

BOKLOK

LAND TO THE SOUTH OF LITTLEHAMPTON ACADEMY

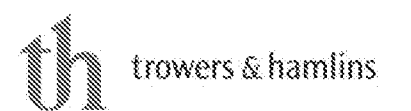
Energy and Sustainability Statement

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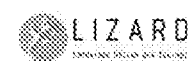
March 2021



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BoKlok, Littlehampton Academy Energy and Sustainability Statement

For BoKlok UK

Date: 5 March 2021

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Executive Summary

Hydrock Consultants has been appointed by BoKlok UK to provide planning stage advisory services in relation to the design and construction of the proposed BoKlok development at Littlehampton Academy along Fitzalan Road, Littlehampton.

This document forms part of the detailed planning application for the site and will inform the Arun District Council Planning Department of the proposed energy strategy for the site.

At this early stage, while it is difficult to estimate the potential reduction in CO₂ emissions and energy demand, because the scheme is prefabricated the design is more advanced than a typical development at planning stage, we therefore have greater clarity on the expected energy use, carbon emission and embodied carbon. There are a number of energy solutions for the BoKlok product, however, we anticipate the energy solution will be a community boiler/ASHP system, providing space heating and hot water to all blocks.

This system will provide a **27% reduction** in energy demand through renewables against a typical gas boiler system without the need for photovoltaics. The document below explains how policy compliance is met, in particular Policy ECC SP2.

Additionally, Section 4 outlines the sustainability measures for the site including; Sustainable Design & Construction, Ecology, Flooding & Drainage, Waste management, Transport, Pollution and Broadband connectivity. The embodied carbon analysis equates to a total embodied carbon of 230.15kgCO₂e/m², a reduction of over 55% against RICS.

