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Energy Report

Air Conditioning Inspection
For ACME School

This additional energy report is associated to the Air Conditioning Energy Certificate for ACME School , BH17 8LW. This report is not proof of compliance, compliance is only achieved when the associated certificate is available on the Government Register at https://find-energy-certificate.digital.communities.gov.uk

Prepared for

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Key Findings

Top 3 recommendations based on potential annual savings

Type	No.	Recommendation	Systems	Annual Saving *
Controls Action	1	The system controllers should have time schedules set to ensure the system does not operate outside of main occupancy hours.	All Systems	£1,058.44
Controls Action	2	Consideration should be given to setting up 'off' only timers on the system controllers, so the systems isolate at various ...	All Systems	£1,058.44
Controls Action	3	It is recommended that seasonal set-points are introduced to maximize system efficiency.	All Systems	£1,058.44

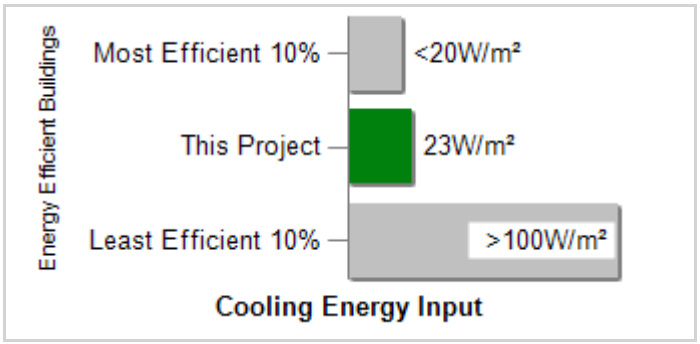
* Assumes £0.12 per kWh and operational times as detailed in Table 2 of the report

Building Performance

Total building Conditioned Area = **750m²**

Installed Cooling Capacity = **77.1kW**

Cooling Electrical Input = **17.6kW**



The above figures are based on the average estimated energy consumption across 4000 inspected buildings carried out using the ACE Wizard Software since 2012. The figures do not include the kW consumption from installed chilled water pumps, chilled water fan coil units, mechanical ventilation systems, remote condenser fans, cooling tower fans or system redundancy. This figure should be used as a guide only and may not reflect the accurate W/m² of the inspected facility.

Estimated total Operational Cost = **£2,279.74 per annum** *
Total estimated kWhs per week = **679.0kWhs** *
Total Building Refrigerant Charge = **18.55Kg**
Total System GWP (Global Warming Potential) Equivalent to **35 Tonnes CO2**

Building Average System Energy Rating

Air Conditioning Systems — **EER 3.3 = A**

Air Cooled Chillers — **N/A**

Water Cooled Chillers — **N/A**

Remote Condenser Chillers — **N/A**

Recommendations...

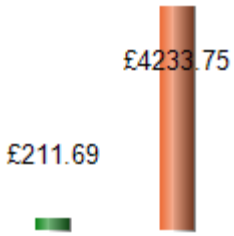
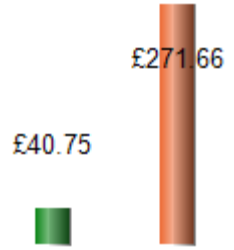
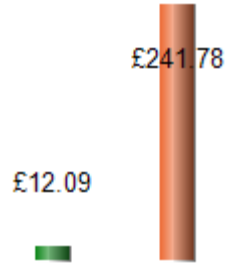
A summary of the key recommendations is made below with the estimated impact on operational costs.

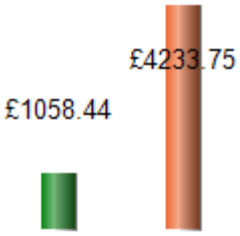
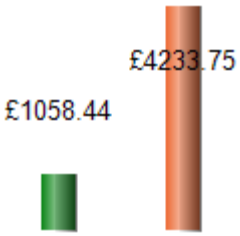
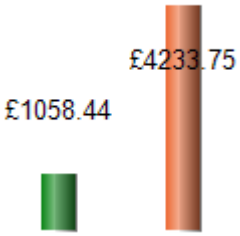
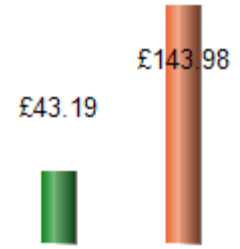
The consumption figures are provided as a guide only and no equipment has been metered by the inspector. To correctly analyze actual consumption data the client should sub-meter and monitor the individual items of plant.

