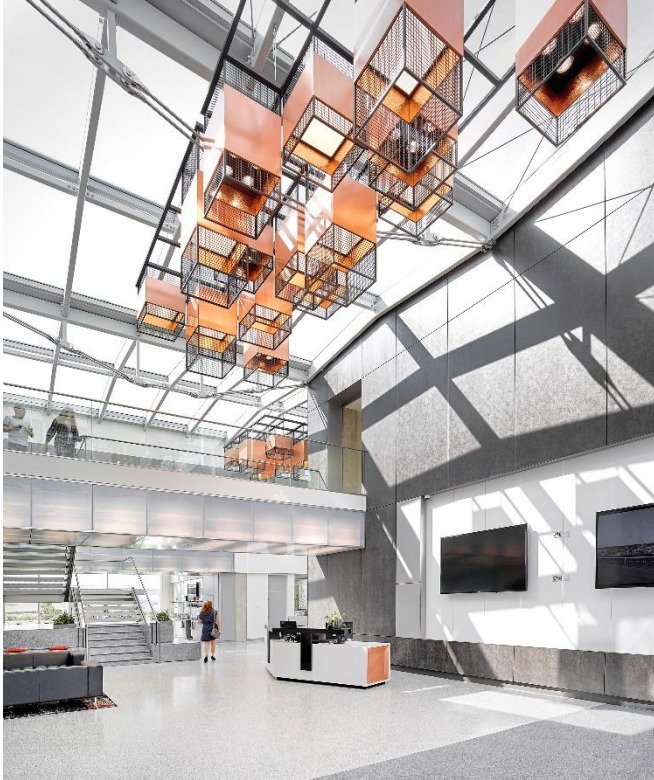


Cascades Leisure Centre

Energy and Low Carbon Technology Statement



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1.0 EXECUTIVE SUMMARY

Our proposals are to demolish the existing building that is old, tired, inefficient and by current standards and towards the end of its lifespan. This existing building is to be replaced with a new building that is to be built based on Passivhaus standards which will equate to an extremely efficient new building. The new building will incorporate the Passivhaus standard building fabric 'U-Values', very low air permeability and a building services strategy that utilises extremely efficient systems (heat pumps) which also produce considerably less carbon when compared to the existing building which is served by gas fired boilers.

We propose that the new building is heated and cooled by a heat recovery air source heat pump. The air source heat pump will provide most of the heating to the facility via a low temperature heating circuit (with flow temperatures of approx. 45°C), the rest of the heating will be provided by a high temperature circuit (with flow temperatures of approx. 70°C) which is generated by a high efficiency water to water heat pump. The high temperature circuit will primarily provide heat for the domestic hot water and pool air heating where a higher temperature is required for those specific elements.

To further increase the efficiency and sustainability, the new building will utilise a wastewater heat recovery system to recover heat from shower water which runs to drain. Heat is recovered from the shower wastewater which would typically be lost when sent to drain, this allows a 'pre-heat' of the cold-water supply to the domestic hot water generator. We believe that the wastewater heat recovery system will play a large role in increasing efficiency due to the nature of the building as leisure centres naturally tend to have a very high domestic hot water requirement.

Another element of sustainability that the new building will incorporate are Photovoltaic Panels (PV panels) which will be located on the roof. As the heating and cooling to the new leisure centre will be electrically driven via heat pumps as mentioned above, the electricity generated by solar PV panels will help to offset the requirements of running the heat pumps and will work in tandem to reduce the buildings energy demand from the grid, and reduce the running costs of the heating, cooling and hot water systems.

The items described above in relation to the Passivhaus approach all drastically outperform both the existing building and the current building regulations compliance requirements. When measured for Building Regulations Part L compliance, the proposed building has carbon emissions 45% lower than required and 13 times lower than the existing building. Primary energy use of the proposed development is also 45% lower than a Building Regulations complaint building. The proposed building has an estimated EPC rating of A, just short of a net zero carbon building, compared to a B, almost C rating for the existing building.

The proposed building offers a huge upgrade over the existing facility, with close to zero carbon performance.

2.0 INTRODUCTION

This report looks at the sustainability requirements and proposals for the development of Cascades Leisure Centre located in Gravesend in the south of England. The report identifies the proposals for the scheme and how they achieve regulatory compliance at both national and local level.