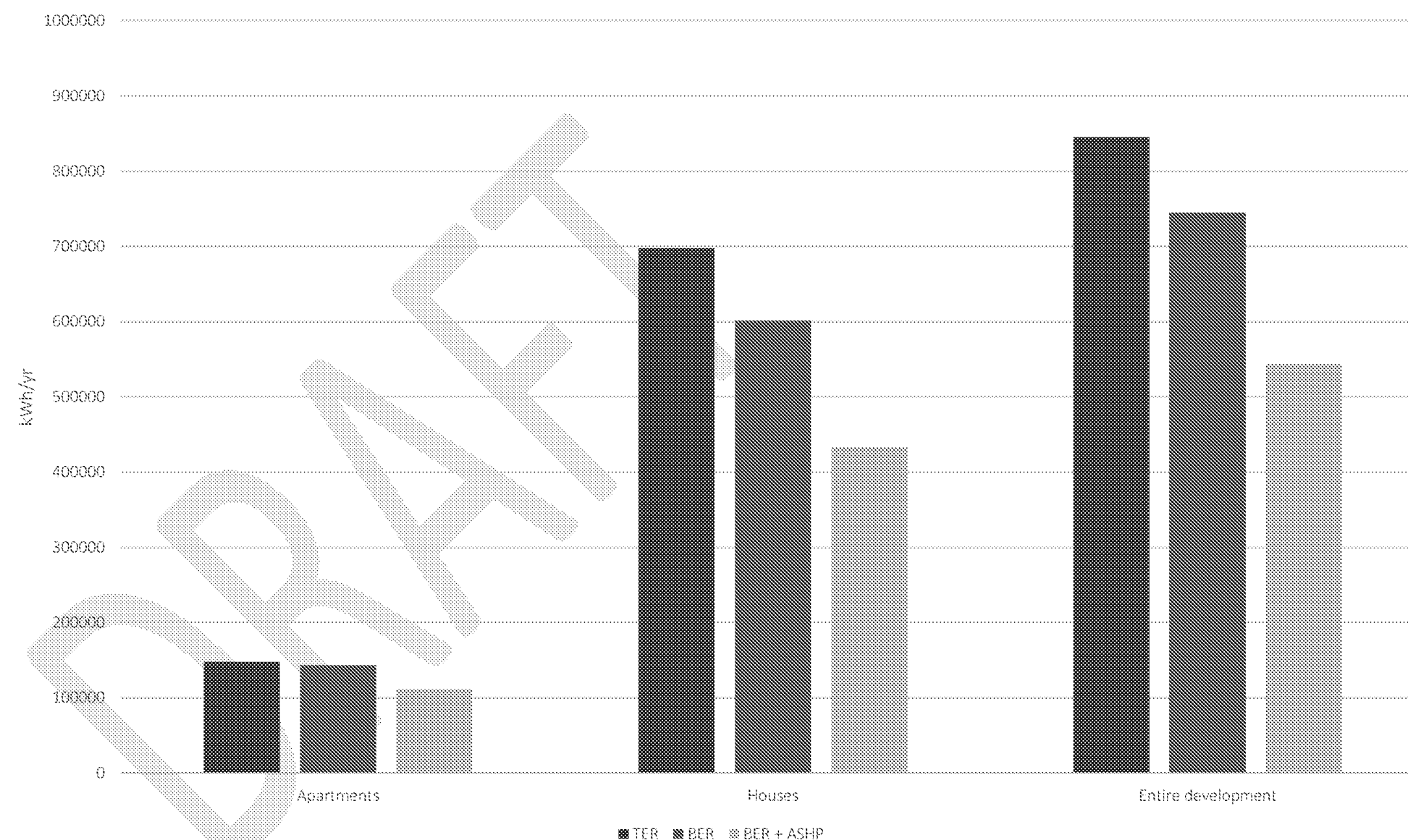


Figure 1: Estimated Target Energy Demand, Building Energy Demand, Building Energy Demand with the inclusion ASHP for the apartment block, houses and entire development

Introduction

BoKlok, Littlehampton Academy

Hydrock Consultants has been appointed by BoKlok UK to provide planning stage advisory services in relation to the design and construction of the proposed BoKlok development at Littlehampton Academy along Fitzalan Road, Littlehampton.

This document forms part of the detailed planning application for the site and will inform the Arun District Council Planning Department of the proposed energy strategy for the site.

1.1 Purpose of Report

The purpose of this document is to inform the design team, and Arun District Council, of the energy strategy for the project and how it relates to the local Planning requirements.

This document summarises an initial options appraisal that has been carried out for the development in terms of energy. This includes looking at the inclusion of renewable energy systems as well as passive and active design measures.

Throughout this report carbon emissions are split into two categories:

- » Regulated: Emissions associated with heating, cooling, hot water, lighting and any other fixed building services equipment (those that are covered under Building Regulations Part L1A and L2A); and
- » Unregulated: Emissions that are associated with small power and plug-in items and any other process or plant equipment (these are not covered by Building Regulations Part L1A and L2A).

1.2 Site and Location

The development is bounded by Fitzalan Road along the west of the site. The site is currently grassland, is bordered to the south by a cycle path and the Littlehampton Academy to the north.

The site location is shown in Figure 2.

1.3 Description of Development

Full planning permission for the erection of 112 new high-quality modular dwellings including Affordable Housing, consisting of 23 no. 1-bedroom apartments & 9 no. 2-bedroom apartments and 26 no. 2-bedroom house & 54 no. 3-bedroom houses, with associated car and cycle parking, open space, landscaping and new access via at Fitzalan Road, Littlehampton, BN17 6EH.

