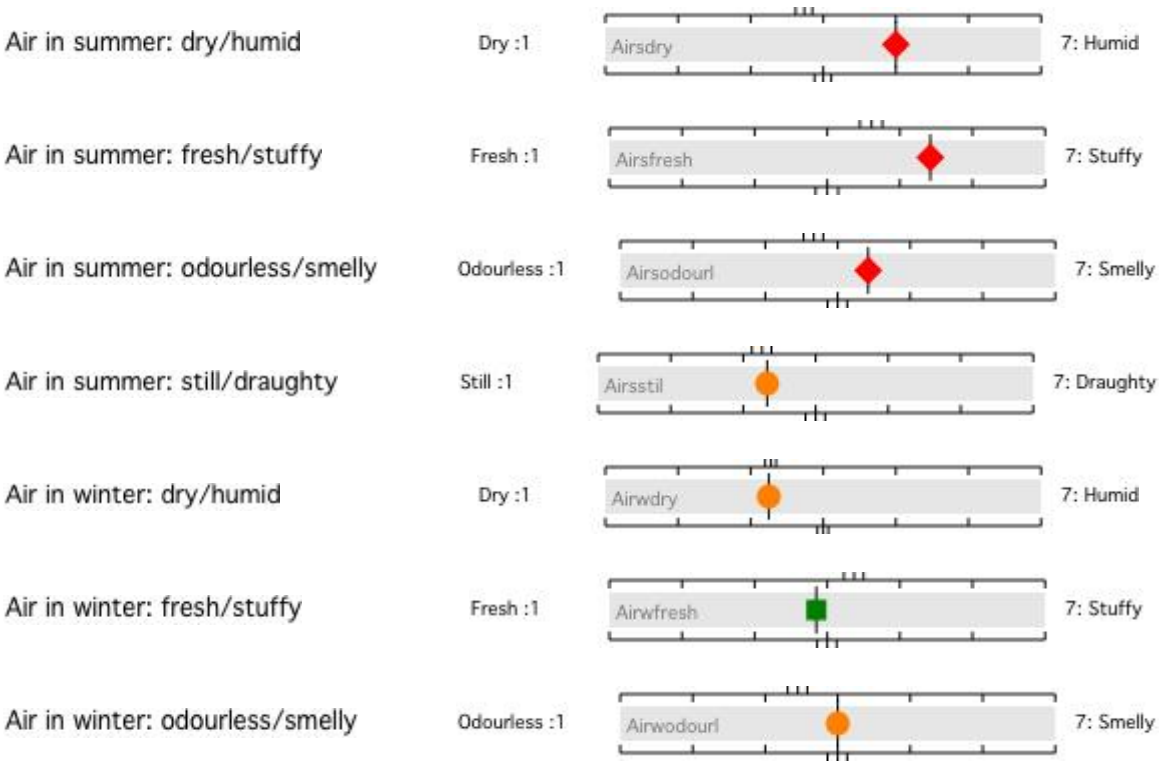
Graphs showing the results of analysis of the BUS survey conducted by ARUP are contained within this report. Below are some diagrams which briefly explain how the results can be interpreted.



4.1.2 Air

The air tightness of the building is a design feature of the build. Hotel rooms are built with fixed triple glazed windows and mechanical ventilation heat recovery systems. Triple glazed windows are a feature throughout.

The questions in this section covered humidity, freshness and odour.



As mentioned previously, this survey was conducted on 30th September, after a hot (well, for the UK at least) summer. It is also worth remembering that the majority of respondents are not stationary during their working day.

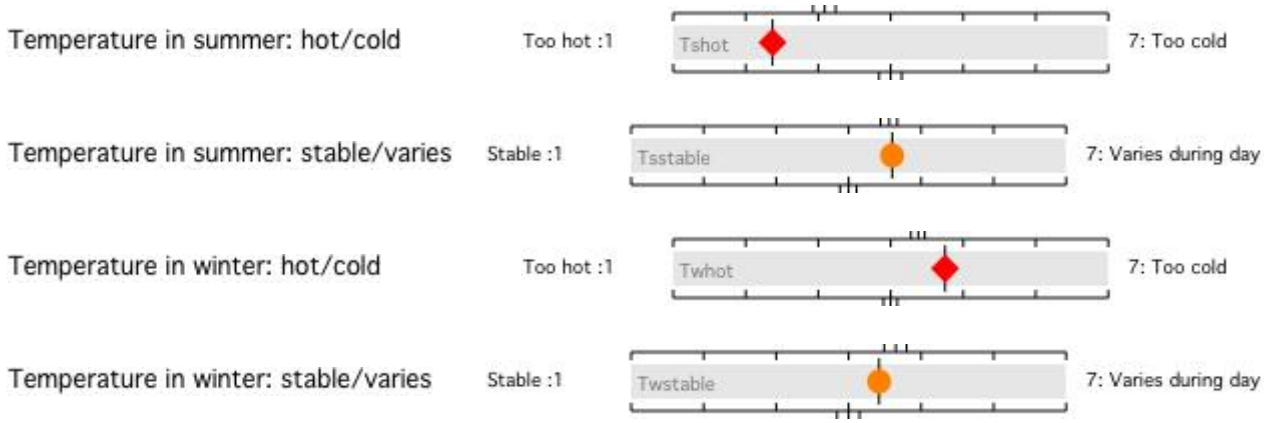
The summer temperature/humidity monitoring that has also been conducted as part of the BPE does not correlate to the respondents feelings.

Temperatures and humidity levels were within CIBSE guidance levels, even when temperatures outside reached very high levels.

Perhaps one of the reasons for the perception of uncomfortable air is due to staff having no control on-site. The BMS has been replaced twice and there is no knowledge on-site how to change temperatures.

4.1.3 Temperature

Summary (Temperature variables)



As the graphs clearly show, summer temperatures are perceived as being too hot.

The Summer temperature analysis that we conducted showed that the internal temperatures were within CIBSE benchmarks but as mentioned earlier, this is not an office. With kitchen and bar staff, running about like loons, “normal” working temperatures could seem excessive.

Again, a lack of control could also have an impact on perceptions of heat.

4.1.4 Lighting

Summary (Lighting Variables)

Orientation was never a factor for this build and as such solar gain or natural lighting was never built into the design. There are 2 sun pipes in back of house areas to avoid the use artificial lighting as much as possible.

During the building walkthrough it was noted that there is a high level of decorative lighting in both the reception and restaurant locations.

4.1.5 Noise

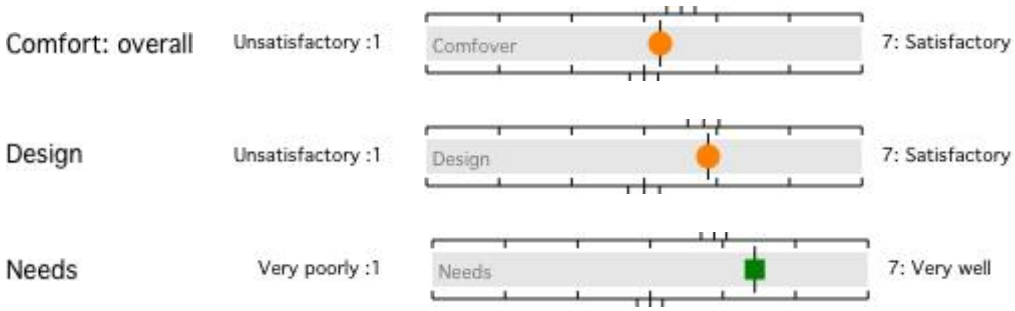
Summary (Noise Variables)

Acoustics are very important in a build such as this. Whitbread offer hotel guests a no quibble money back offer so negating noise is very important.

Triple glazed windows are designed to minimize external noise issues.