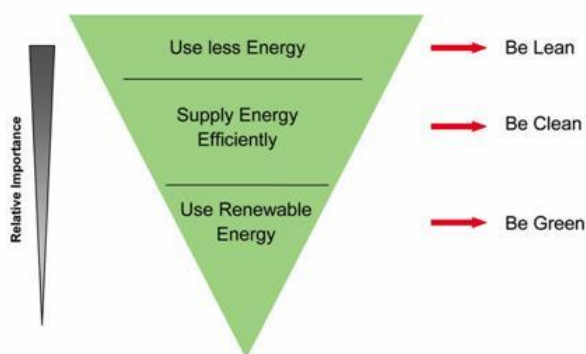


The building shown in the background of image above is the existing leisure centre, which was constructed in the 1960s and 70s. The proposal is for the existing building to be demolished and a new leisure centre to be built on the same site close-by, bringing the building and services up to modern efficiency standards. The new building is proposed to be built approximately where the existing carpark and treeline are in the foreground of the above image.

This report identifies the proposed new build elements, how energy efficiency will be incorporated into the design, and how this new building greatly improves upon the existing building and its services.

3.0 SUSTAINABILITY APPROACH

Our approach to design is to design in line with the energy hierarchy, be lean, be clean and be green, as shown below.



It's important to adopt this method and approach in the order shown above. The strategy is to minimise the amount of energy required, where energy is required, use the energy as efficiently as possible and finally make use of renewable technologies as appropriate.

The starting point to sustainable design is a 'fabric first' approach. Ensuring that the building fabric is to a high standard will reduce heat lost from the building, and in turn reduce the energy required to keep the building operational and the occupants comfortable. Table 1 below shows some typical U-values from 2021, and the proposed U-values based on Passivhaus principles. The lower the U-value, the better the building fabric performs to retain heat energy within the building. Table 1 shows the proposed U-values are considerably better than last year's average.

Table 1.

Fabric Element	2021 Building Regulations U-value (W/m ² /k)	Passivehaus Proposed U-value (W/m ² /k)
Walls	0.26	0.1
Floors	0.18	0.1
Roofs	0.18	0.1
Windows	1.6	0.82
Air Permeability	8.0m ² /(h.m ²) @ 50 Pa	0.6m ² /(h.m ²) @ 50 Pa

The next step of our strategy is to supply energy efficiently. Our proposals for how we are serving the building are explained within this report and the principles of our design are focused around using highly efficient systems and equipment throughout the building.

The third element of our sustainability approach is to use renewable energy where possible. The proposal to achieve this is the combination of highly efficient electrically driven heat pump systems and renewably generated on site electricity via solar PV panels.

3.1 LOCAL REQUIREMENTS

3.1.1 Core Strategy (as amended by the Core Strategy Selective Review 2019), Gravesham Local Plan

The current local plan for this development was amended in 2019. The key elements of that plan with regards to building services are outlined and responded to below.

Policy CS18: Climate Change – Section 5.14.41

Water Demand Management

5.14.41 The Council will seek to manage the supply of water in the Borough and reduce the impact of new development on the supply of potable water as much as possible. In particular, the Council will:

- Require all new homes to be built to at least level 3/4 of the Code for Sustainable Homes in terms of water use (105 litres per person per day consumption). Where it can be demonstrated that a development is unable to meet these standards, or the additional standards set out below, permission will only be granted if provision is made for compensatory water savings elsewhere in the Borough;
- Seek 5% of homes on Key Sites to act as exemplars by meeting level 5/6 of the Code for Sustainable Homes in terms of water use (80 litres per person per day consumption);
- Require all non-residential developments of 1,000 sq m and above to meet the BREEAM "excellent" standards of water efficiency and include provision for the collection of rainwater; and
- Support proposals to retrofit existing residential properties in ways which reduce water consumption.

