AJ ENERGY CONSULTANTS LIMITED

[Property Name]

EPC Improvement Report

August 2012

CUTTING THE COST OF CARBON

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1 Issue Register

Revision	Reason for Issue	Date of Issue	Issued By
1.0	For internal comment	08/08/12	J Simpson CEng MCIBSE

2 Contents

3 Introduction

3.1 Purpose of Report

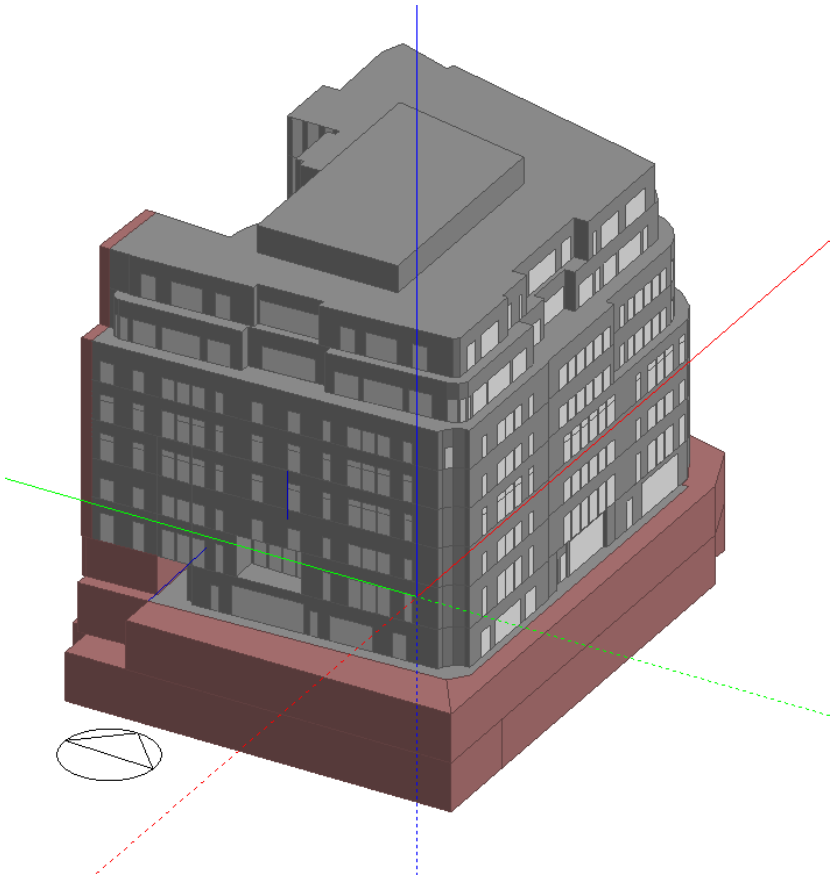
AJ Energy Consultants Ltd has been appointed by [Client] to undertake an EPC Improvement review at [Property Address].

An EPC was undertaken for the office building in January 2012. Since this time there have been minor changes to the EPC calculation software, and therefore this report initially reviews any impacts on the current EPC rating due to these changes.

The current EPC score for the office building is 142, which equates to an F rating. The Energy Act 2011 contains enabling legislation to make renting out a domestic or business premise which has less than a defined EPC rating unlawful, with an implementation dated of April 2018 in England and Wales. The EPC rating boundary has not been officially confirmed, but recent proposals that F and G rated premises would be targeted. It is therefore important to review improvement options for [Property Address] in order to mitigate any future risks.