4.1.6 Design

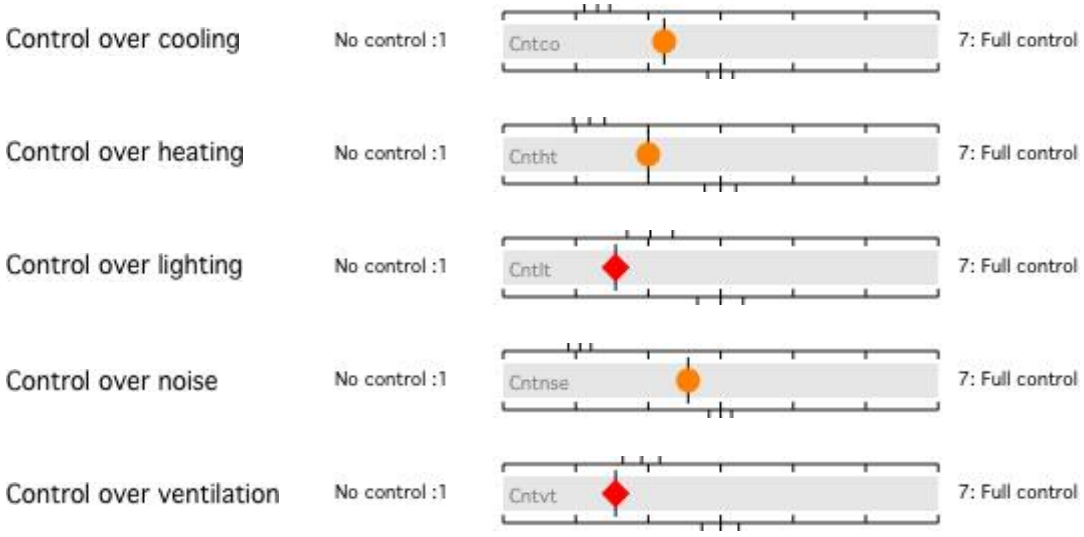
Summary (Design/needs Variables)



Interestingly here the overall comfort of the build is rated as satisfactory even though previously respondents had rated the air and temperature as unsatisfactory.

4.1.7 Control

Summary (Control Variables)



The overall feeling when talking to the staff is that they are frustrated at the inability to control either temperature or lighting.

The BMS on-site currently works but the staff have no access to the unit

4.2 Conclusions and key findings for this section

Some of the key issues discovered were;

- Perceived poor air quality in summer
- Perceived uncomfortably warm temperature in summer
- Lack of controls – staff highlighted that they could not make any modifications to the system as the BMS was too complicated and they had no training.

- On the plus side, the respondents felt that the building met their needs very well, space was utilized very well and portrayed a good image to visitors, very important in the hospitality industry.

5 Details of aftercare, operation, maintenance & management

Technology Strategy Board guidance on section requirements:	This section should provide a summary of building operation, maintenance and management – particularly in relation to energy efficiency, metering strategy, reliability, building operations, the approach to maintenance i.e. proactive or reactive, and building management issues. This section should also include some discussion of the aftercare plans and issues arising from operation and management processes. Avoid long schedules of maintenance processes and try to keep to areas relevant to energy and comfort i.e. avoid minor issues of cleaning routines unless they are affecting energy/comfort.

5.1 Maintenance Policy

Whitbread's policy is to ensure maintenance contracts are in place for key technologies within new premises. This is particularly important where new technologies have been used, such as at Burgess Hill. Maintenance contracts were agreed with key companies:

Hopkins – Mechanical and Electrical services

Norton – Gas

Waterscan – Grey water collection system

Whitbread were unable to reach agreement with ISO Energy who provided the Ground Source unit. These units are serviced under a one off agreement. This is particularly costly to Whitbread and contributes to the reluctance to further roll out the technology.

Whitbread's policy for repairs and maintenance is that these are centrally sourced, so if a hotel has an issue with their boiler, they contact Whitbread Head Office, who contact the relevant organisation to facilitate a repair.

5.2 Maintenance and Repairs at Burgess Hill

The post occupancy evaluation has highlighted some issues with the current processes. Due to the number of callouts required in the first year, the hotel staff developed contacts with the installers and contacted them directly. This has made it difficult to track issues with the system. For example, as no maintenance calls have been logged in Whitbread's system, it has been assumed that the grey water collection system is working effectively, but in reality, it was switched off for long periods since opening.

A copy of the maintenance and repair records for Burgess Hill are appended to this report. This is not sufficiently detailed to confirm the complexity of the issue. For example, there are a number of references to 'Ventilation/Cooling System – Faulty/Not Working', but it is not clear whether this is one room or the entire system. We are aware, from the energy monitoring analysis that there have been periodic issues with the heating, cooling and ventilation systems, but it is has been difficult to track these. During the monitoring period, it was noted that backup boilers were firing more than would be expected. See Figure 6 below. The analysis raised this issue and a query was raised with the hotel, where it was determined that the Ground Source Heat Pump had failed and turned off. As the system is automatic, without the analysis, the hotel had not noted that there was a problem.

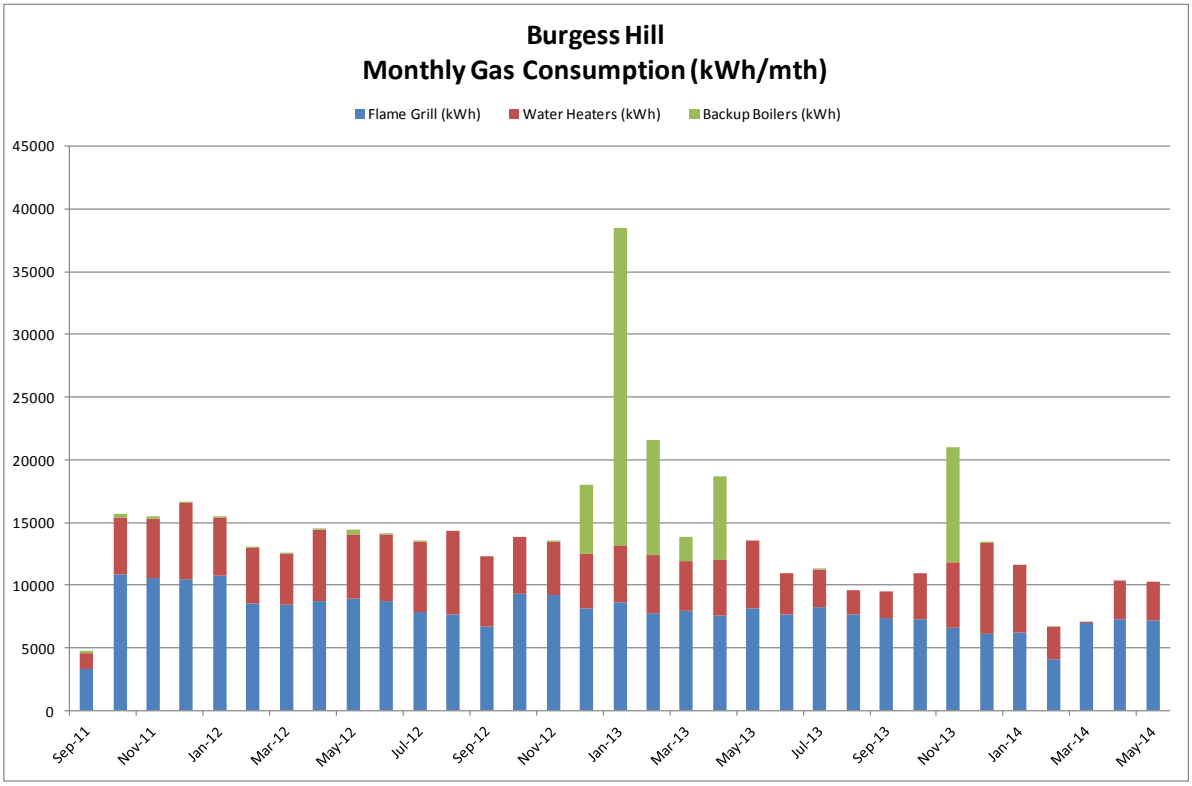


Figure 6: Chart showing monthly gas consumption

5.3 On-construction issues at Burgess Hill

During the first year of occupation, a number of issues were highlighted which are detailed below. It was clear that the system did not operate as it was designed. The design and construction audit highlighted that the specified bedroom air handling units were too noisy and gave rise to occupant complaints (which is a key issue for Whitbread). The units were then replaced, but the design engineers were not consulted, and the new units did not fit the existing pipework and so were effectively installed backwards. This gave rise to leaks in the system which meant that the units had to be replaced for again.