Using manufacturer data, the total operational costs for all the systems on this site has been estimated to be **£2,279.74 per annum**. This figure is not definitive as it is affected by many conditions such as maintenance issues and temperature set points. It is therefore the case, that while certain recommendations such as the upgrading of inefficient systems will decrease this figure. Many of the recommendations will not result in a reduction from this figure but will prevent an increase in the annual operational costs over and above this figure. It is also the case that the estimated projected impact costs are applicable to the individual recommendation only and are not accumulative.

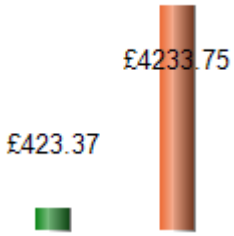
All calculations have been based on an average of £0.12 per kWh and assumes that systems are left to be operational for 52 weeks per annum during occupancy hours only and are not manually isolated during this time. It should be noted that energy calculations have been made using systems operating in cooling mode, this figure is usually marginally but not significantly, different when heat pump systems operate in heating mode.

A more detailed explanation of the operating parameters and calculations used to estimate the consumption costs of the equipment can be found in section 3.

Action	Efficiency Improvements	Estimated Impact on Operation (%)	Applicable Systems	Potential Impact on Costs (per annum)
1	Consider sub-metering the individual items of HVAC plant on site and then record the energy consumption figures to enable areas of excessive consumption to be identified.	 5 %	All Systems	
Action	**System Maintenance**	**Estimated Impact on Operation (%)**	**Applicable Systems**	**Potential Impact on Costs (per annum)**
1 **(Priority Rec)**	The filters on the terminal unit were clogged and should be inspected and cleaned by the refrigeration contractor at the earliest opportunity to ensure the most efficient operation of the system.	 15 %	AC02	
2	The gap between the rear condenser coils and the rear wall was minimal and appeared insufficient for airflow. This is likely to affect system efficiency and will also restrict access for maintenance/cleaning purposes. It is recommended, if possible, the condenser/s is re-installed with a gap of at least 30cm to the rear of the unit.	 5 %	AC03, AC04	

Action	Controls Action	Estimated Impact on Operation (%)	Applicable Systems	Potential Impact on Costs (per annum)
1	The system controllers should have time schedules set to ensure the system does not operate outside of main occupancy hours.	 25 %	All Systems	
2	Consideration should be given to setting up 'off' only timers on the system controllers so the systems isolate at various times during the day and do not automatically start without manual activation by occupants within the area.	 25 %	All Systems	
3	It is recommended that seasonal set-points are introduced to maximise system efficiency.	 25 %	All Systems	
4 **(Priority Rec)**	Consider increasing the server room set point from 16°C to, if possible, 23°C. This may be done in small increments to ensure equipment stability.	 30 %	AC08	
5	The controller within a number of inspected areas could not be located during the inspection. The controller should be replaced/returned at the earliest opportunity to allow full & efficient control of the system to resume.	 0 %	N/A	£0.00

Action	Management Action	Estimated Impact on Operation (%)	Applicable Systems	Potential Impact on Costs (per annum)
1	REHVA, the Federation of European Heating, Ventilation and Air Conditioning Associations, has produced interim guidance on the operation and use of building services in areas with a coronavirus disease (Covid-19) outbreak. The general advice is to supply as much outside air as possible into a building. Operators should be aware that virus particles in extract air can re-enter the building. Heat-recovery devices may carry over the virus attached to particles from the exhaust airside to the supply airside via leaks. In rotary heat exchangers (including enthalpy wheels) particles deposit on the return airside of the heat exchanger surface, after which they might be resuspended when the heat exchanger turns to the supply airside. Based on current evidence, REHVA therefore recommends turning off heat recovery sections during SARS-CoV-2 episodes. The full details of the REHVA guidance can be found on the web page https://www.rehva.eu/activities/covid-19-guidance	0 %	N/A	£0.00
2	An F-Gas Log Book should be compiled by the client and should include the refrigerant data of all of the applicable systems. This legal document should be held on-site & kept up to date.	 0 %	N/A	£0.00
3	The client should be aware of the EU HFC (Hydrofluorocarbons) "Phase Down" particularly when considering future installations and system replacements. The client should when possible opt for systems which contain refrigerants with low GWPs (Global Warming Potential) such as R32 (GWP = 675 kgCO2e). One immediate consequence of the "Phase Down" has been that prices of the refrigerants with high GWPs such as R407C and R410A have already increased substantially making repairs more costly.	 0 %	N/A	£0.00