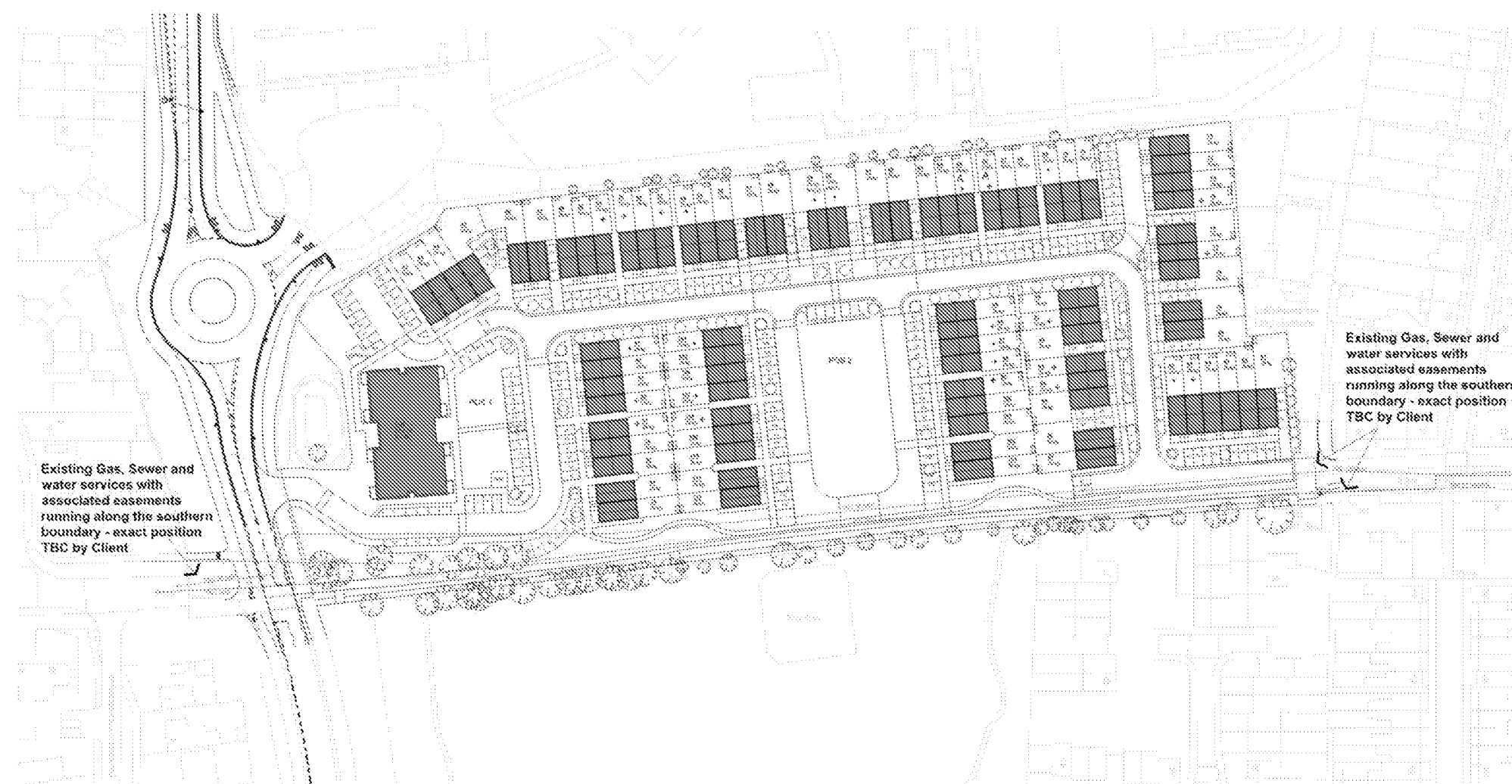


Figure 2: Site plan proposed for BoKlok Littlehampton Academy

Planning Policy

2. NATIONAL

2.1 National Planning Policy Framework

The National Planning Policy Framework (NPPF) acts as guidance for local planning authorities and decision makers, both in drawing up plans and making decisions about planning applications.

The NPPF sets out the Government's planning policies for England and how these are expected to be applied through local authorities. It sets out the Government's requirements for the planning system only to the extent that it is relevant, proportionate and necessary to do so.

The NPPF also provides a framework within which local people and their accountable councils can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities.

2.2 Building Regulations Part L

The development will need to meet the standards set by Building Regulations Approved Document Part L1A and L2A, Conservation of Fuel and Power in New Dwelling and New Buildings other than Dwellings respectively (2013).