The first year of operation, also highlighted that there were elements of the system which did not work well together (or were not commissioned correctly). It was clear, from the issues raised within the first year, that the system had not been commissioned as a whole and whilst each element was properly commissioned, it did not take into account the effect of one piece of equipment on another.

At site visits during the project, the monitoring team determined that staff had replaced the efficient LED lightbulbs with halogen bulbs (purchased from the nearby Tesco).

Following customer comments at a number of Premier Inn hotels, customer service advisors at Whitbread Head Office sent a memo out giving instructions on how to bypass the BMS. This is a further illustration of a lack of joined up thinking.

The monitoring team observed that the backup boilers were firing in winter 2013/2014, more than was expected. This was reported to the hotel who determined that the ground source heat pump had stopped operating. The hotel staff had no warning that the system was not working and there was no feedback to Whitbread from the extensive energy monitoring system to highlight that there was a data anomaly.

It is clear from this project, that keeping up to date with the energy data from Whitbread's large building stock if a large task which should be addressed to ensure that the data provides useful information and Whitbread can address issues in a timely fashion.

5.4 Conclusions

- A number of issues have arisen with this project, but some key issues have not actioned due to the lack of formal reporting to Whitbread. Staff have not logged all call outs to the external teams, service and maintenance logs have not provided enough detail to assess what issue has been dealt with.
- Other issues include staff insufficiently briefed on the key environmental features (e.g. LED light bulbs).
- Insufficient staff training on managing the building. For example the Building User Guide contains the specifications for each of the individual items of equipment but is not written in a manner likely to prove useful for a hotel receptionist or night porter. Even simple procedures, such as how to log into the on-line BMS portal, were not sufficiently documented so that, not even 6 months after occupation, no-one from Whitbread has access to the system.
- Staff turnover - the team were hand-held in the first 6 months but the movement of management and team drives a need for repeated refreshment of operating procedure. Currently there is no budget for this.
- There is a lack of joined up thinking and a lack of feedback from the data collected.
- Without this monitoring project, Whitbread would not have been fully aware of all of the issues arisen at Burgess Hill.

6 Energy use by source

Technology Strategy Board guidance on section requirements:	This section provides a summary breakdown of where the energy is being consumed, based around the outputs of the TM22 analysis process. This breakdown will include all renewables and the resulting CO_2 emissions. The section should provide a review of any differences between intended performance (e.g. log book and EPC), initial performance in-use, and longer-term performance (e.g. after fine-tuning and DEC – provide rating here). A commentary should be included on the approach to air leakage tests (details recorded elsewhere) and how the findings may be affecting overall results. If interventions or adjustments were made during the BPE process itself (part of TM22 (process), these should be explained here and any savings (or increases) highlighted. The results should be compared with other buildings from within the BPE programme and from the wider benchmark database of CarbonBuzz.

6.1 TM22

A TM22 spreadsheet has been prepared. It has become evident that whilst every effort has been made, it is impossible to corroborate the installed equipment against specific meters and therefore the project has been unable to fully utilise the functionality of TM22. Analysis has been undertaken as outlined below.

6.2 Energy Comparison between Hotel and Restaurant

Whitbread continually analyse their energy data across their stock, however, their stock is large and varied. The Burgess Hill project has given a real understanding of the key energy uses within a Premier Inn and Restaurant.

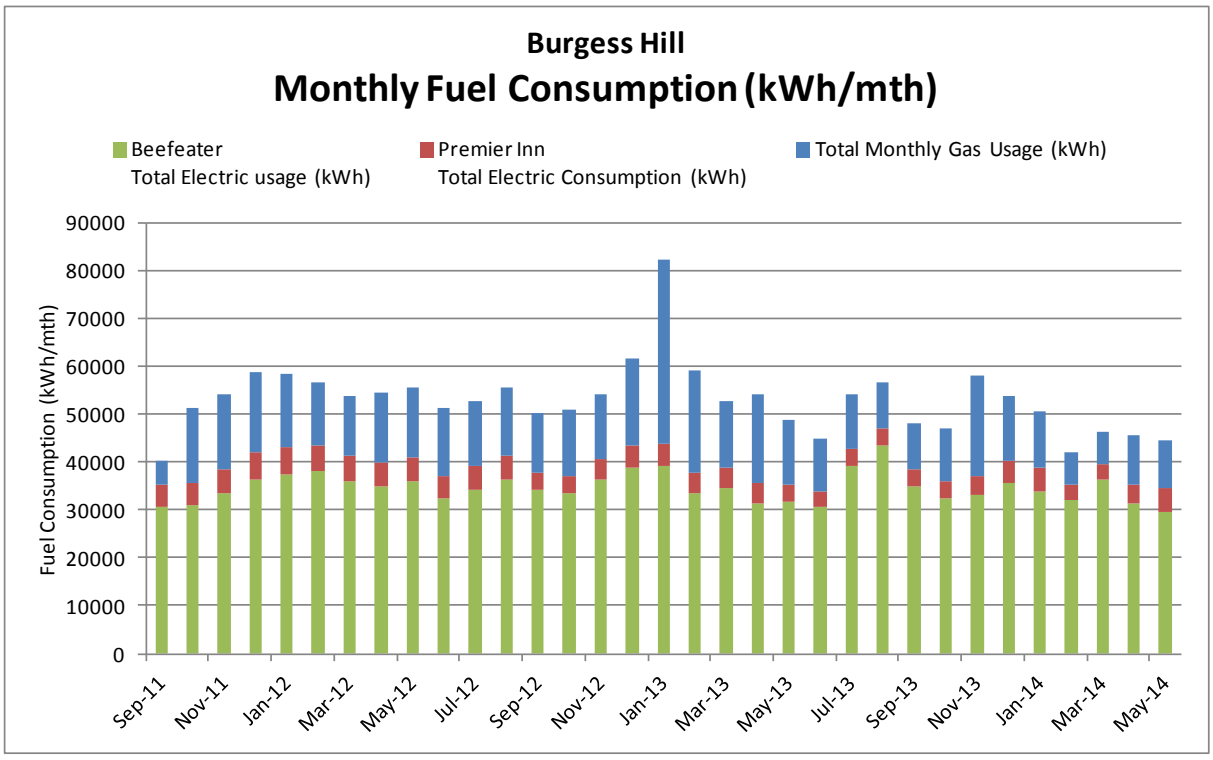


Figure 7: Chart showing total monthly fuel consumption

Figure 7 shows the summary of energy use within the building. It is clear that electricity use within the Beefeater is significantly higher than the electricity use within the Premier Inn.