4	Consider placing notices alongside the local system controllers to advise occupants on the method of control for efficient operation of the AC system.	 10 %	All Systems	

Executive Summary

The following report has been prepared to discuss the findings of an air conditioning system inspection commissioned by ACME Industries on a property for which they own/occupy.

Building and Occupancy

The detached brick building comprises a single storey. The building has double glazed windows that occupy approximately 50% of the perimeter wall.

The main activities within the building relate to desk-based learning and office duties.

Based upon some basic site measurements, the building comprises a net internal conditioned area of approximately 750m².

The building occupancy is for approximately 55 hours per week and the maximum number of occupants expected within the conditioned areas is in the region of 195 persons.

Documentation and Maintenance Regime

Time was taken prior and during the inspection to review the supplied documentation pertaining to the air conditioning; Planned Preventative Maintenance (PPM) paperwork, an F-Gas Log Book and an asset list was available for inspection and is held on-site.

The air conditioning equipment is maintained by an external refrigeration contractor, who carry out 1 maintenance visits per annum.

The PPM schedules are in line with industry guidelines and the client is commended for ensuring this is regularly carried out.

Sampling Statement

During the assessment 3 cooling plants were selected for a more detailed inspection in-line with a sampling approach outlined in the CIBSE TM44 guidelines:

The areas, controls, and several linked terminal units that these cooling plants serve were also inspected.

The following sampling methodology was applied as outlined in the CIBSE TM44:

- Packaged systems (including DX splits, multi splits and VRF/Vs) – A representative sample of the systems to include a minimum of 10% of the total number of packaged units with a minimum of 3 units and an equal number of terminal units. With at least one of each different make of system.

The following sub systems were inspected in accordance with DCLG guidance to produce this report:

VOL001 SYS001: 1 of 1 Sanyo Single Split System Serving Soft Play

VOL001 SYS002: 1 of 1 Fujitsu Single Split System Serving Meeting Room

VOL001 SYS003: 1 of 1 LG Single Split System Serving IT Room

Summary of Findings

The following systems were noted as being installed:

1 Fujitsu Single Split System

11 LG Single Split Systems

1 Sanyo Single Split System

The 13 external condensing units are located along the perimeter wall.

There is no mechanical ventilation and no heat recovery in operation within the conditioned areas of this building.

The types of refrigerant used in the air conditioning systems include: R32 (1 system, 2.70kg) and R410A (12 systems, 15.85kg). Under current legislation, 1 of the system require an annual F-Gas/ODS Logbook as the refrigerant charges within these systems has an equivalent CO2 GWP (Global Warming Potential) of between 5 to 50 tonnes. 12 of the systems do not require an F-Gas/ODS Logbook but it is best practise to maintain a voluntary F-Gas/ODS Logbook. The total GWP of the refrigerant within the air conditioning systems is equivalent to 35 tonnes of CO2.

The combined cooling duty supplied by the air conditioning is 77.1kW. Based on the conditioned area of 750m², this equates to an average cooling load density of 102.8W/m². Based on observations made during the inspection it is thought that 100W/m² would be an appropriate average cooling load density for the air-conditioned areas of this building.

The total amount of comfort cooling installed is therefore likely to be correctly sized.

Within individual areas, there are fixed speed systems which appear to be oversized for the areas they serve, such as those systems which serve the Reception , and this has been tabulated within Table 7 – Calculated Room/System Cooling Load within the 'Advanced Energy Report'. The client should pay particular attention to oversized fixed speed systems which are operating for long periods of time as these are more likely to give the fastest ROI.

It should be noted that the general scope of this inspection does not include a detailed building cooling load profile and this would need to be carried out before making any judgement on the sizing suitability of the air conditioning plant.

At full power the installed air conditioning has a combined electrical rated input power of 23.6kW, however when this is reduced to reflect part loading capabilities, it is estimated that the air conditioning would have an average power input of 17.6kW which equates to 23.5W/m² of conditioned space. This figure is not expected to reflect energy usage but is intended to help the client with a benchmark to compare with other facilities.