3.2 Building Description

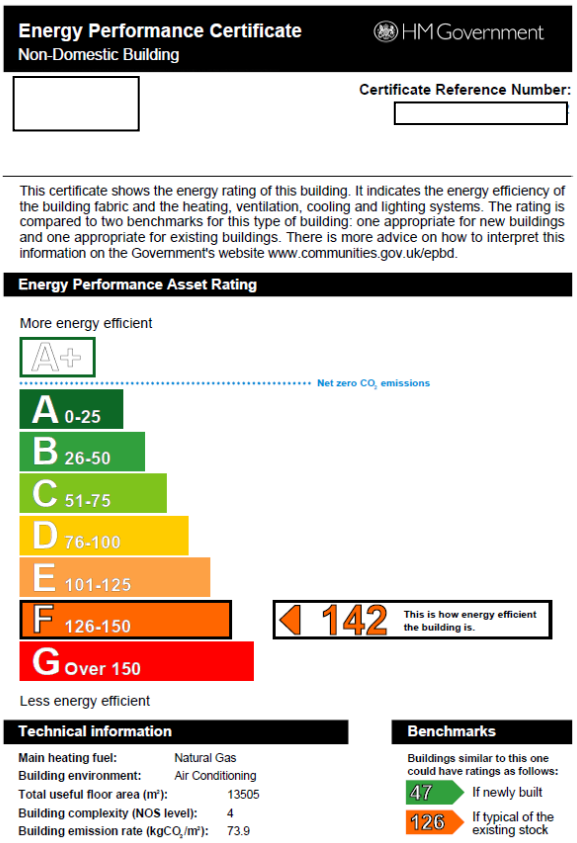
[Description of building and servicing strategy]



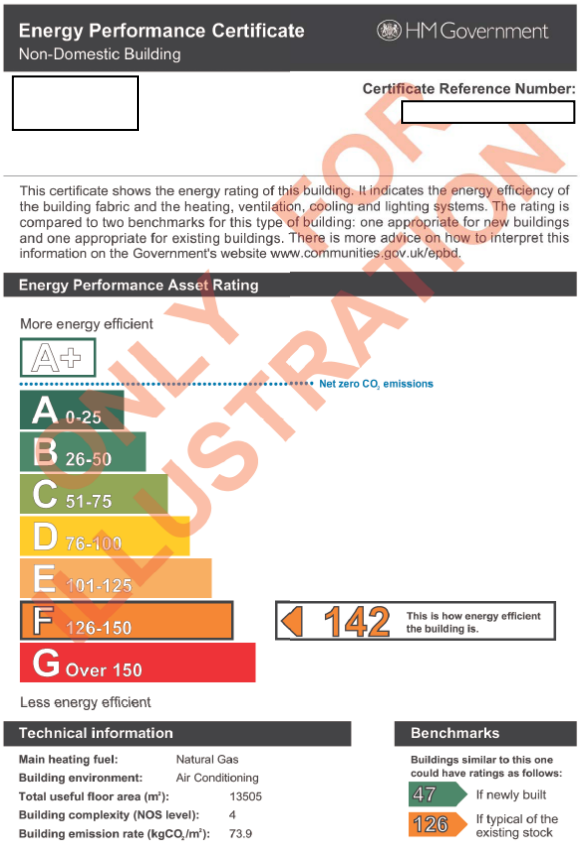
4 EPC Review

The current EPC was undertaken in January 2012 by AJ Energy, and achieved an EPC score of 142 which equates to an EPC rating F. This score is also within the higher half of the EPC band, and is closer to the F/G boundary than the E/F boundary.

The EPC was calculated using accredited DesignBuilder software, which at the time was v3.0.0.095 – the current version of the DesignBuilder software is v3.0.0.105, and this latest version of the software has been used to rerun the EPC. The current and rerun EPCs are shown in the table below, with the EPC score remaining at 142. This is due to the major changes to the software occurring in October 2010, prior to the completion of the original EPC, and the minor software changes since the survey not affecting the particular heating, ventilation and air conditioning systems installed within this building.



Existing building EPC



Recalculated building EPC using latest software

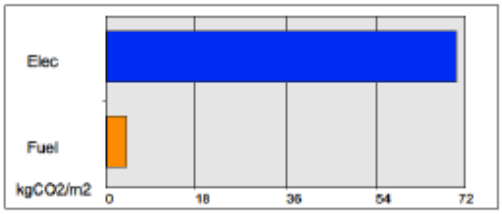
The EPC software provides a useful breakdown of the energy consumption in the following areas that is used to calculate the EPC rating:

- Heating

- Cooling
- Auxiliary (fans and pumps)
- Domestic hot water
- Lighting

The graphs below provide details of the annual energy consumption of each energy end-use, both as a kWh per metre square value and as a percentage of total energy consumption. Please note that the Equipment end-use is shown for information only, and is not included within the EPC rating calculation.