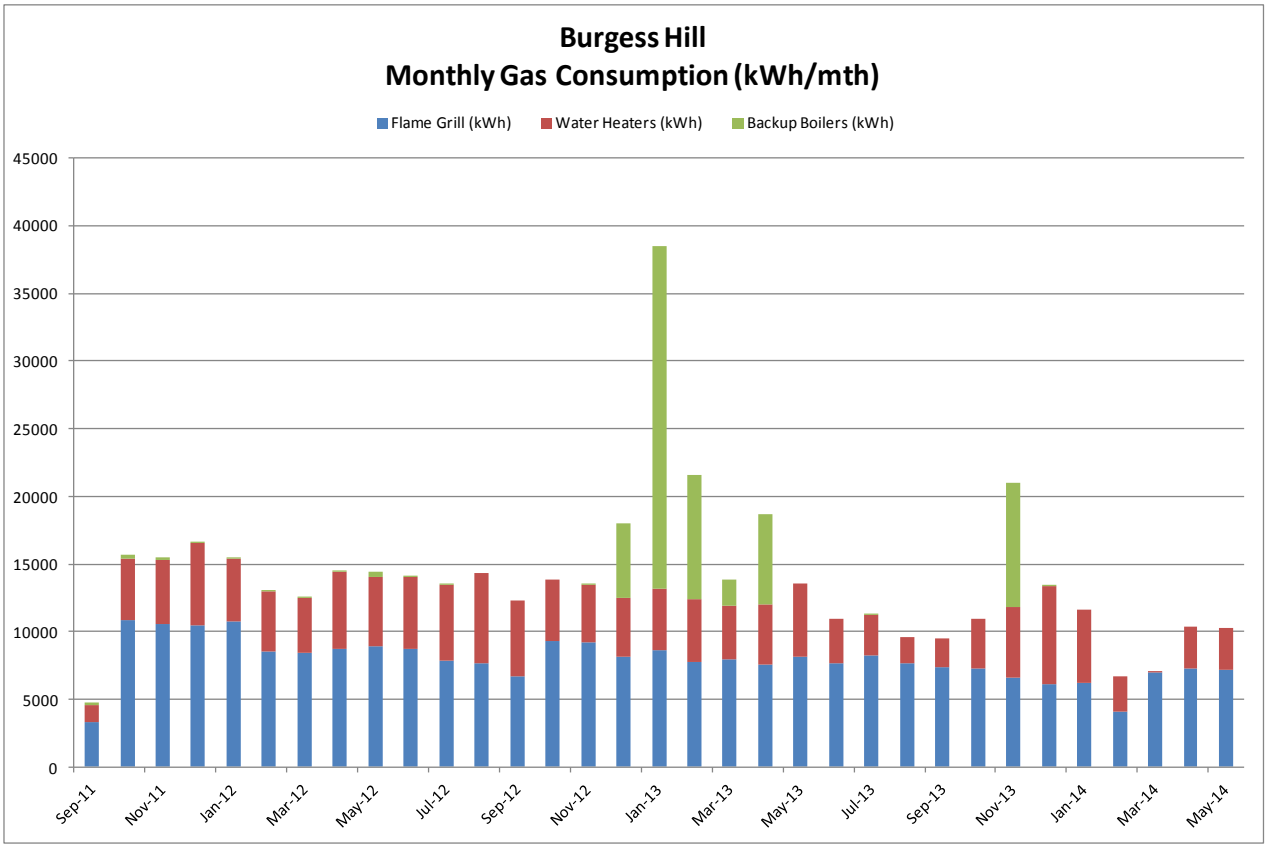


Figure 8: Graph showing monthly gas consumption

Figure 8 shows the monthly gas consumption which indicates that the flame grill uses significantly more gas than the water heaters. Figure 8 shows a marked increase in gas consumption for January and February 2013. Figure 8 shows that until December 2012, the backup boilers were rarely used, December 2012, January 2013 and February 2013 (in particular January 2013) show significant use of the backup boilers. After further investigation it was determined that the increase in gas use by the backup boilers was due to the Ground Source Heat Pump not operating correctly.

There is a noticeable reduction in gas use from the water heaters in March 2014. The hotel reported no heating in 15 rooms around this time. The data shows no readings for a number of meters (including some electricity meters) around the same time. This was not reported to Whitbread via their meter reporting system (but has been reported as part of the project). By the time Whitbread were alerted to the meter issues, the meters had been restored, but the project team have been unable to determine what happened.

Taking Figure 7 and Figure 8, it is clear that the restaurant utilises more energy than the hotel.

6.2.1 Char Grill

Whitbread have noted that Burgess Hill utilises a more efficient gas char grill than other installations. The main savings are achieved as the unit can be segregated into up to four sections allowing only the area required to be heated. On this basis, a comparison has been undertaken with Beefeater flame grill at Eureka Park, Ashford.

Figure 9 shows a comparison between the flame grill at Burgess Hill and the flame grill at Ashford. It is clear that the flame grill at Burgess Hill has utilised significantly less gas than the one at Burgess Hill. The annual gas use is as follows:

	Gas Use
Ashford	188,691
Burgess Hill	82,711.1

Table 2: Table of flame grill gas use

Based on Table 2 Burgess Hill flame grill utilises approximately 56% less gas than Ashford flame grill.

Ashford represents a reasonable comparison with Burgess Hill as they are of similar size and have similar usage.

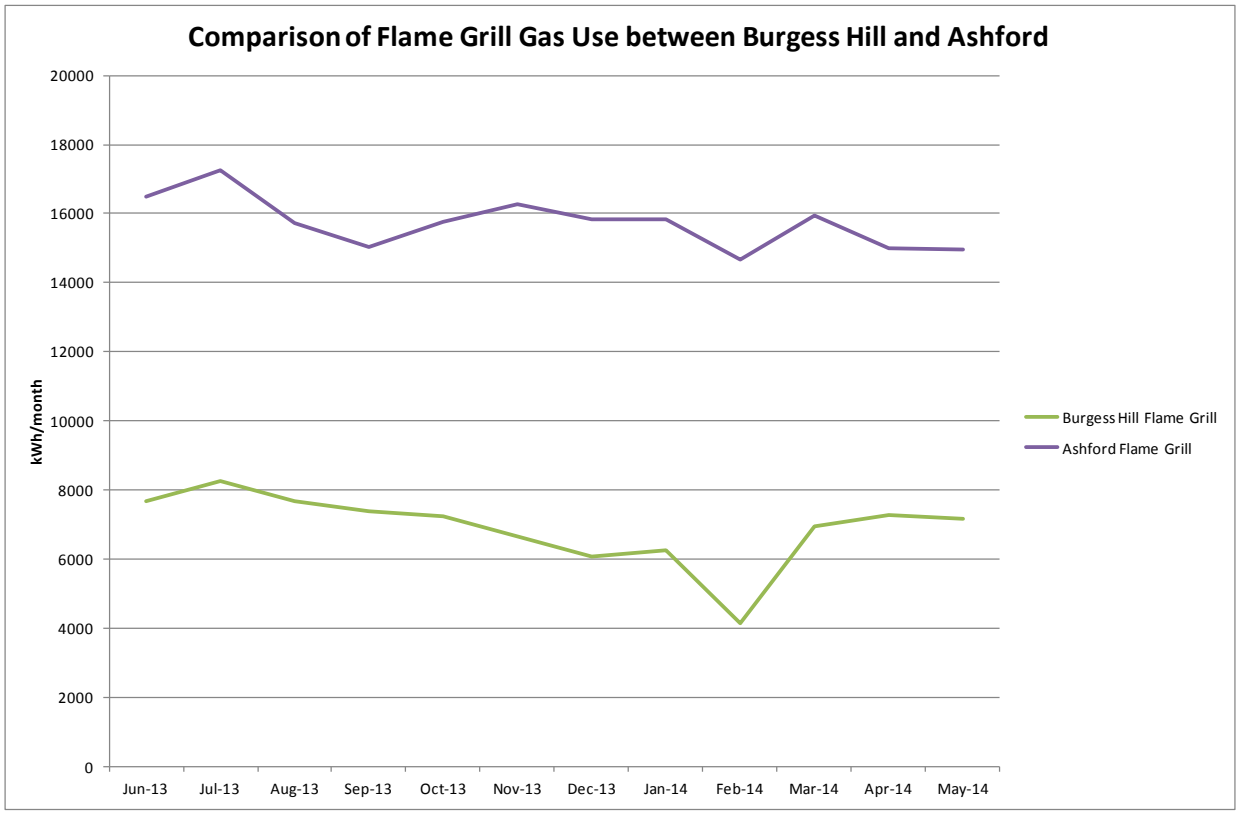


Figure 9: Graph showing comparison of flame grill energy use between Burgess Hill and Ashford.

As a direct result of the TSB study, Whitbread have sourced more efficient char grills offering a further 30% saving over the unit installed at Burgess Hill and these are now the Whitbread standard. The new unit uses atomising technology to keep the food moist and perfectly cooked and with no fat or grease build up on the char-grill which is potentially a fire hazard, The power also means that different food types can be cooked at the same time such as meat, vegetables and fish with no cross contamination. No fat tray means a reduced risk of fire as no combustible hot grease or oil sits on the unit The super high temperature generated from the gas burners along with the ceramic plates focuses the heat back towards the grill and vaporises the oils and fats into a fine mist, which is blasted back towards the underside of the food resulting in a moist yet flavoursome product. With no fat or grease being able to remain in the grill the charcoal taste is eliminated resulting in a better tasting product.