Packaged DX and Split Systems Efficiencies: As previously mentioned, the combined amount of cooling duty supplied by the split and packaged DX systems is 77.1kW. Based on manufacturer's data the total amount of electrical power consumed by all of these systems at full load is 23.6kW which translates to an average building EER of 3.3 this translates to an average system energy label "A" which shows that overall the systems have very good energy ratings.

There is 1 system which is considered to have a poor EER (Energy Label "D" or lower).

There are also 1 system which are not installed with inverter technology to modulate power in accordance with demand.

When considering any future installations or upgrades it is recommended the client ensures that more efficient inverter driven systems are procured and the EER rating and the ESEER (European Seasonal Energy Efficiency) rating of the systems is closely considered.

Packaged DX and Split Systems – Maintenance: As part of the inspection the maintenance standard and operating temperatures of the inspected packaged/split systems was assessed: Details regarding the maintenance standard and actual recorded temperatures of the inspected systems can be found within the relevant CP (Cooling Plant) and TU (Terminal Unit) sections within this report and where applicable recommendations to improve any observed issues or defects will be noted within the main "Recommendations" section.

System Controls

The systems are controlled by wall mounted controllers located adjacent to the units that they serve; they are not linked to a central controller or BMS (Building Management System). The local controllers did not appear to have been prohibited / restricted in any way.

As these systems are generally smaller split systems a full BMS may not be financially viable, however the client should consider investigating some of the smart AC controllers which are now coming onto the market, many of which can link to a PC, tablet or mobile phone.

It is recommended that suitable operating schedules are programmed. Ensuring systems are not operating when areas are vacant is often the single biggest energy saving that can be made, and this could offer an immediate ROI.

In relation to the above, where possible all local controllers should be set up with an "off only" timer so

that systems do not automatically start without manual activation by the occupants within the area. Off timers could be programmed in to deactivate the systems for 2 or 3 times during the day, such as 08:00, 12:00 and 15:00. Adopting this approach to staff comfort could considerably reduce the operational costs of the systems and should seriously be considered.

The temperature set points on individual unit controllers were set to maintain a space temperature of 18°C to 21°C. These set points are not ideal from an energy management perspective, the adjustment of internal temperatures are one of the easiest ways to make fast energy savings, with between 3% - 4% savings possible from each degree of adjustment, and the client be aware of the seasonal set point strategy outlined below.

Seasonal set point strategy - The winter set points should be between 19°C and 20°C with the unit set to heating only mode. Summer set points should be 23°C to 24°C with the unit set to operate in cooling only mode. Due to the fluctuating external conditions during spring/autumn, systems should be set to operate in auto mode with set points of 21°C - 22°C. From previous studies it is estimated that a saving of 4% on annual system running costs can be achieved for every 1°C increase in cooling set point temperature.

It is also recommended that notices are put in place to advise staff members of the recommended temperature set points and as a reminder to switch off the air conditioning systems before turning on the heating, opening windows or before the area becomes unoccupied.

The room temperature sensors are positioned in the internal units and these appeared to be adequately positioned to reflect an average room temperature in each of the inspected areas.

The savings that could be made by utilizing the cooling provided from natural ventilation before activating the mechanical cooling systems should also be considered. The air conditioning could always be reactivated if the internal space temperature cannot be maintained; however, it should be ensured that the windows are closed before this occurs.

There is no sub-metering of the main condensers and it is recommended that the client investigates the usefulness of sub-metering the main HVAC Plant. Typically metering can identify savings of up to 10% in some applications and so could prove economic.