Building Energy Performance and CO2 emissions

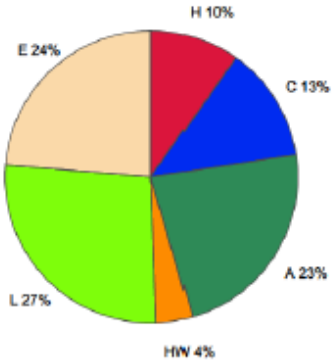


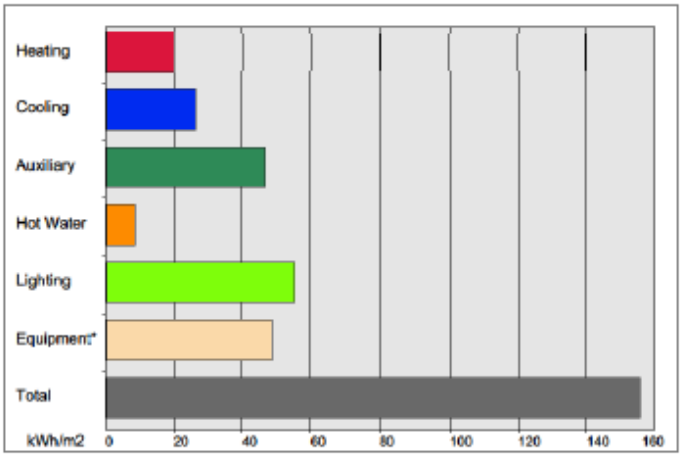
0 kgCO2/m2 displaced by the use of renewable sources.

Building area is 13505.1 m2

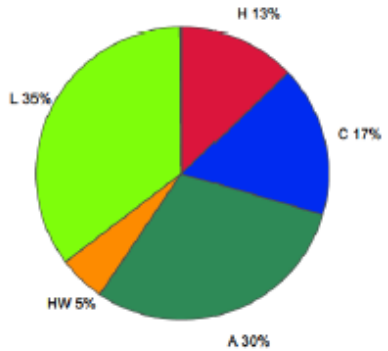
Annual Energy Consumption

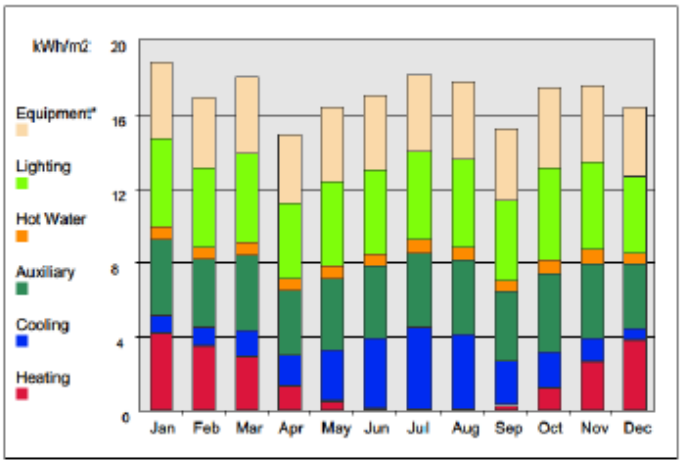
(Pie chart including Equipment end-use)





(Pie chart excluding Equipment end-use)





(*) Although energy consumption by equipment is shown in the graphs, the CO2 emissions associated with this end-use have not been taken into account when producing the rating.

This information is useful as it provides initial information on where to focus improvement works to improve the EPC rating. It should be noted that the EPC energy results are not directly related to the building's actual energy results – the EPC SBEM software is designed as a simple modelling tool, and

therefore over simplifies some of the complexities of real buildings. However, measures included to improve the EPC rating will also reduce energy consumption within the building.