- (i) *'Require all non-residential developments of 1,000 sq m and above to meet the BREEAM "excellent" standards of water efficiency and include provision for the collection of rainwater'*

BREEAM has two criteria for water efficiency. Wat 01 and Wat 02. To achieve BREEAM 'excellent' standards in line with the local plan we propose the following:

Wat 01 is an assessment of the efficiency of the buildings domestic water-consuming components and the general water consumption compared against a baseline performance. There are five credits available for the Wat 01, to achieve a BREEAM 'excellent' rating we need a minimum of one credit from this item. One credit requires a 12.5% improvement over the baseline water consumption of the building and to achieve this there will be careful consideration on the selections of sanitaryware to ensure the water outlets are the low water usage type. Flow restrictors will also be considered if necessary to ensure the domestic water systems will meet the low water usage requirements of policy CS18 section 5.14.41.

The above policy also refers to making provision for rainwater collection and while we understand the desire and drive for sustainable design principles, our proposal is to not install a rainwater harvesting system as we are proposing two other strategies that will both reduce water consumption and increase efficiency.

The first of these strategies is to utilise microfiltration for the pool water instead of a traditional media bed filtration system (sand filtration). This means that much less water is sent to drain during the backwash procedure and therefore waste much less water which in turn reduces the water usage of the building. We also propose to recover heat from the wastewater from the showers. We foresee this outperforming a rainwater collection system as it will reduce the energy usage of the building as it recovers heat typically lost to drain. This should also give an increase in sustainability for the project due to the extremely high efficiency of the wastewater heat recovery units linked with the high domestic hot water demand of the building.

Policy CS18: Climate Change – Section 5.14.42

Carbon Reduction

5.14.42 The Council will seek to reduce the overall carbon footprint of the Borough. In particular, the Council will:

- In the context of national policy on the transition to zero carbon development via amendments to Part L of the Building Regulations, require proposals for development of the Key Sites throughout the Borough and other major development elsewhere in the Gravesend Town Centre Opportunity Area to consider the potential and include proposals for low carbon and renewable energy generation, including combined heat and power. Where choosing not to do so, applicants must submit evidence which demonstrates that compliance is not technically or financially feasible or that improved fabric energy efficiency or an allowable solution results in improved carbon saving benefits;
- Support stand-alone decentralised, renewable or low carbon energy development where it is compatible with national policies for protecting the Green Belt and where it accords with policies in this plan, in particular those relating to Development and Design Principles, Transport, Green Infrastructure, and Heritage and the Historic Environment; and
- Support other proposals which lead to a reduction in carbon footprint including the retrofitting of existing homes and businesses, including local initiatives based on carbon off-setting via allowable solution

- (i) *'In the context of national policy on the transition to zero carbon development via amendments to Part L of the Building Regulations, require proposals for development of the Key Sites throughout the Borough and other major development elsewhere in the Gravesend Town Centre Opportunity Area to consider the potential and include proposals for low carbon and renewable energy generation, including combined heat and power. Where choosing not to do so, applicants must submit evidence which demonstrates that the compliance is not technically or financially feasible or that improved fabric energy efficiency or an allowable solution results in improved carbon saving benefits'*

When Combined Heat and Power units (CHPs) were introduced to the UK they were seen as an energy efficient solution to provide both heat and power to buildings while reducing carbon footprint and energy bills. However, since the recent update to Part L of the building regulations gas driven systems no longer outperform electrically driven systems when calculating the carbon emissions of a building within the SBEM calculation, therefore burning gas (which now performs worse under the new Part L) to generate electricity (which now performs much better under the new Part L) is counter intuitive when there are other technologies available that are electrically driven and provide heat at much higher efficiencies – such as heat pumps.

CHPs are approximately 85% efficient so for every 1kW of gas input a modern CHP engine produces approximately 0.4kW of electricity and 0.45kW of hot water.

Air source heat pumps typically have an average Coefficient of Performance (COP) of approximately 2.5. This means that for every 1kW of electrical energy input to the heat pump it produces 2.5kW (on average, this will be higher in warmer weather and may be lower in colder weather). As can be seen above, heat pumps are much more efficient than CHP units, and not only that but they produce much less carbon based on the current Part L Building Regulations.

Our proposal for the new building is to operate an air source heat pump to provide most of the hot water for heating the building at a lower temperature (approx. 45°C) which enables the heat pump to operate closer to its peak efficiency. Where there is a demand for higher temperature water (domestic hot water generation and pool air heating) a water-to-water heat pump will raise the lower temperature water to approx. 70°C to provide higher temperature water only to specific targeted areas that require it.