These standards include a minimum level for Regulated carbon emissions defined by the Target Emission Rate (TER) which relate to a 'Notional Building', automatically generated as part of the Standard Assessment Procedure (SAP) and Simplified Building Energy Model (SBEM) toolkits for residential and non-residential respectively. In addition, there are minimum levels of fabric efficiency set by the Target Fabric Energy Efficiency rating (TFEE) under the SAP methodology.

The resulting Dwelling Emission Rate (DER), L1A or Building Emission Rate (BER), L2A, must be

less than the relevant TER in order to comply. A benchmark Energy Performance Certificate (EPC), rated A (most efficient) through G (least efficient) will also be calculated as part of this assessment via comparison of each building assessed to a 'Reference Building', also automatically generated as part of the SAP and SBEM toolkits. Domestic EPCs are required whenever a property is built, sold or rented, while non-domestic EPCs are required on the sale, rent or construction of buildings other than dwellings with a floor area greater than 50m² from 6 April 2008, that contain fixed services that condition the interior environment.

2.3 SAP 2012 vs SAP10

An emissions assessment has been undertaken for the gas and electric options.

Using current Building Regulations SAP 2012 CO₂ emission factors, the following would be derived (this takes into account conversion efficiencies, distribution losses etc. as previously described):

Option	SAP 2012 (kgCO ₂ /kWh)	kgCO ₂ /kWh Heat Delivered	kgCO ₂ /dwelling/ year
Gas Heating	0.216	0.264	1,100
Elec Heating	0.519	0.519	2,100

Table 1: Emissions per unit of heat delivered (SAP 2012)

The emission factors contained within current Building Regulations are known to be significantly out of date.

Proposed revised fuel emission factors have recently been published by UK Government under SAP 10. The revised document is due for adoption in late 2021. Emissions will undergo a significant change for electricity - from 0.519 kgCO₂/kWh to 0.233 kgCO₂/kWh, which is only slightly higher than mains gas at 0.210 kgCO₂/kWh.

This change has resulted from the increased use of renewable energy feeding electricity to the national grid.

The change would have the following impact on predicted emissions for each option:

Option	SAP 10 (kgCO ₂ /kWh)	kgCO ₂ /kWh Heat Delivered	kgCO ₂ /dwelling/ year
Gas Heating	0.210	0.256	1,050
Elec Heating	0.233	0.233	1,030

Table 2: Emissions per unit of heat delivered (SAP 10)

Indirect CO₂ emissions are predicted to be approximately equivalent to the gas heating option (slightly saving).

Due to the SAP 10 software not yet being released, all current calculations within this document have been undertaken in SAP 2012.

3. LOCAL

3.1 Arun Adopted Local Plan

The following policies of the Arun Adopted Local Plan are of relevance.

3.1.1 Policy 6 - Sustainable Development

All new developments must make a positive contribution towards ensuring that there is high quality, affordable housing with excellent social infrastructure; a diverse and thriving economic base that improves the vibrancy of the town centres; efficient and sustainable movement.

3.1.2 Policy ECC SP2 - Energy and climate change mitigation

The development should implement energy efficiency measures, and use design and layout to promote energy efficiency. Where feasible incorporate decentralised, renewable and low carbon energy supply systems.

All major developments must produce **10%** of the total predicted energy requirements from renewable or low carbon energy generation on site, unless it is unfeasible.

4. SUMMARY

New development will be required to demonstrate as part of an Energy Statement submitted with the planning application, how the above issues have been addressed.

This document seeks to provide response to these objectives.

5. SUSTAINABILITY

5.1 Sustainability Design and Construction

Passive design measures, including daylight access, natural ventilation and risk of overheating, and active design measures including building services, district or communal heating infrastructure and renewables are covered under the energy strategy sections of this report.

5.1.1 Design & Access

The site will be designed to allow safe and easy access for all potential users, including pedestrians and cyclists. 179 car parking bays have been included on site.

5.1.2 Material Selection

The BRE 'Green Guide to Specification' is proposed to be used when selecting the construction materials, to encourage the use of materials which have been produced with minimal impact to the environment in line with good-practice methodology. The Guide promotes the use of sustainable materials with low embodied energy, minimal ecotoxicity and long-life span.