From the energy information it is considered that heating, cooling, ventilation and lighting could all be reviewed and reduced.

5 EPC Improvements

5.1 Heating

Heating is provided by three gas-fired Viessmann Vertomat boilers, with fan coil units installed throughout the building. The boilers also serve air handling units at each floor, which provide fresh air to the building. There is currently no heat recovery on the air handling units even though the siting of the extract fan on top of the supply unit would have made this a simple inclusion at design stage.

Recommendation:

Install run-around-coil heat recovery systems on each air handling unit, in order to reclaim the heat from the exhausted air. This would significantly reduce the heating demand for the air handling units, and reduce heating demand overall. We have modelled the inclusion of a run-around-coil heat recovery system which could be installed within the existing air handling units.

This measure would improve the EPC rating from 142 (F) to 136 (F).

The efficiency of the run-around-coil is lower than that of plate heat exchangers or thermal wheels, but it is considered that the more efficient heat recovery systems would require the replacement of the existing air handling units with new systems. This would have a significantly higher capital cost, but would provide a greater annual energy reduction and EPC rating improvement, as well as enabling new high efficiency fans to be installed. The impact of installing new air handling units is discussed in Section 4.3 below, as there are a number of other important energy savings relating to auxiliary energy that would be relevant as well.

5.2 Comfort Cooling

Cooling is provided by three air cooled Carrier 30 GX 102 chillers, with fan coil units installed throughout the building. The chillers also serve the air handling units at each floor. The efficiency for the chillers is given by the manufacturer as 2.68 – this is the efficiency under factory testing for a new unit, and therefore the efficiency is likely to be lower than this for the installed chillers. This efficiency is significantly lower than the latest chillers, with the air cooled Airedale Deltachill Freecool chiller achieving an efficiency of 3.4, and a seasonal energy efficiency rating (SEER) of 4.8, for the same cooling output.

Recommendation:

Replace the existing air cooled chillers with high efficiency chillers with coefficient of performance of 3.4 and a SEER of 4.8.

This measure would improve the EPC rating from 142 (F) to 130 (F).

5.3 Ventilation

There are individual air handling units on each floor, providing mechanical supply and extract to the building. As discussed in the heating section above, no heat recovery has been installed on the units. It was also identified as part of the Air Conditioning Inspection that the specific fan power (which is the amount of energy required to move the air around the ventilation system) of some of the ventilation systems were significantly higher than current Building Regulations standards. It is considered that the replacement of the existing fan motors with new high efficiency motors could provide an improvement in the average SFP from 2.99 W/l/s to 2.40 W/l/s.

Recommendation:

Replace existing supply and extract fan motors with high efficiency motors (or direct drive motors if possible) to reduce average specific fan power from 2.99 W/l/s to 2.40 W/l/s.

This measure would improve the EPC rating from 142 (F) to 139 (F).

The existing air handling units can also be insulated to reduce the amount of air leakage from the units. This reduces the amount of energy required to heat and cool the air. Existing air handling units can be upgraded to achieve CEN Class L1 classification.

Recommendation:

Upgrade existing air handling unit housings to achieve CEN Class L1 classification to reduce the amount of air lost from the system.

This measure would improve the EPC rating from 142 (F) to 141 (F).

A more radical approach would be to replace all existing air handling units with new units with high efficiency plate heat exchangers for heat recovery, direct drive fans with inverter control, low pressure filters and air handling unit air tightness to CEN Class L1 classification. The low pressure filters and high efficiency fans reduce the energy consumption need to move the air around the building, with the plate heat exchangers and air tightness standards reducing the amount of energy required to heat and cool the air. The inverters are important to enable close commissioning of the system, as they allow the fans to be turned down to match the air volume requirements – this is very important as reducing the fan speed by 10% can result in a 20% reduction in energy consumption. A specific fan power of 2.5 W/l/s has been targeted due to the additional resistance created by the plate heat exchangers, and is in line with current Building Regulation standards.

Recommendation:

Replace existing air handling units with new air handling units with high efficiency plate heat exchangers, high efficiency inverter controlled fans and low pressure filters to achieve a specific fan power of 2.5 W/l/s, and with an air leakage standard of CEN Class L1.