6.3 Beefeater Electricity Use

Whitbread have always understood that the restaurant utilises more energy than the hotel, but the split has generally assumed to be 60/40, or possibly 70/30. This project has shown that the energy use from the restaurant is significantly more than predicted (around 80/20). Whitbread have concentrated their efforts on improvements in their flagship hotel brand (Premier Inn), whereas energy use in the restaurant has been driven by other factors. In particular, the flamed grilled steak, which is a popular product within the restaurant. There would be a further project to analyse the chosen options within the restaurant against the energy use. Based on the data, the total energy use has been determined as follows:

Year Ending	PI Total	Beefeater Total	Total energy use	PI %	Beefeater %
Aug-12	121104.5	521133.8	642238.3	18.86%	81.14%
Sep-12	124346.4	527863.8	652210.2	19.36%	82.19%
Oct-12	122984.9	528896.7	651881.6	19.15%	82.35%
Nov-12	121556.8	530649.1	652205.9	18.93%	82.62%
Dec-12	124395.8	530729.9	655125.7	19.37%	82.64%
Jan-13	148420.4	530385.6	678806	23.11%	82.58%
Feb-13	156457.6	524991.9	681449.5	24.36%	81.74%
Mar-13	157564.5	522926.4	680490.9	24.53%	81.42%
Apr-13	161722.2	518413.7	680135.9	25.18%	80.72%
May-13	160170.8	513329.2	673500	24.94%	79.93%
Jun-13	156640.9	510413.3	667054.2	24.39%	79.47%
Jul-13	152781.6	515807	668588.6	23.79%	80.31%
Aug-13	146536.9	522833.1	669370	22.82%	81.41%
Sep-13	142743.579	524448.051	667191.6	22.23%	81.66%
Oct-13	141704.684	521369.106	663073.8	22.06%	81.18%
Nov-13	151131.248	515578.79	666710	23.53%	80.28%
Dec-13	148661.81	510283.931	658945.7	23.15%	79.45%
Jan-14	124499.472	502771.047	627270.5	19.39%	78.28%
Feb-14	112194.495	497844.788	610039.3	17.47%	77.52%
Mar-14	104793.168	498790.295	603583.5	16.32%	77.66%
Apr-14	96649.039	498332.382	594981.4	15.05%	77.59%
May-14	95499.426	495371.436	590870.9	14.87%	77.13%

Table 3: Table showing energy use split between Beefeater and Premier Inn

The gas usage from the water heaters and backup boilers has been allocated to the Premier Inn and the flame grill to the Beefeater. The water heaters also provide the preheat for the Nilan unit in the restaurant but there is no mechanism for separating this out.

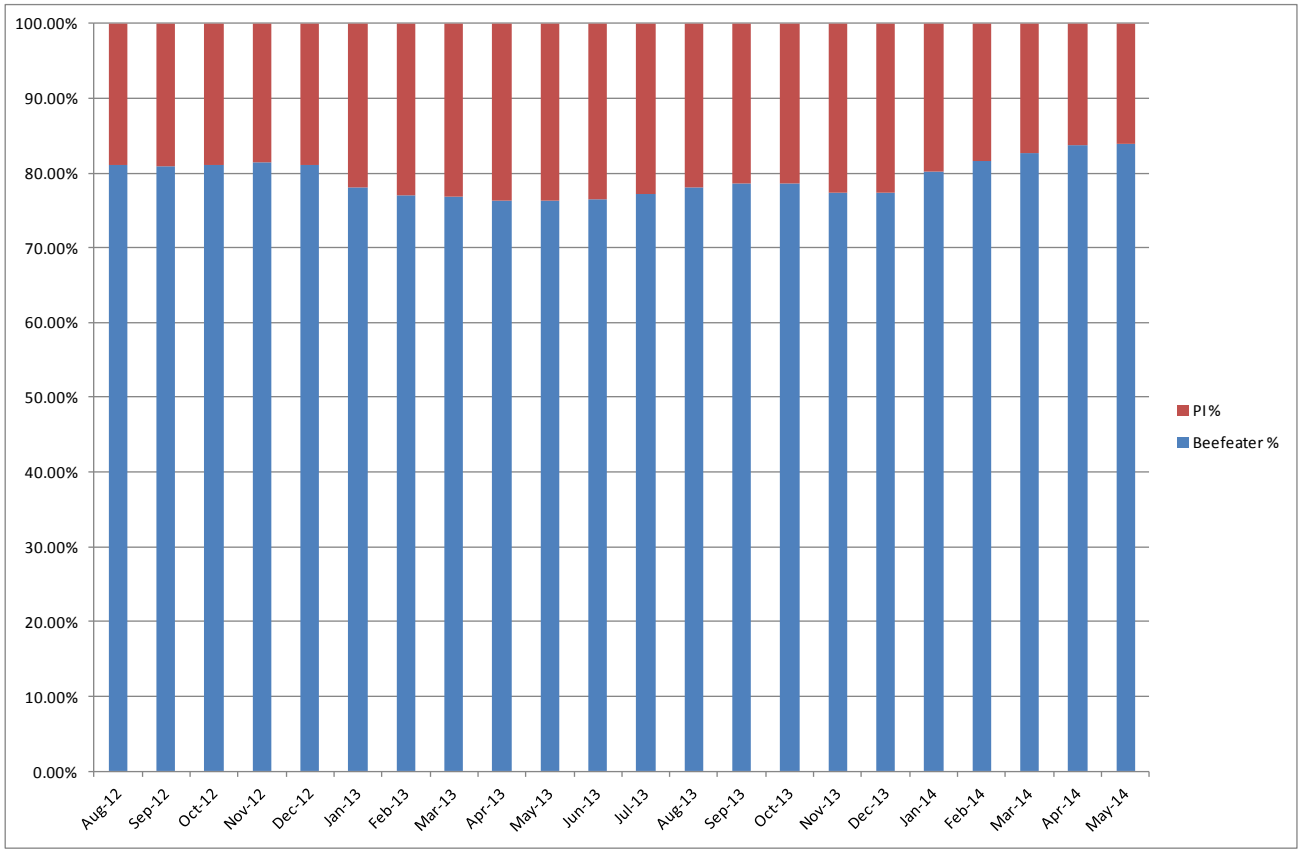


Figure 10: Chart showing proportion of energy use between the Premier Inn and the Beefeater

Figure 10 illustrates that the split between the Premier Inn and the Beefeater is reasonably consistent at approximately 80%/20%.

The energy use for the Beefeater has been monitored extensively. Figure 11 shows the breakdown by end use. This shows that the hot board, cold board, Nilan Unit, GSHP and lights and small power utilise similar amounts of energy. A review of the lighting within the Beefeater showed significant decorative lighting which could be reviewed further. We would also note that the design utilised mostly LEDs, but in some areas, particularly behind the bar, it was noted that the hotel staff has replaced some of the LED bulbs for equivalent halogen units. The halogen units utilise approximately 5 times the energy of the equivalent LED. The small power also includes the tills which are permanently on. A further project could review the energy use of the tills and break down the lighting further to understand where the energy is being used. In particular an investigation of lighting used for decorative features.