Additionally, the materials selected will be responsibly sourced and where practicable meet the following guidelines:

- ISO14001;
- BES6001;
- PEFC / FSC;
- Chain of Custody.

5.1.3 Security

The development should be designed in a manner which minimises the risk of crime. The site should be designed securely and seek to ensure a safe working environment and ensure that the building is safe and accessible.

5.2 Ecology

5.2.1 Biodiversity

A Preliminary Ecological Appraisal of the site conducted in August 2020 identified the site as comprising c. 2.4ha of previously developed land of broad low ecological value. The site consists of patchy semi-improved grassland with bramble scrub, tall ruderal vegetation and young scattered trees which offers the potential to support reptiles and nesting birds. Reptile surveys were conducted in September 2020 and none were found. Proposals do not stand to impact upon any nature conservation designated sites.

A Biodiversity Net Gain assessment of proposals was conducted in February 2021 using the DEFRA 2.0 metric, which calculated that proposals would result in a 395% increase in the biodiversity value of hedgerows on site and a 70% loss in the biodiversity value of the habitats on site. Proposals are to create discrete areas of higher value habitats and provide nesting and roosting provision for widespread bats and birds.

5.3 Flooding & Drainage

5.3.1 Flood Risk

A site-specific Flood Risk Assessment (FRA) was prepared by AKSWard for new development at Land to the South of Littlehampton Academy, Littlehampton.

Whilst it is deemed that flood risk is only associated to those areas noted on the flood risk maps, additional flood checking is to be carried out to determine the climate change flood extents of food zones 2 and 3.

The proposed development is at low risk of fluvial flooding, at low risk of surface water flooding and will not increase the risk of flooding on or off site.

Sustainable Drainage Systems have been incorporated into the surface water drainage network for the discharge of surface water on

site which will minimise flood risk and improve water quality. The foul drainage from the proposed development will be collected by a foul drainage network and discharged into the Local Sewer network.

5.4 Water (Supply)

To reduce the consumption of potable water, efficient sanitary ware and water-saving features will be specified.

This will include limiting flow rates and reducing flush levels of sanitary ware fittings. The development aims to reduce water usage and improvement in water efficiency over a notional baseline established by the BRE in line with best practice guidelines.

At present, and where applicable, this will include:

- Low and dual flush WCs - Dual flush cisterns with low effective flush volume will be specified;
- Taps – Wash hand basins and sinks will be water efficient.
- Showers – Aerated or low flow showerheads will be included to help reduce water consumption; and
- Kitchen appliances – Low water consuming equipment to be considered.

All external planting will rely on manual watering, or precipitation only.

Plumbed rainwater harvesting has not currently been included for the scheme, due to the practicality and cost of installing the system, in lieu of targeting other energy and water saving measures.

5.5 Waste

The new development aims to minimise waste throughout construction and also to reduce waste throughout operations by providing appropriate facilities, in accordance with good-practice principles. Throughout construction,

the appointed contractor will make effort to minimise waste and, where possible, divert waste from landfill through reuse or recycling.

Waste will be minimised throughout the demolition and construction phase through the implementation of the waste hierarchy. The principles of the waste hierarchy are shown below.

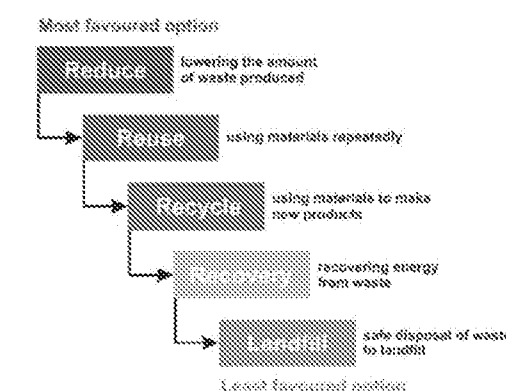


Figure 3: Waste Hierarchy.