In addition to the above, the wastewater heat recovery heat pump unit will further increase efficiencies of the building operation due to high amounts of hot water demand of the leisure centre. The wastewater heat recovery unit will reduce the domestic hot water load by pre-heating the incoming cold water and reducing the amount that the domestic hot water generators need to raise the temperature by to provide domestic hot water to the building.

Our proposal will provide considerable energy and carbon savings over an equivalent system using CHP

3.2 BUILDING REGULATION'S PART L

As the proposal is to build a new leisure centre building to replace the old existing building, the requirements of Approved Document L (2021) apply. However, since we are designing the building to Passivhaus standards these standards outperform the minimum requirements of the latest part L of the Building Regulations across the board, therefore complying with Approved Document L will be easily achieved, as demonstrated below.

3.2.1 Building Fabric

As stated in our sustainability approach, the key first step for us to achieve a very energy efficient building is by starting with a 'fabric first' strategy. The proposed building fabric U-values and air tightness figures identified in table 1 are a considerable improvement over minimum building regulation requirement. These figures are also an improvement over the respective notional building values that is used as a comparison against the proposed building within the Simplified Building Energy Model (SBEM) calculation, and as such the proposed building will perform favourably on the calculation.

The existing building's U-values are unknown so we are unable to provide a specific comparison, although it is quite clear that the proposed U-values of the new building will be a drastic improvement over the current existing building's fabric. This is clear to see due to the gradual progression and stringent targets set by the Building Regulations over time since the existing building was built (1960s), as well as the proposal far outperforming even the most recent targets from the current Building Regulations Part L (2021)

3.2.2 Energy Efficient Systems

The energy efficient systems that we are proposing for the new building are as follows:

- 4 pipe heat recovery air source heat pumps

This system will provide the cooling to areas in the building and will also satisfy most of the general heating demand. This unit also incorporates heat recovery, so when the unit provides cooling some of the heat extracted is transferred to the heating which increases the units heating output.

- 2 pipe air source heat pumps

We propose that this unit is used in conjunction with the 4-pipe unit to provide additional heating when required. This arrangement avoids us using one 4 pipe unit that is oversized for the cooling demand of this building. If there is no cooling demand, then there is no heat to recover from the cooling generation, so you don't get the benefit of the heat recovery.

- Water to Water heat pump

This proposed unit will work in conjunction with the air source heat pumps to provide a very efficient and green solution. The water-to-water heat pump will take in the lower temperature heating water that is generated by the air source heat pump and raise that temperature to provide higher temperature heating water to the specific areas that require higher temperatures which are the domestic hot water generation, and the pool hall air heating system. Providing lower grade heat across the building other than the specific areas that require a higher temperature gives an increased efficiency and uses less energy.

- Wastewater Heat Recovery Heat Pump

This system will recover heat from shower wastewater which is an element of heat energy that is typically lost. This will increase the efficiency and reduce the required load of the domestic hot water generators when in operation.

- Pool filtration via Microfiltration

We propose Microfiltration is for this project due to the energy savings it provides compared to a traditional media bed system such as sand filtration. Microfiltration uses a lower filtration rate while keeping the water quality high, this reduces the pumping power required to move the water around the system. When a backwash occurs, microfiltration uses much less water for this process than a traditional system which ultimately goes to drain. This means that there is a lower pool water heating requirement as the pool water requires less of a top up if less water is sent to drain.

3.2.3 BRUKL and EPC Results

We have carried out an initial assessment and calculation of the proposed development based on the current Building Regulations Part L documentation that was updated in 2021 and came into effect for new building applications on 15th June 2022. The information input to the calculation software is based on the services strategies explained within this report with the following results.