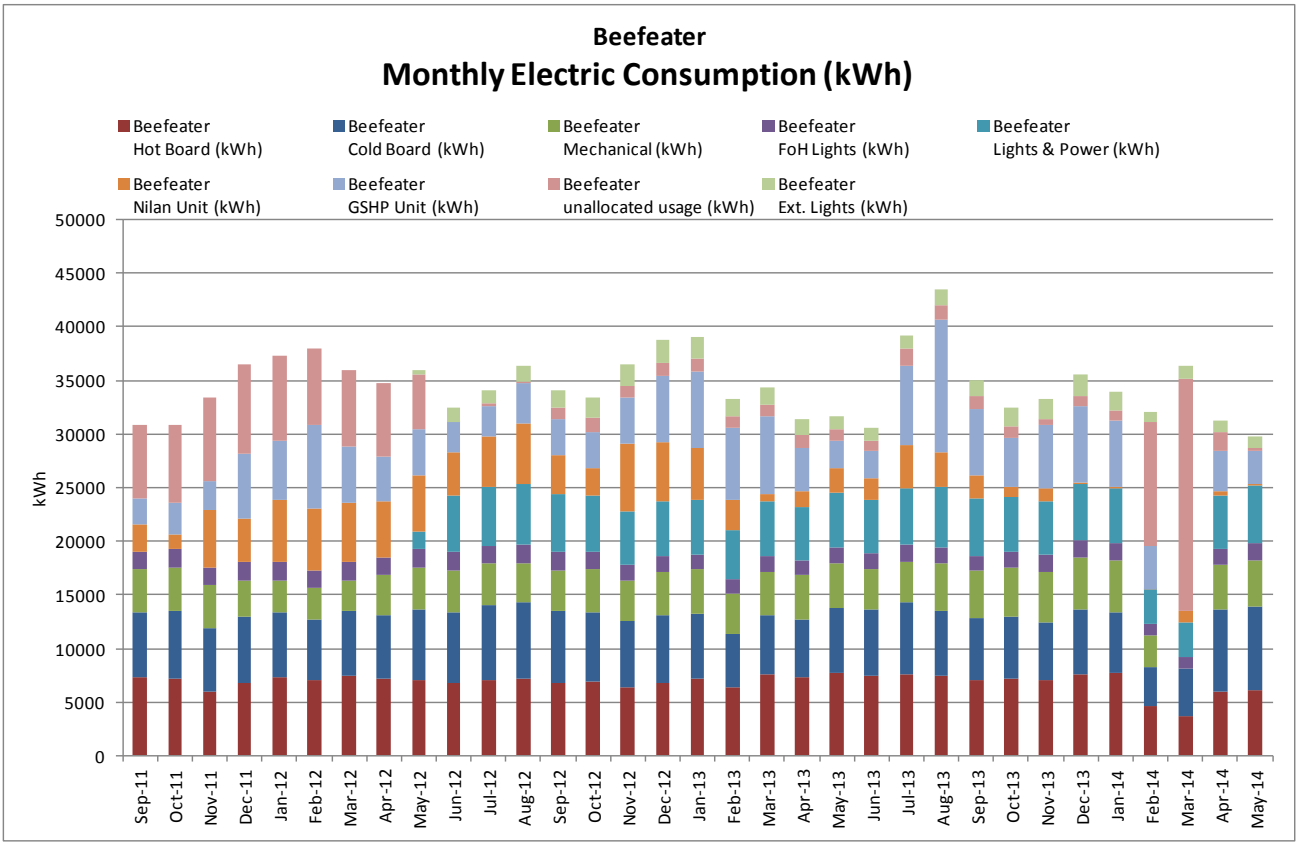


Figure 11: Graph showing energy use by output within Beefeater

It is clear that the kitchen energy use makes a significant contribution to the energy use within the Beefeater. The project utilised the most energy efficient equipment possible, incorporating innovative features such as pan sensors to ensure that cooking equipment is not left on. It can be seen within the data, that there were occasions when pans were left and equipment was left on overnight, but these occasions were rare. It can also be seen from the data that, in particular soon after the restaurant opened, the fridge door was left open. This was observed and staff informed that the door should be closed. Staff were informed verbally and new posters have also been put up by the fridge and freezer doors to encourage staff to close the door after use.

6.4 Comparison with other 'Green' Whitbread sites

A preliminary comparison has been undertaken of the Burgess Hill development with other sites which have utilised 'green' strategies. The following summarises the key technologies incorporated within the comparison hotels.

Hotel	Features
Burgess Hill	Ground source heat pumps, heat recovery, air source heat pumps, improved building fabric, good air tightness
Three Fish Newport, Telford & Wrekin	Ground source heat pumps,
Trevithick Inn, Cambourne, Cornwall	Ground source heat pumps, small scale solar (PV) and air source heat pumps
Barry, Wales	Air source heat pumps, low occupancy
The Colliers, Rugely, Derbyshire	Ground source heat pumps

Oakley Hay Corby, Northamptonshire	Good thermal insulation, good air tightness, air source heat pumps with underfloor heating in the restaurant.

Table 4: Table summarising key 'green' features

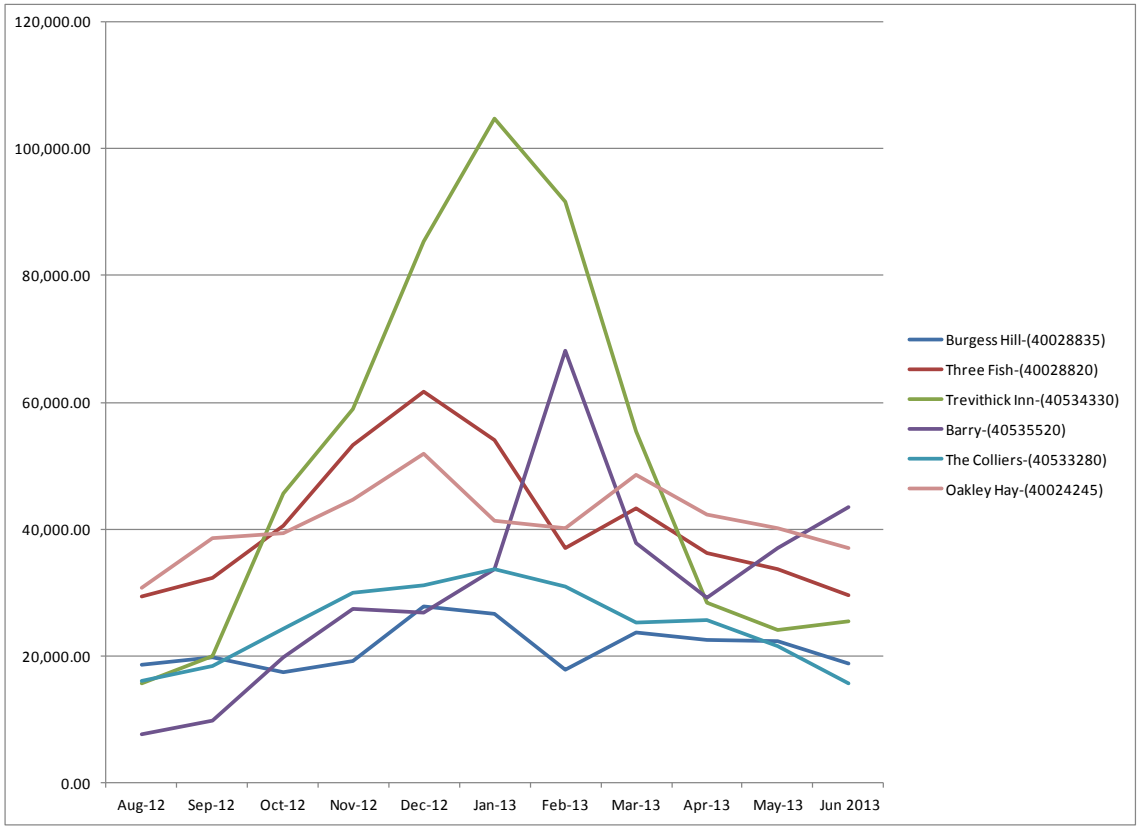


Figure 12: Graph comparing gas use against other Whitbread sites

The graph above highlights the different energy profiles of several Whitbread sites with differing types of equipment but all are 60 bed hotels with 220 cover restaurants so perfect for comparison. Burgess Hill performs consistently through the year and has a lower profile than most of the other sites with the exception of the Colliery in Rugely.