1 Tables & Calculations

1.1 External Plant Asset Register

Asset ID	Unit Location	Area Served	Manufacturer /Model	System Type	Refrigerant		*Rated Output	*Age	General Condition
					Type	*Charge (kg) (GWP Equivalent CO2 Tonnes)	(kW)		
AC01	Perimeter Wall	Soft Play	Sanyo SAP-CRV186EH	Single Split	R410A	1.30 (2.7144)	5.2	2008	Reasonable
AC02	Perimeter Wall	Meeting Room	Fujitsu AOYG54KBTB	Single Split	R32	2.70 (1.8225)	13.4	2019	Good
AC03	Perimeter Wall	Classroom 08	LG AM12BP	Single Split	R410A	0.95 (1.9836)	3.5	1010	Reasonable
AC04	Perimeter Wall	Classroom 07	LG P18EN.UL2	Single Split	R410A	1.20 (2.5056)	5.0	2010	Reasonable
AC05	Perimeter Wall	Classroom 06	LG P18EN.UL2	Single Split	R410A	1.20 (2.5056)	5.0	2010	Reasonable
AC06	Perimeter Wall	Classroom 05	LG P18EN.UL2	Single Split	R410A	1.20 (2.5056)	5.0	2010	Reasonable
AC07	Perimeter Wall	Unkown indoor	LG P18EN.UL2	Single Split	R410A	1.20 (2.5056)	5.0	2010	Reasonable
AC08	Perimeter Wall	IT Room	LG P18EN.UL2	Single Split	R410A	1.20 (2.5056)	5.0	2010	Reasonable
AC09	Perimeter Wall	Classroom 04	LG P18EN.UL2	Single Split	R410A	1.20 (2.5056)	5.0	2010	Reasonable
AC10	Perimeter Wall	Classroom 03	LG P18EN.UL2	Single Split	R410A	1.20 (2.5056)	5.0	2010	Reasonable
AC11	Perimeter Wall	Classroom 02	LG P18EN.UL2	Single Split	R410A	1.20 (2.5056)	5.0	2010	Reasonable
AC12	Perimeter Wall	Classroom 01	LG P18EN.UL2	Single Split	R410A	1.20 (2.5056)	5.0	2010	Reasonable
AC13	Perimeter Wall	Reception	LG S36AHP	Single Split	R410A	2.80 (5.8464)	10.0	2010	Reasonable
					Total Cooling:	**18.55**	**77.10**		

Table 1 – Asset Register

* Where exact manufacturers data was not available, expected values have been based on similar system data.

1.2 Equipment Energy Usage

System	Manufacturer /Model	Time Zone	Period of Operation*		Electrical Costs Per kWh	kWhs Per Week **	Operation Costs	
			Hours Per Week	Weeks Per Year			Weekly (£)	Annual (£)
AC01	Sanyo SAP-CRV186EH	Comfort Cooling	55.0	28	£0.120	40.4	£4.85	£135.83
AC02	Fujitsu AOYG54KBTB	Comfort Cooling	55.0	28	£0.120	80.9	£9.70	£271.66
AC03	LG AM12BP	Comfort Cooling	55.0	28	£0.120	29.1	£3.49	£97.80
AC04	LG P18EN.UL2	Comfort Cooling	55.0	28	£0.120	42.9	£5.14	£143.98
AC05	LG P18EN.UL2	Comfort Cooling	55.0	28	£0.120	42.9	£5.14	£143.98
AC06	LG P18EN.UL2	Comfort Cooling	55.0	28	£0.120	42.9	£5.14	£143.98
AC07	LG P18EN.UL2	Comfort Cooling	55.0	28	£0.120	42.9	£5.14	£143.98
AC08	LG P18EN.UL2	Comfort Cooling	55.0	28	£0.120	42.9	£5.14	£143.98
AC09	LG P18EN.UL2	Comfort Cooling	55.0	28	£0.120	42.9	£5.14	£143.98
AC10	LG P18EN.UL2	Comfort Cooling	55.0	28	£0.120	42.9	£5.14	£143.98
AC11	LG P18EN.UL2	Comfort Cooling	55.0	28	£0.120	42.9	£5.14	£143.98
AC12	LG P18EN.UL2	Comfort Cooling	55.0	28	£0.120	42.9	£5.14	£143.98
AC13	LG S36AHP	Comfort Cooling	55.0	28	£0.120	142.5	£17.09	£478.63
					Comfort Cooling Operating Costs:	679.0	£81.39	£2,279.74
						679.0	**£81.39**	**£2,279.74**

Table 2 – Estimated System Operating Costs

* The calculated figures assume that systems operate for 70% of occupancy time to achieve internal set temperatures (Excluding water chillers and mechanical ventilation systems).

** DX/Split systems with part load capabilities have had a 30% reduction to input power applied to reflect modulation.

A more detailed explanation of the operating parameters and calculations used to estimate the consumption costs of the equipment can be found in section 3.

The above table represents the estimated weekly energy consumption for this site.