5.6 Transport

A Transport Technical Note has been prepared by RGP. The proposals have been assessed in relation to the site's accessibility in sustainable travel terms as well as the sites potential net highway impact on the existing highway network in addition to the future accessibility credentials and likely highway impact being taken into consideration.

The site is accessible to a wide range of local education, healthcare, employment, retail and leisure opportunities, including a range of facilities within Littlehampton, within walking and cycling distance in its current form and the extent of sustainable travel facilities will be significantly improved locally in light of the North Littlehampton strategic development, to the benefit of the site.

Local public transport provision is good with bus stops within walking distance serving a range of destinations locally and further afield with a wide range of facilities and amenities including Rail Stations.

For further information refer to Transport Statement prepared by RGP. An outline Travel Plan would be prepared to support the planning application stage, to agree these key initiatives with WSCC.

5.7 Pollution

Pollution can harm both the natural environment and the human environment and consequently can negatively influence the wellbeing of wildlife and humans.

Best practice pollution prevention measures will be implemented throughout construction to reduce the potential negative impacts on water, and air, to minimise disturbance to the surrounding areas. In addition, the design of the buildings have been undertaken in a way which negates or reduces the impact of pollution.

5.7.1 Air

An Air Quality Assessment (AQA) has been prepared for the proposed residential development at Land to the South of Littlehampton Academy, Littlehampton.

A qualitative construction dust risk assessment has been undertaken in line with Institute of Air Quality Management guidance. It has been shown that the construction phases of the proposed development could give rise to emissions that are 'Medium' Risk for dust soiling effects on adjacent use, and a 'Low' Risk for human health impacts. However, by adopting appropriate mitigation measures to reduce emissions and their potential impact, such as those recommended in this report, there should be no significant residual effects.

By following screening criteria provided in EPUK and IAQM Planning for Air Quality guidance, the need for detailed dispersion modelling to assess the significance of potential impacts of the development on air quality has been scoped out of this assessment, as it is likely that this would be insignificant. This is as scheme

generated traffic is less than 500 Annual Average Daily Traffic.

UK-AIR background concentrations and local air quality monitoring have been used to establish baseline air quality in Littlehampton. This review shows that both modelled and monitored concentrations of air pollutants in the area are well below the National Air Quality Objectives (NAQOs). The potential exposure of future occupants on the site, to poor air quality, was assessed taking into consideration the future Fitzalan Link Road that is set to be adjacent to the proposed site. A qualitative assessment using several lines of evidence was performed to show the risk of new occupants being exposed to air quality above the NAQOs is low. Therefore, it is concluded the site suitable, in terms of air quality, for the proposed use.

As a requirement of the Sussex-Air Partnership's Air Quality and Emission Mitigation Guidance for Sussex (2020), an emissions mitigation assessment has been produced. The damage costs of the development have been calculated, as based on the development generated traffic, and are £20,320. This is the indicative value of a package of air quality mitigation measures to be provided to offset the impact of emissions from the proposed development.

The development will be designed to be 'air quality neutral' where practicable and minimise the generation of air pollution during the following stages:

- Construction – Minimise impacts using necessary mitigation measures relating to demolition, earthworks, construction, trackout, and non-road mobile machinery (NRMM), as appropriate; and
- Locally-generated emissions from any heating and hot water generators that are installed will be specified as low NOX in line with CIBSE guidelines.

5.7.2 Land

Any existing land contamination will be remediated prior to the commencement of construction activities on site.

Further intrusive ground investigations will be required prior to the commencement of any development. The testing and remediation have been carried out and these tests will be taken into account during the construction to ensure:

- There will no unacceptable environmental risks to future residents of the site and that they and the ground water environment will be protected from pollution; and
- There will be no foreseeable criminal, civil or other liability as a result of contamination in, at or under the site and/or the migration of contamination from the site.

5.7.3 Water (Foul)

All areas of the development will connect to the public foul sewer network.