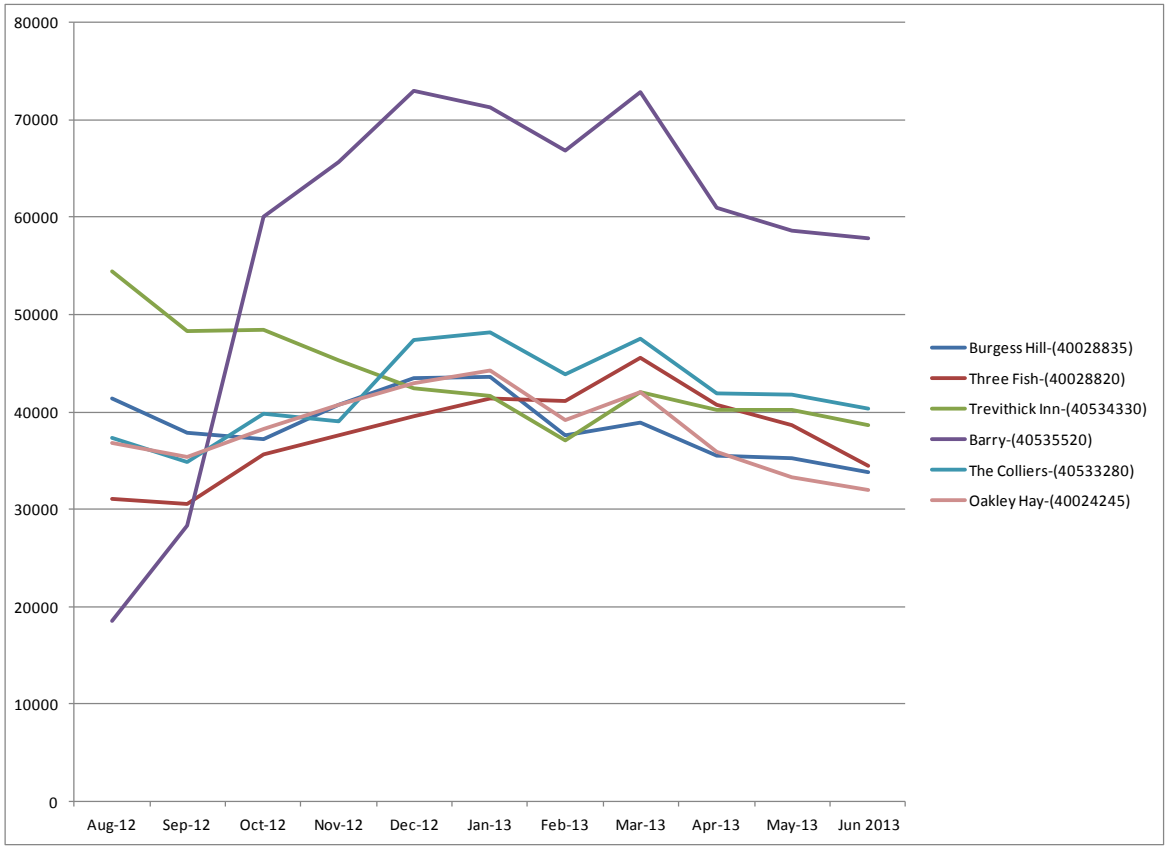


Figure 13: Graph comparing electricity use against other Whitbread sites

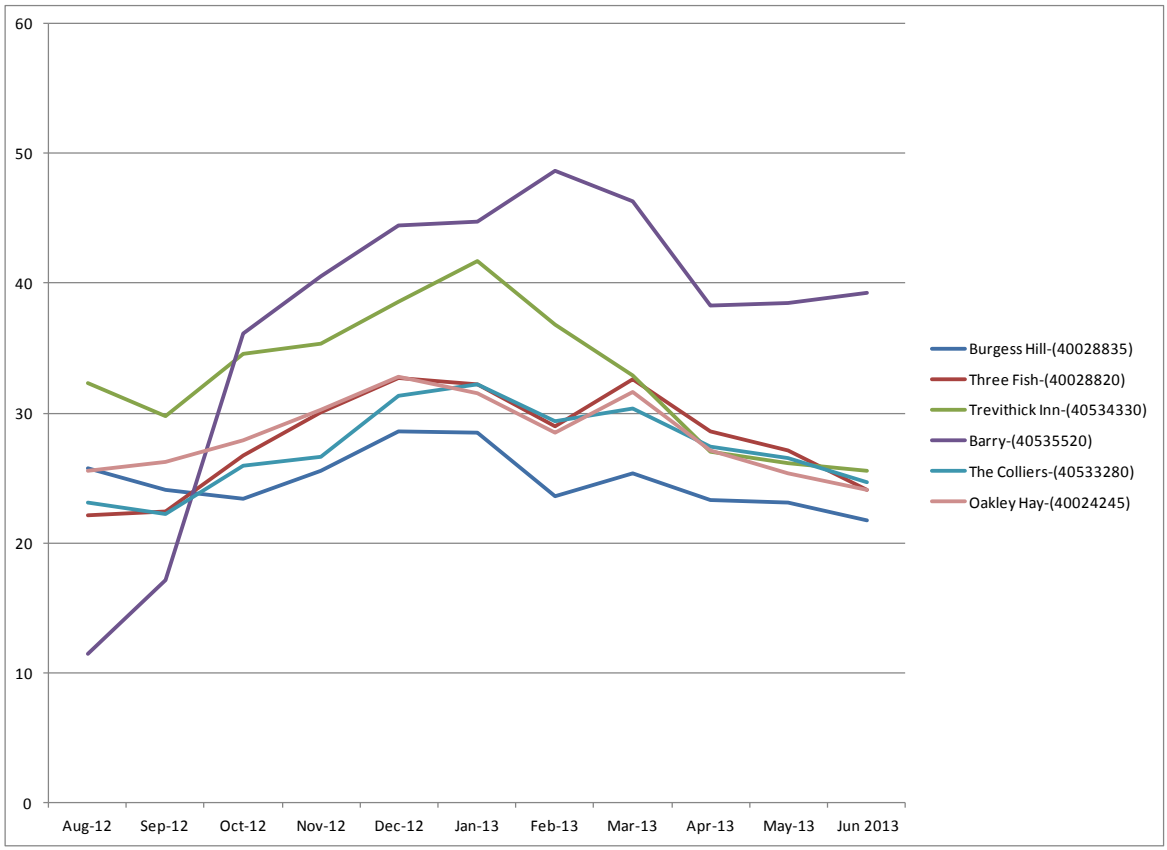


Figure 14: Graph comparing CO_2 emissions against other Whitbread Sites

6.5 Conclusions and key findings for this section

The project has shown that work by Whitbread to reduce energy use in the hotel has been successful. The energy use in the restaurant, however, is significant. The split between Beefeater and Premier Inn is approximately 80/20.

Much of the energy use in the restaurant is from unregulated energy.

It is clear that there are maintenance and reporting issues within the hotel and restaurant.

7 Technical Issues

Technology Strategy Board guidance on section requirements:	This section should review the underlying issues relating to the performance of the building and its systems. What are the technical issues that are leading to efficiency results achieved to date? Are the automated or manual controls effective, and do the users get the best from them? Are there design related technical issues which either need correcting/modifying or have been improved during the BPE process? Did the commissioning process actually setup the systems correctly and, if not, what is this leading to?

7.1 Technical Issues

Other sections outline the technical issues at Burgess, however they are summarised here.

The main issue with Burgess Hill, is that no one member of the design team took responsibility for the services design as a whole. This has led to issues as the systems are designed to work independently of each other. There has also been little consistency of approach, for example, the selected air handling units in the bedrooms were too noisy to meet the stringent acoustic standards set out by Whitbread. These units were changed, but the new units required a different pipework configuration. As the design team were uncommunicative, the installer did what they could, but the units were installed in such a way as to leak into the bedrooms. The air handling units were then changed again.

During the monitoring, a number of issues have been raised. The ground source heat pump stopped operating. There is no effective warning system to let anyone know that the system is not operating. Usually this would be highlighted by Whitbread maintenance or the hotel would be alerted. The monitoring team were the first to notice, as the backup boiler was firing, but the ground source heat pump was non-operational for more than a month.

There have been a number of issues with the grey water recycling system. The grey water recycling system has rarely operated as designed since installation despite multiple callouts by the installers. As the grey water recycling system has not operated, the heat recovery from the grey water has not operated and it is unknown from this project how effective this system could be. Theoretically it offers great advantage, as the grey water is then cooler when it is stored, reducing the risks of bacterial growth.

Whilst not a technical issue, communication has been an issue relating to repairs and maintenance. As the hotel staff have contacted the companies directly, it has proved difficult to track what repairs have been required. This has led to an assumption that everything is working and elements being specified for future projects which have proved unreliable at Burgess Hill.

There has been a particular issue with the LED light bulbs. Staff have replaced the bulbs with halogen bulbs from the nearby Tesco. This has had an effect on energy use, but has also affected occupant comfort, particularly in the bar area, as the halogen bulbs give off significantly more heat than their LED equivalent.

7.2 Conclusions and key findings for this section

Whitbread has already implemented changes are result of the experience of Burgess Hill.

There are now more stringent requirements for managing the services design and installations.

Whitbread have introduced a Clerk of Works to manage the fabric installations.

Whitbread are also looking at managing maintenance and repair within their hotels and ensuring compliance across the estate.

8 Key messages for the client, owner and occupier

Technology Strategy Board guidance on section requirements:	This section should investigate the main findings and draw out the key messages for communication to the client/developer, the building owner, the operator and the occupier. There may also be messages for designers and supply chain members to improve their future approaches to this kind of building. Drawing from the findings of the rest of the report, specifically required are: a summary of points raised in discussion with team members; recommendations for improving performance, with expected results or actual results where these have already been implemented; a summary of lessons learned: things to do, things to avoid, and things requiring further attention; a summary of comments made in discussions and what these could be indicating. Try to use layman's terms where possible so that the messages are understood correctly and so more likely to be acted upon.