The 'Expected Weekly Consumption' (Column 3) is based upon UK industry expectations. Using an average seasonal external temperature, heat pump air conditioning systems usually operate for approximately 70% of the time to achieve internal set temperatures of 22°C. Based on the above operational hours and assuming an average of 0.12p per kWh, the systems on this site consume **679.0kWh** per week which equates to **£81.39** per week.

It should be noted that an adjustment in set temperature of 1k will change the expected weekly consumption figure by around +/- 4%, by adjusting the temperature set points by 2°C this site could potentially make annual fiscal savings of **£182.38** per annum.

The client is reminded that the consumption figures are provided as a guide only and no equipment has been metered by the inspector. To correctly analyze actual consumption data the client is advised to install sub-meters to the equipment and record the data.

A more detailed explanation of the operating parameters and calculations used to estimate the

consumption costs of the equipment can be found in section 3.

Manufacturer /Model	Number of Systems	Manufacturers Rated Input *(kW)	Total Rated Input (kW)	Energy Efficiency Ratio	Energy Label Class	Inverters Y/N
Fujitsu AOYG54KBTB	1	3.0	3.0	**4.5**	**A**	Yes
LG AM12BP	1	1.1	1.1	**3.2**	**A**	Yes
LG P18EN.UL2	9	1.6	14.3	**3.1**	**B**	Yes
LG S36AHP	1	3.7	3.7	**2.7**	**D**	No
Sanyo SAP-CRV186EH	1	1.5	1.5	**3.5**	**A**	Yes
Total:	**13**		**23.6**			

Table 3 – Plant Energy Usage

* Where exact manufacturers data was not available, expected values have been based on similar system data.

When systems are operating at full power the total kW input of the air conditioning refrigeration systems at this building is **23.59kW**. As there is an expected average 30% reduction in energy usage for systems which are installed with inverters or can operate at part load, a more realistic input for the installed systems is **17.62kW**, this figure will be used as the base for the energy calculations throughout this report.

The Energy Efficiency Ratio (EER) is calculated on the amount of energy input required to produce the stated cooling kW output of each unit. The higher the EER number, the more efficient the unit is deemed to be. It should be noted that the EER is not constant and will vary depending on external and internal temperatures, air flow restrictions including filter and coil conditions and many other factors.

With ever increasing pressure to reduce energy consumption the refrigeration manufacturing sector has made some very positive advances in improving the overall system Energy Efficiency Ratio (EER), reducing the energy input required to produce a similar level of cooling. With inverter technology enabling systems to operate at part load it is not unusual to find systems with an EER of up to and over 5. The table below has been included to demonstrate energy label classification compared to EER.

Energy Label Class	Split and Multi-Split Appliances
EER > 3.2	A
3.0 < EER ≤ 3.2	B
2.8 < EER ≤ 3.0	C
2.6 < EER ≤ 2.8	D
2.4 < EER ≤ 2.6	E
2.2 < EER ≤ 2.4	F
EER < 2.2	G

Table 4 – Energy Label Air Conditioning Classification (Cooling Mode)

1.3 Building Occupancy

Time Zone	Weekly Occupancy/ Trading Hours	Weekly Plant Set Hours	Total Plant Energy Consumption (kW)*	Expected Weekly Consumption (kWh)	Surplus Weekly Operational Hours	Surplus Weekly Energy Consumption (kWh)
Comfort Cooling	55.0	40.0	17.62	678.5	-15.0	-185.0

Table 5 - Surplus Time Schedule Costs

* Systems with part load capabilities have had a reduction applied to reflect modulation.

** A more detailed explanation of the operating parameters and calculations used to estimate the consumption costs of the equipment can be found in section 3.

The table above compares the occupancy hours with the plant time schedules which were observed at the controllers during the inspection. If plant timers have not been set up or are not in line with occupancy hours then this should be rectified. Significant fiscal and energy savings can often be realized by this simple operation.

During the HarmonAC field trials it was concluded that setting timers correctly was the single biggest energy conservation opportunity (ECO) that could be made by companies. It was also found that in more than 10% of trials systems were found to be operational outside of occupancy hours when manual isolation was common practice.

It is also strongly advised that all clocks on controllers are checked to ensure they display the correct time and date and they are seasonally adjusted. By neglecting to change clocks from summer to winter time will result in systems operating when areas are unoccupied. Based on an 8 hour working day this is an additional 12.5% of unrequired operation per day.