Carbon Emissions (kgCO₂/m² per annum)

- Target CO₂ Emission Rate (TER): **18.81**
- Building CO₂ Emission Rate (BER): **10.44**
- Existing Cascades BER: **130.84**

Our proposals produce 45% less carbon than a Building Regulations compliant building and up to 13 times less than the existing facility

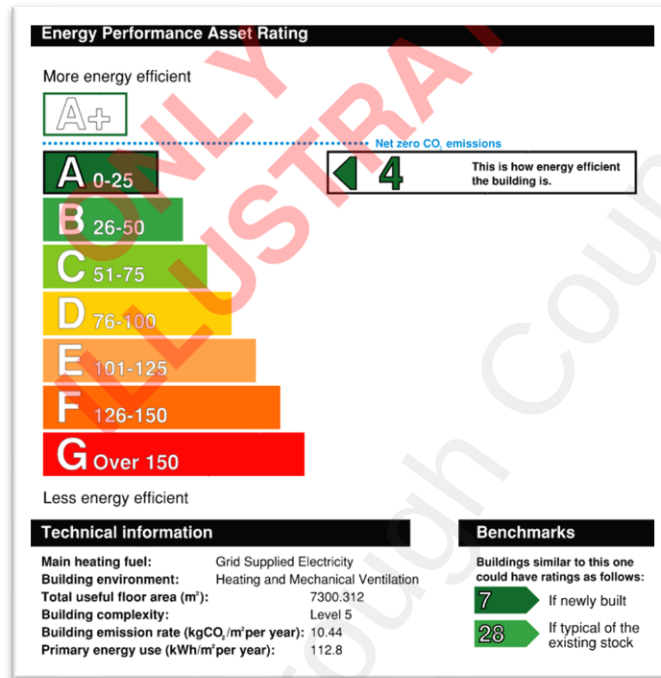
Primary Energy (kWh/m² per annum)

- Target Primary Energy Rate (TPER): **204.45**
- Building Primary Energy Rate (BPER): **112.79**

Our proposals use 45% less energy than a Building Regulations compliant building

3.2.4 Predicted EPC Rating

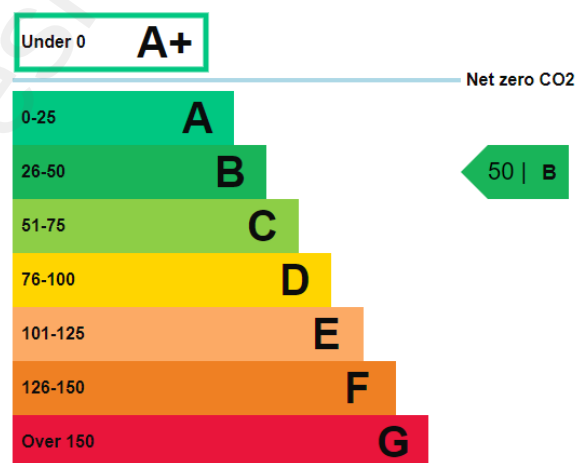
The following image indicates the predicted EPC rating of the building.



The predicted EPC rating for the proposed development is a band A and close to a net zero carbon building (above), while the EPC rating for the existing building is a B, close to C rating (below)

Energy efficiency rating for this property

This property's current energy rating is B.



Properties are given a rating from A+ (most efficient) to G (least efficient).

Properties are also given a score. The larger the number, the more carbon dioxide (CO₂) your property is likely to emit.

3.3 BE LEAN

3.3.1 Building Thermal Performance

As demonstrated above, the building is much better than the minimum standards of fabric performance, as required by Approved Document L.

Ensuring the building fabric is efficient is the cornerstone of any buildings energy strategy and we have demonstrated that here.

3.3.2 Reduce Solar Gain

There has been consideration to the amount of glazing on the building to strike a balance between enough glazing to maximise natural light to reduce lighting energy usage but restrict the amount of glazing to reduce the potential of overheating to internal spaces via solar gain.

3.3.3 Natural Daylight

The proposed building makes use of roof lights in certain spaces to maximise natural light where possible, and vertical windows.

Our proposals will make maximum use of the daylight, by combining this with artificial lighting which will reduce the output when the amount of natural daylight allows.

3.4 BE CLEAN

Where energy is used, the design will ensure that energy use is minimised by looking at the following.

3.4.1 High Efficiency Fans

Where fans are required, the design will ensure that fans are efficient as possible, thus reducing the amount of electrical energy required. These will be much improved over the requirements of Approved Document L2A as they will be based on Passivhaus standards. This will result in much lower (better) specific fan powers than the minimum Building Regulation requirements.

The existing building likely doesn't make use of modern high efficiency fans.