This measure would improve the EPC rating from 142 (F) to 132 (F).

5.4 Domestic Hot Water

Domestic hot water is provided by point-of-use electric heaters. This is considered to be the most energy efficient means of delivering hot water for the building, as a central storage system heated by the boiler plant would require additional pumps. There would also be significant standing losses from any central calorifier, and therefore the current provision of point-of-use electric heaters provides the best solution.

We have also reviewed whether omitting/reducing the number of showers within the building would improve the EPC rating. This is usually the case where a centralised storage system is used, but the use of electric showers actually improves the EPC rating in this building, and therefore is not recommended.

5.5 Controls

A full Building Management System (BMS) is installed within the building, and this has also been included within the EPC model, with the maximum number of heating efficiency credits provided. The EPC rating could be improved by providing energy metering to the individual boiler, air handling unit and chiller plant, with alarms for out-of-range values.

Recommendation:

Install energy meters to each boiler, air handling unit and chiller, with alarms for out-of-range values to be monitored by the BMS, or separate BMS if not able to integrate into existing system.

This measure would improve the EPC rating from 142 (F) to 138 (F).

Additional improvements to the EPC could be made by installing a lighting BMS to provide monitoring and targeting of lighting systems, with out-of-range alarms to indicate when lights are left on out of work hours for example. It is not considered feasible to retro fit this around the existing lighting, but could be considered as part of any future refurbishment works.

Recommendation:

Install lighting BMS to providing monitoring and targeting of lighting systems, with alarms for out-of-range values. We would recommend that this is separate to the current BMS.

This measure would improve the EPC rating from 142 (F) to 139 (F).

5.6 Lighting

Lighting is generally provided to the office and circulation areas by fluorescent fittings. There is no information available from the manufacturers on the efficiency of the light fitting and the Light Output Ratio, and therefore the lighting system can only be entered as a default lamp type. For compact fluorescent fittings the lighting efficiency default is 22.5 lumens per circuit Watt – with a modern high efficiency lighting system it would be expected that the lighting efficiency would be approximately 60 lumens per circuit Watt.

One option is to undertake light level measurements within the building, and to use this information along with the lamp wattage to input the design watt and illuminance levels into the DesignBuilder model. This would need to be undertaken at night time to ensure that no natural daylight is affecting

the readings, as it is considered too disruptive to cover all windows. The impact on the EPC will depend on the survey results, but will need to be less than 6 W per 100 lux to improve the rating. It would be sensible to undertake an initial test survey on a typical area before instructing a full building survey.

Recommendation:

Undertake light level measurements within the building to use within the EPC model. In order to provide an improvement this would need to demonstrate lighting consumption of less than 6 W per 100 lux.

Assuming measured lighting consumption of 5 W per 100 lux, this measure would improve the EPC rating from 142 (F) to 133 (F).
Assuming measured lighting consumption of 4 W per 100 lux, this measure would improve the EPC rating from 142 (F) to 122 (E).

The installation of a complete new lighting installation, with PIR controls throughout, would provide a significant reduction in lighting consumption. We have assumed a lighting efficiency of 75 lumens per circuit Watt, and a Light Output Ratio of 0.7 in the calculations.

Recommendation:

Provide new lighting installation throughout, with lighting efficiency of 75 lumens per circuit Watt, Light Output Ratio of 0.7, and PIR controls throughout.

This measure would improve the EPC rating from 142 (F) to 103 (E).

5.7 Building Fabric

The insulation standards within the building are in compliance with the 1995 Building Regulations. While there have been improvements to the Building Regulations since then, these are not significant for commercial buildings, and it is not considered feasible to further improve the existing insulation standard without impacts on the external facade and internal net lettable space.

The building was construction prior to the requirement for building pressure tests, designed to calculate the air tightness standard of the building. As such, a default value of 25 $m^3/hr/m^2$ at 50 Pa has to be assumed within the calculation, which does increase the heating requirements within the building – however, it also reduces the cooling requirements and therefore has a minimal impact on the EPC rating. Assuming that an air pressure test is carried out for the building, and achieves a result of 10 $m^3/hr/m^2$ at 50 Pa, then this would only improve the EPC score from 142 to 141 – as such, it is not considered feasible given the disruption that would be caused, unless a full refurbishment was undertaken.