The table represents the estimated weekly energy consumption for this site.

The final column shows the potential additional weekly wastage when usual occupancy hours are compared to plant timer settings and although may not reflect actual usage, highlights the importance of ensuring that where possible all timers are set to reflect occupancy hours. By implementing correct time schedules this site could potentially save **-185.0 kWh** per week which equates to **£0.00 per annum**

1.4 Size Comparison

The following table shows that the average cooling load density across all air conditioned areas of this building is **103 W/m2** and the average energy consumption to operate this equipment is **23 W/m2**.

Total Cooled Area * (m2)	Total Cooling Capacity (kW)	Cooling Load Density (W/m2)	Total Cooling Electrical Input (kW)	Cooling Energy Input (W/m2)
750	77.1	103	17.6	23

Table 6 – Total Site Cooling Density and Energy Input Density

*Where detailed measurements were not supplied, conditioned area has been based on basic onsite measurements.

During the inspection the kW output of a number of systems was compared to the areas they operate in, the following tables shows the inspection results:

Area Served	Asset ID	Conditioned Floor Area (m2)*	Estimated Required Cooling Load (W/m2)**	Actual Cooling Load (W/m2)	Estimated Required Cooling Capacity (kW)	Actual Cooling Capacity (kW)	Comment	Variance (%)	Partial Loading Capability
Soft Play	AC01	25	130	**208**	**3.3**	**5.2**	**Oversized**	**58%**	**Yes**
Meeting Room	AC02	115	120	**117**	**13.8**	**13.4**	**Correctly Sized**	**-3%**	**Yes**
Classroom 08	AC03	55	90	**64**	**5.0**	**3.5**	**Undersized**	**-30%**	**Yes**
Classroom 07	AC04	55	90	**91**	**5.0**	**5.0**	**Correctly Sized**	**0%**	**Yes**
Classroom 06	AC05	55	90	**91**	**5.0**	**5.0**	**Correctly Sized**	**0%**	**Yes**
Classroom 05	AC06	55	90	**91**	**5.0**	**5.0**	**Correctly Sized**	**0%**	**Yes**
Unkown indoor	AC07	55	90	**91**	**5.0**	**5.0**	**Correctly Sized**	**0%**	**Yes**
IT Room	AC08	55	90	**91**	**5.0**	**5.0**	**Correctly Sized**	**0%**	**Yes**
Classroom 04	AC09	55	90	**91**	**5.0**	**5.0**	**Correctly Sized**	**0%**	**Yes**
Classroom 03	AC10	55	90	**91**	**5.0**	**5.0**	**Correctly Sized**	**0%**	**Yes**
Classroom 02	AC11	55	90	**91**	**5.0**	**5.0**	**Correctly Sized**	**0%**	**Yes**
Classroom 01	AC12	55	90	**91**	**5.0**	**5.0**	**Correctly Sized**	**0%**	**Yes**
Reception	AC13	60	120	**167**	**7.2**	**10.0**	**Oversized**	**39%**	**No**

Table 7 – Calculated Room/System Cooling Loads

*This is an estimate based upon measurements taken on site.
**Estimated sizing requirement has been based on the BSRIA rule of thumb for cooling load densities (W/m²) (See Table Below) However adjustments may have been made where high occupant densities or excessive heat loads / heat gains are thought to be factors.

It should be noted that estimated cooling loads are based on a 'rule of thumb' and may not reflect the actual cooling load. It is normally acceptable for a margin of error of ±20% as per the latest guidelines from CIBSE.

Systems which are installed with a partial loading capability will modulate power in accordance with demand, this will help to negate oversizing in areas where they are installed.

As can be seen from the above table, that systems AC13 are not fitted with inverters, this will result in full power operation when cooling/heating is required.

Equipment	BSRIA's Rule of Thumb Sizing (Wm^2)
Offices General	100 - 160
Offices Internal	70
Retail Establishments	140
Banks	160
Hotels	150
Restaurants	200
Residential Buildings	70

Table 8 – 5th Edition BSRIA's Rule of Thumb – Cooling Load Densities

1.5 Maintenance Regime

The information below highlights that the installed equipment is being maintained as regularly as recommended good practice guidelines.