5.7.4 Noise

RBA Acoustics have been appointed by BoKlok to assess acoustic compliance of the proposed site layout with the requirements of Arun District Council (ADC) and, following liaison with the EHO, have subsequently responded to specific feedback and additional queries relating to acoustics. Assessment have been undertaken to predict future noise levels at the facades of the proposed buildings, calculated through the use of 3D modelling software (CadnaA), using traffic noise level predictions produced by WYG Environment and supplemented by RBA noise survey data and site observations. Due to the pre-fabricated nature of BoKlok developments, the scheme is compliant with the required British Standard criteria through the use of standard Boklok specification units.

In addition to assessing noise break-in in relation to the proposed glazing & ventilation specifications, the report also assesses the level of noise ingress from both road traffic and nearby nursery/school sources to external amenity spaces. Furthermore, the report reviews acoustic issues relating to overheating through the inclusion of an AVO Level 1 assessment, including specific analysis of the use of balcony doors in the apartment buildings during periods of overheating. The conclusion of the assessment is that the scheme is capable of meeting all the relevant project-specific and Local Authority criteria.

5.7.5 Light

Light pollution can result from any adverse effect of artificial lighting and includes the following:

- Glare – the uncomfortable brightness of a light source when viewed against a dark sky;
- 'Light trespass' – the spread of light spillage the boundary of the property on which a light is located; and
- 'Sky glow' – the orange glow seen around urban areas caused by a scattering of artificial light by dust particles and water droplets in the sky.

All external lighting for the site will be designed in line with current British Standards and ILP Guidelines.

5.8 Broadband Connectivity

A review of broadband connectivity options has been carried out for the site to determine providers and expected bandwidths. High speed broadband is available from a number of different suppliers; standard broadband up to 11Mb and fibre optic up to 67Mb. Suppliers serving the area include TalkTalk, Plusnet, BT and EE.

6. EMBODIED CARBON

Embodied carbon refers to the carbon footprint of a material, it considers the quantity of greenhouse gases (GHGs) that are released during the manufacture, transport and construction of a building as well as its life cycle and decommissioning at the end of its life. Typically, this figure is represented as one kilogram of carbon dioxide ('equivalent' to normalize other GHGs emitted) per meter squared of building area; kgCO₂e/m².

This allows for direct comparison between different materials, construction processes, buildings and services solutions and further more to benchmark a buildings (or sites) carbon footprint throughout its life cycle. A lower carbon footprint during manufacturing and construction will be much easier to offset with ever improving efficiency of renewable technologies and de-carbonisation of the grid in the future.

6.1 Traditional New Build

The Royal Institute of Chartered Surveyors (RICS) provide information on existing and new builds. A typical low-rise apartment scheme can have a range of embodied carbon from 540 to over 1100 kgCO₂e/m².

Comparing other residential schemes that we have worked on with the information provided by RICS is a good indicator and average for the industry. These figures can vary by a large factor once construction processes, use and end of life elements are taken into account. We have given an example of a recent scheme in the following section.

6.2 Current Design Schemes

For comparison an internal study of a recent project revealed that for a traditional two-storey two bed build results in 591 kgCO₂e/m². Once carbon saving measures had been implemented this figure dropped to 516 kgCO₂e/m².

6.3 BoKlok – Proposed Apartments

The embodied carbon analysis for the BoKlok development has allowed for the following processes; main build, waste, transportation and an additional 5% for site based abnormalities to give a comparable score to the schemes listed above. The figures equate to a total embodied carbon of 230.15 kgCO₂e/m². The current design proposals do not currently include any allowance for solar panels. So, by comparison to the RICS Low Case (LC) we are proposing a reduction of over 55%. This gain has largely come from the pre-fabrication of the BoKlok product which is assembled off-site based on a standardised set of constructions, which utilise low embodied carbon materials and reduce the amount of waste from the construction process.