5.8 Major Refurbishment

If the building undergoes a major refurbishment with all plant and lighting to be removed, then a centralized Variable Refrigerant Flow (VRF) system to provide both space heating and cooling would be the most efficient system in terms of the EPC rating. Fan coil units would be provided internally, with a number of installation options including ceiling recessed units. A mechanical ventilation system would still be required, with plate heat exchangers recommended for heat recovery, and

external condensers for heating and cooling the supply air. A modern high efficiency lighting system has been allowed for, with lighting controls and BMS.

6 Summary of Recommendations

It is considered that there are 3 separate routes to improving the EPC rating for the building:

A. Minor improvements to existing systems to achieve minimum E rating;
B. Major improvements to main plant only, with no works on office floorplates to achieve best possible EPC rating;
C. Complete refurbishment throughout to establish best possible EPC rating.

Each recommendation is applied consequentially for each of the three routes, so that the improved EPC rating noted takes into account the cumulative effect of the recommendations – this is because two recommendations may both reduce the same energy end-use. The impact of individual measures has already been noted in section 4 of this report.

6.1 Minor Improvements to Existing Systems – Option A

No.	Category	Recommendation	Improved EPC Rating	Budget Cost
Baseline			142 (F)	-
A1	Lighting	Undertake light level measurements within the building to use within the EPC model (estimated results).	122 (E)	£7k
A2	Ventilation	Undertake air tightness work on existing air handling units to achieve CEN L1 standard.	121 (E)	£7k
A3	Heating	Install run-around-coils for heat recovery on the air handling units.	114 (E)	£55k
A4	Ventilation	Replace supply and extract fan motors with high efficiency inverter controlled motors.	111 (E)	£45k
		Cumulative Result	**111 (E)**	**£114k**

6.2 Major Improvements to Main Plant Only – Option B

No.	Category	Recommendation	Improved EPC Rating	Budget Cost
Baseline			142 (F)	-
B1	Lighting	Undertake light level measurements within the building to use within the EPC model (estimated results).	122 (E)	£7k
B2	Ventilation	Replace existing air handling units with units with plate heat exchangers, air tight casings, high efficiency direct drive fans and inverters.	111 (E)	£120k
B3	Cooling	Replace existing chillers with high efficiency chillers.	101 (E)	£150k
B4	Controls	Install energy meters to each boiler, air handling unit and chiller, with alarms for out-of-range values.	99 (D)	£120k