Equipment	Expected Frequency (Months)	Actual Frequency (Months)	Maintenance Standard
Internal Filters	6	6	1
Internal Units Other	6	6	1
External Units Coils	6	6	1
External Units	6	6	1
External Pipe Insulation	6	6	1

Table 9 –Current Maintenance Regime

The general maintenance standard of the inspected equipment has been graded 1 to 4, where 1 is very good and 4 is very poor. As the maintenance of the systems is generally of a very good standard it should not be necessary to increase the frequency of the PPM.

By ensuring that filters are free of dust can greatly increase the efficiency of air conditioning systems. During the HarmonAC field trials it was found that when it was deemed visually necessary to clean a condenser by brushing or blowing out, the efficiency was reduced by an average of 3.9%. It was also recorded that dusty filters which produced a 7.5% loss in air flow resulted in a 21.5% decrease in efficiency.

It is not unusual to find external pipe insulation weathered and in a deteriorated state. Heat gains and heat losses due to poor insulation will affect the temperature of the refrigerant and therefore affect evaporation temperatures. It is always recommended that pipe insulation is regularly checked and repaired / replaced when necessary.

2 Site Photographs

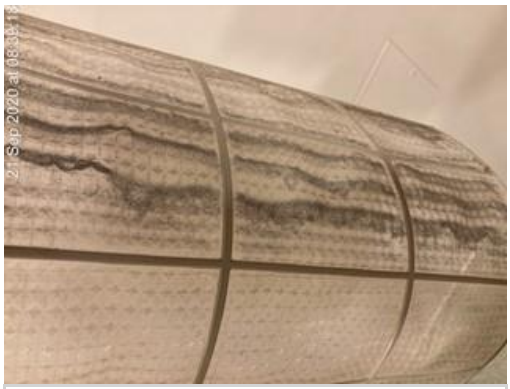


Figure 1 - AC01 Filter clean

Figure 2 - AC01 Coil clean

Figure 3 - AC02 Condenser coil clean

Figure 4 - AC02 Filter clean

Figure 5 - AC02 Controller

Figure 6 - AC08 Condenser coil clean

Figure 7 - AC08 Filter

3 ACE WIZARD Energy Calculations

The calculations made within the ACE Wizard software are based on rules of thumb only and no equipment has been metered during the inspection.

Although every effort has been made to ensure that where possible, the calculations are in line with industry standards so as operational costs and savings can be realistically represented. It should be noted that the calculations are intended to be "ball park" figures only and are not intended to replace a detailed examination of actual operational costs. In all cases it is always strongly advised that metering of equipment is put in place so as building owners are aware of the costs to operate their systems.

Equipment consumption has been based on the manufacturer's operating data, where this data is not available specifications from similar system types and sizes may have been used. Manufacturer's data itself is based on systems operating at specified design parameters and include certain criteria such as benchmarked internal and external temperatures. No provision is made within the ACE Wizard for calculating the consumption of systems operating outside of the manufacturers specified design parameters. And no provision is made to reflect circumstances that would deviate from systems operating outside of design conditions such as the deterioration of components, fouling of coils and filters or loss of refrigerant (Unless stated). It is therefore the case that many systems, particularly older systems or systems in a poor state of repair may consume far more energy than has been stated and therefore greater savings than have been calculated may often be possible.

All Air conditioning units have been calculated as though they are operated for 52 weeks per year and are not manually isolated during the operational hours. This enables the costs for heating in the winter from heat pump systems as well as cooling in the summer months to be taken into account; it also means that process cooling systems such as server systems which require year round cooling can be calculated. If these figures are not reflective, ie the systems are used in summer only or they are manually isolated when rooms are vacant, then the client has the opportunity to make adjustments to this data and to tailor the usage of each system to help ascertain specific site costs. This facility is available on line at www.acewizard.co.uk and by logging in with the attributed user name and password.

Assuming an average seasonal temperature, air conditioning systems usually operate for approximately 70% of the time to achieve an internal space temperature of 22°C. This 70% reduction to the operational hours has been applied to all energy calculations within the reports, with the exception of chilled water systems. It has also not been applied to mechanical ventilations systems which have been calculated to operate for 100% of the set time.

It should also be noted that energy calculations for heat pump units which operate in heating mode have been made using input figures for cooling mode not the heating mode input figure. However these figures are not usually significantly different from each other and as such "ball park" figures are still represented.