3.4.2 Ventilation Heat Recovery

The design will make use of Mechanical Ventilation Heat Recovery (MVHR). The use of MVHR units minimise the heating requirement of the building. Due to the Passivhaus strategy MVHR is used across almost the whole building. The MVHR units will have a minimum heat recovery efficiency of 75% as per the Passivhaus standard, however the likelihood is that a much better heat recovery efficiency than this will generally be achieved, especially in the pool hall which is a very energy demanding space. The heat recovery of the pool hall can expect to be upwards of 90% efficient.

The existing building services are largely unknown, but it is likely that the existing buildings ventilation systems either do not incorporate heat recovery, or if they do, they likely to be much less efficient than the proposed new systems, thus our proposals will be significant improvement over the efficiency of the existing building's ventilation.

3.4.3 LED Lighting

The whole of the proposed artificial lighting installation will make use of high efficiency LED lighting. This is likely a significant upgrade on the existing buildings light fittings.

3.4.4 Lighting Controls

The design will incorporate controls to lighting to limit the use of artificial light where appropriate as follows.

Presence detection – Where suitable, a detector will automatically switch lighting on when the room is occupied and switch lighting off when people leave the room.

Absence detection – In some areas it can be more suitable to provide a switch to turn lighting on and have lights switch off automatically when people leave the room. Where suitable, this will be incorporated.

We will also make use of daylight sensors, with daylight dimming, allowing fittings to reduce output when natural daylight levels allow.

3.4.5 Variable Speed Fans

All fans will be provided with variable speed motors, which can vary their speed. The use of such fans greatly minimises the use of electrical energy.

3.5 BE GREEN

The above measures reduce the requirements for energy by good design first, then where energy is required, good design and careful selection of appropriate systems uses that energy as efficiently as possible.

The final element of the hierarchy triangle is to use green technology where required and where appropriate. Below we outline our proposals for this development.

3.5.1 Heat Pumps

Our proposals for the scheme are to make use of air source heat pumps throughout. The heat pumps will provide heating, cooling and domestic hot water.

The existing building used natural gas fired boilers to provide the heating, so the use of heat pumps for the proposed building is a significant improvement on the carbon emissions of the building when compared to the existing building.

3.5.2 Wastewater Heat Recovery

The proposed building is to incorporate the usage of wastewater heat recovery from the shower water that runs to drain. Typically, the heat energy within the warm shower water would be lost to the sewer as it drains away, but our proposal is to collect this warm water in a holding tank which then passes through a heat recovery water to water heat pump before going to drain. This water provides a 'pre-heat' to incoming cold water before it reaches the hot water generator which reduces the work required of the hot water generator. The holding tank gives the heat recovery wastewater unit a prolonged run time as there should be water to reclaim heat from for longer periods between peak usage.

It is very unlikely that the existing building has any technology like this, and as such the proposed system should have a vastly reduced domestic hot water load when compared to the existing building when there is warm wastewater available to recover heat from.

3.5.3 Solar PV Panels

The development will utilise solar PV panels on the roof where possible. As the proposed building systems are electrically driven, the building will have a relatively large electrical demand. Solar PV panels will help to offset this by providing a clean and renewable source of electricity on site.

3.5.4 Electrical Vehicle Chargers

Building Regulations require a minimum of 1 electric vehicle charger for a new development such as this. Our proposals though are to provide way more than the minimum, providing 7.2kW chargers to 10% of the parking spaces, a total of 23.

4.0 SUMMARY

Our proposals are to provide the following.

- A highly energy efficient building with a 'fabric first' approach to minimise the energy requirements of the building.
- The building will be built based on Passivhaus standards. These standards for building fabric, air tightness and energy efficiency of building services systems drastically outperform the minimum requirements of Building Regulations Part L
- The building heating and cooling will be provided by heat pumps. This will ensure that the building operates very efficiently with a low carbon footprint.
- The main ventilation systems will all incorporate very high heat recovery to retain as much heat energy within the building as possible and increase sustainability
- A wastewater heat recovery system is incorporated to reclaim heat from the shower water that is sent to drain. This will both increase efficiency and sustainability of the building due to its predicted high domestic hot water demand.
- Make best use of passive measures, such as high levels of natural daylight where possible and making use of thermal mass to reduce the energy use
- The proposed building will be all electric, thus making the building carbon zero ready as decarbonisation of the grid occurs in the future.
- A building that performs way better than the existing building in terms of energy use and carbon emissions.