8.1 Specific Lessons from Burgess Hill

Whitbread have been involved in the review of this project from the start and the results have proved very valuable. The project has shown Whitbread where there are issues in their procurement and in continuing maintenance strategies.

Whitbread have key targets for reducing energy use in their hotels, including designing for zero carbon. In order to meet this target, it is clear that the strategy must be clear and that design team roles are well defined. It is also clear that good project management and a contractor who is engaged in the strategy are key to ensuring the building operates as intended.

Increase commissioning time

Commissioning was a key issue at Burgess Hill. The specification required that a design team member was responsible for commissioning, but in reality, due to the conflicts in the design team, each discipline worked on their own items and did not work together to ensure a coherent approach.

In order to ensure that the project was delivered on time, commissioning time was squeezed from the end of the project. This meant that the numerous different types of equipment were not optimised to ensure that they worked well together. In order to ensure that commissioning isn't removed from the project plan for future project, commissioning will be split into several stages of the project plan. There should also be a requirement to spend some time post occupancy to ensure all equipment is balanced and optimised with all other equipment based on the way that the building is being used.

In addition, there is a need to ensure that all disciplines work together i.e. architects, structural engineers and services engineers as well as the contractor and sub-contractors. This ensures that the building can operate as intended.

Introduce soft landings or similar programme in order to ensure that all relevant parties are engaged in the project from the earliest opportunity.

One of the common themes that were heard throughout the project was that people were brought into the project too late to have input into other stages of the build that may have an impact on the latter stages. This was especially true of the external design team meetings. The Soft Landings Framework is a framework

designed to make the transition from construction to occupation as smooth as possible. One of the key steps of the framework is to ensure that all relevant parties are engaged at the concept stage of the project to ensure that everyone has an input at early stages of the project.

Ensure that all suppliers of M&E equipment have a contract in place to ensure commissioning and maintenance of the equipment is place for at least 2 years post occupancy

As a rule, Whitbread does not insist that suppliers of equipment are contracted to provide maintenance. Maintenance is often undertaken by engineers on a central contract. In Burgess Hill, there were numerous pieces of specialist equipment which couldn't be maintained under a central contract. The Ground Source Heat pump is an example. As the equipment did not have a maintenance contract any subsequent visit by the supplier was chargeable and therefore post occupancy commissioning did not occur.

Engage the occupiers at the earliest opportunity to ensure their needs are being met and they are aware of the parameters of the building

One of reasons that we started the project was the awareness of a performance gap between design and occupation. One of the findings of the project was that there is a further gap in performance post occupancy. Typically, Whitbread will hand the building over to the on-site management team with little hand over. The "log book" is simply technical data sheets which mean very little to on-site teams.

Maintenance Issues – future resolution

On-going repairs and maintenance have also been a key issue at Burgess Hill. Where there have been issues at Burgess Hill, the hotel staff have reported these directly to the installer, rather than going through Whitbread's maintenance team. This has meant that Whitbread were unaware of many of the issues until this project highlighted them. The issue for the hotel is the time is takes for Whitbread's Maintenance team to resolve the issue. Whitbread now understand that this is an issue and are looking for suitable solutions.

Ensure that the energy monitoring incorporates notifications when energy use is outside the range.

The extensive energy monitoring for this project has highlighted where equipment has not been operating as intended, for example when the ground source heat pump stopped working. There is a mechanism as part of the Stark online energy monitoring which should highlight when readings are out of range, but this has not been fully implemented. It is clear from the Burgess Hill monitoring that this should be implemented.

Introduce a more efficient flame grill

As part of the project, the energy use has been extensively analysed. This has produced some interesting results which are triggering discussions within Whitbread. In particular the gas use from the flame grill has been much higher than previously thought. The flame grill at Burgess Hill is a particularly efficient model but a newer more efficient model has been found and this is currently being trialled.

Better Whitbread specific benchmarks.

A comparison of energy use at Burgess Hill with other similar hotels has shown a reduction in energy use, although not as low as hoped. It is clear, from this project, that the building regulations model for this type of building does not reflect the actual energy use. There would be a further project to look at the whole of Whitbread's estate and sub-meters to look at carbon dioxide emissions with a view to producing benchmarks. It is clear from other projects that different hotel brands can have quite different strategies and therefore energy use, so there would be benefit to producing a benchmark specifically for Whitbread.

8.2 Conclusions and key findings for this section

- Increase commissioning time
- Introduce soft landings or similar programme in order to ensure that all relevant parties are engaged in the project from the earliest opportunity.
- Ensure that all suppliers of M&E equipment have a contract in place to ensure commissioning and maintenance of the equipment is place for at least 2 years post occupancy
- Engage the occupiers at the earliest opportunity to ensure their needs are being met and they are aware of the parameters of the building
- Maintenance Issues – future resolution
- Ensure that the energy monitoring incorporates notifications when energy use is outside the range.
- Introduce a more efficient flame grill
- Better Whitbread specific benchmarks.

9 Wider lessons

TSB Guidance on Section Requirements:	This section should summarise the wider lessons for the industry, clients/developers, building operators/managers and the supply chain. These lessons need to be disseminated through trade bodies, professional Institutions, representation on standards bodies, best practice clubs etc. As well as recommendations on what should be done, this section should also reveal what not to do on similar projects. As far as possible these lessons should be put in layman's terms to ensure effective communication with a broad industry audience.

9.1 Wider Lessons from Burgess Hill

Keep it simple

It is clear from the Burgess Hill project, that the complexity of the services and the general complexity of the project was a key factor in the issues which the project has encountered. Simple services strategy along with a simple, effective design is more likely to work effectively and offer genuine energy savings.

Simple building operation (complex BMS is pointless for a hotel)

Hotels are run by non-technical hotel managers who do not understand the complexities of a BMS system. The controls either need to be very simple, or controlled centrally by Whitbread. Whilst central controls offers an option, having to phone head office when the hotel is too hot or cold may not be a practical solution.

Ensure that a design team member is responsible for commissioning and ensuring that installed equipment operates together.

Whilst it was a clearly defined requirement in the Burgess Hill specification, this was not enforced. For complex projects it may be worth considering a specialist commissioning agent who will manage the process from concept design through to seasonal commissioning and evaluate how systems can work together. It should also be ensured that there is one design engineer responsible for the design of the systems to ensure that they are compatible with each other.

Ensure adequate commissioning time

It is common that commissioning is not fully considered as part of the construction process. For this project, the initial commissioning schedule was at least 2 weeks, however, due to late running on the construction, only 2 days were allowed for commissioning. This is not adequate time to commission any building, let alone such a complex building.

Post occupancy evaluation

The post occupancy evaluation for Burgess Hill has highlighted many important lessons which Whitbread have taken forward. In particular the analysis has highlighted when equipment hasn't been working (such as when the backup boilers fired unexpectedly). The analysis has also shown the split in energy use which wasn't previously fully evaluated.

Fabric first approach

For a hotel, ensuring good fabric means that services can be simpler and energy use is reduced with little technical input. In addition, fabric has a longer life than services.

Understanding your energy use may reveal that energy use is not where you think it is (e.g char grill)

As discussed above under the post occupancy evaluation, fully evaluating the energy use has highlighted where savings can be made and has offered some innovative solutions. Without this analysis, the high energy use from the Char Grill would not have been fully understood and no further action would have been taken.

Ensure that there are clear targets for both design and in-use

Clearly defining targets to design teams focuses their work to ensure that targets are met. In particular, whilst design targets can be useful, there is a clear gap between predicted energy use and actual energy use. This project has highlighted that even with good design, the prediction model may not fully reflect in-use energy.

Ensure that designers understand the brief and seek further consultancy where appropriate (e.g. air tightness details)

It is clear from this project that whilst all of the designers were experienced, they did not fully understand the brief and did not seek help in areas that they had no previous experience. Whilst it is easier to ensure a one stop shop, training up your preferred consultant can meet your design expectations whilst also meeting the energy efficiency expectations.