		Cumulative Result	**99 (D)**	**£397k**

6.3 Complete Refurbishment – Option C

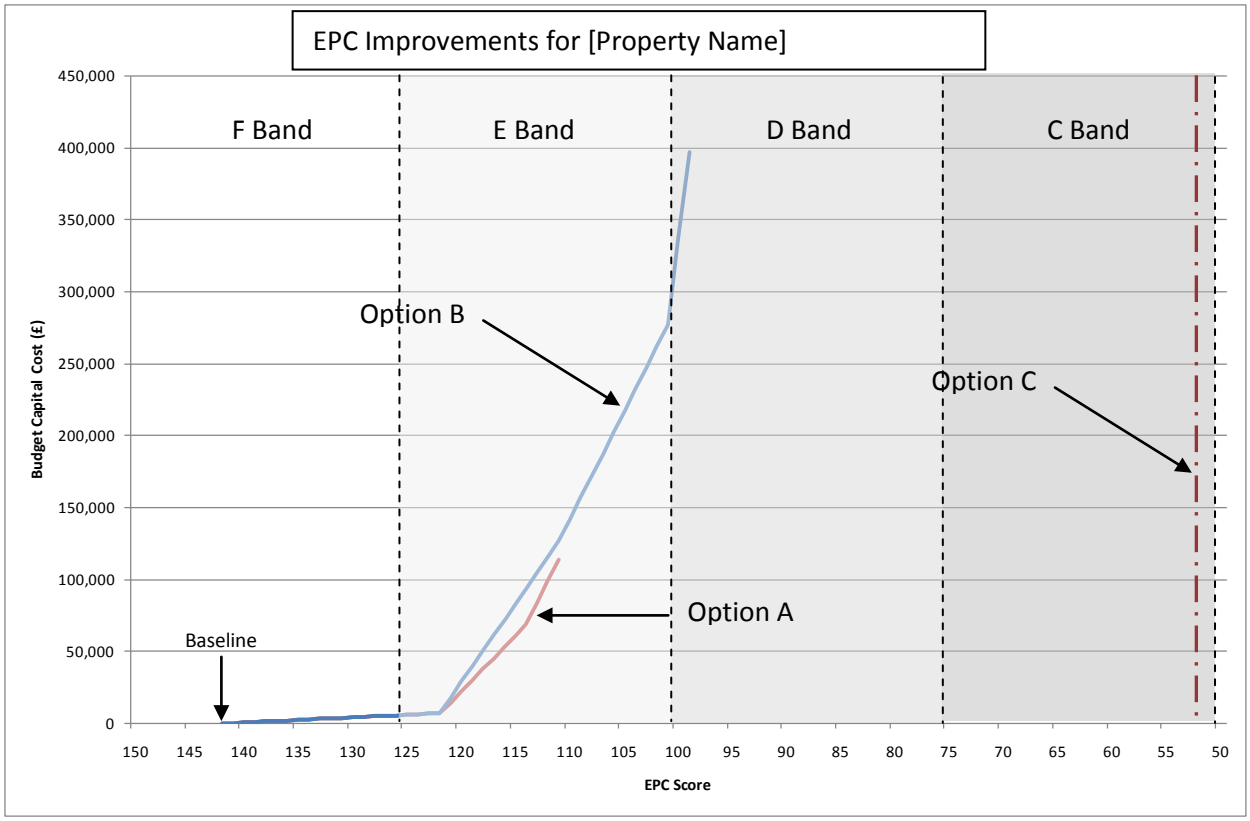
No cumulative EPC ratings have been provided as it has been assumed that all works would be undertaken at the same time as part of the complete refurbishment works. No budget cost has been provided as this is outside of our expertise. This has been undertaken to establish the best possible EPC rating that could be achieved for the scheme.

No.	Category	Recommendation	Improved EPC Rating	Budget Cost
Baseline			142 (F)	-
C1	Heating/ Cooling	Install central VRF system with external condensers, to provide both space heating and cooling.	-	-
C2	Ventilation	Install fan coil units with specific fan power of 0.3 W/l/s.	-	-
C3	Ventilation	New air handling units with plate heat exchangers, air tight casings, high efficiency direct drive fans and inverters. External condensers to provide heating/cooling.	-	-
C4	Controls	Install energy meters to each boiler, air handling unit and chiller, with alarms for out-of-range values.	-	-
C5	Controls	Install lighting BMS to providing monitoring and targeting of lighting systems, with alarms for out-of-range values.	-	-
C6	Lighting	New lighting installation throughout, with lighting efficiency of 75 lumens per circuit Watt, Light Output Ratio of 0.7, and PIR controls throughout.	-	-
C7	Fabric	Undertake air leakage test for building, and achieve result of 10 $m^3/hr/m^2$ or less.	-	
		Cumulative Result	**52 (C)**	-

From the modelling work undertaken, it is considered that a C rating would be very achievable, and that a B rating could be achieved by setting more onerous efficiency standards for lighting, or by installing daylight sensors within office areas.

6.4 Summary

The graph below provides a summary of the three Options in terms of the budget capital cost and EPC improvement.



It should be noted that there are constant updates to the EPC software, with major updates expected when Building Regulations are updated – the next major planned update is October 2013. It is therefore important that the EPC rating of the building is reviewed at each update in order to review the impact of any planned works, and to monitor the anticipated renewal EPC rating for when it is reissued in January 2022 or before.