Above Ground Embodied Carbon Comparison per m² of Development

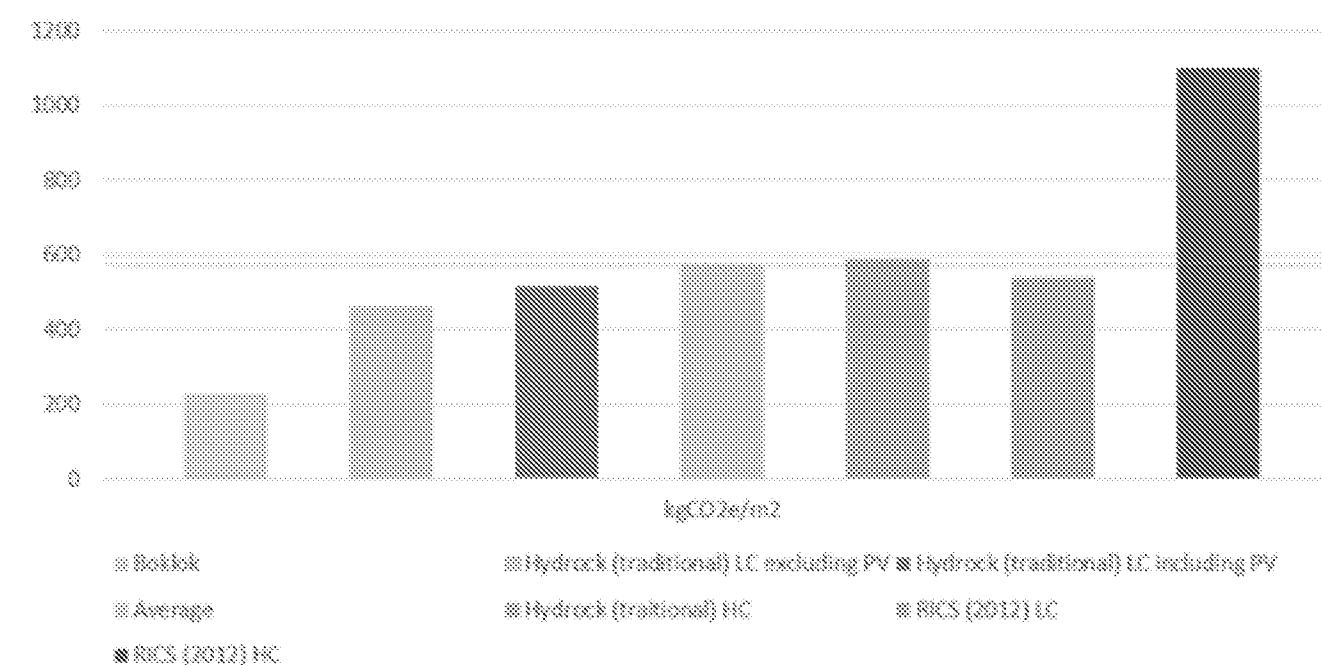


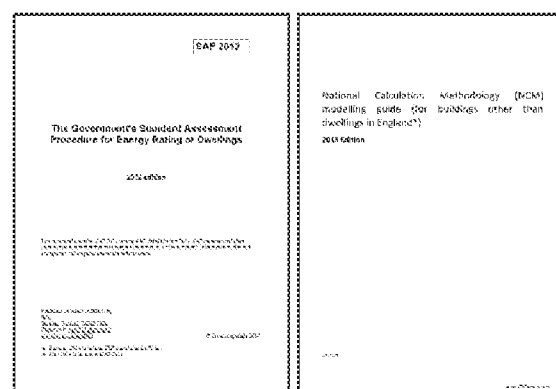
Figure 4: Embodied Carbon Comparison per m²

BoKlok LC	Lowest figure provided by BoKlok
BoKlok HC	Highest figure provided by BoKlok
Hydrock Traditional LC Ex PV	Lowest carbon development without PV
Hydrock Traditional LC	Hydrock analysis of traditional build with improvements
Hydrock Traditional HC	Hydrock analysis of traditional build without improvements
RICS (2012) LC	Weighted above ground only RICS (low range)
RICS (2012) HC	Weighted above ground only RICS (high range)

Energy and Carbon Emissions

This section of the report establishes the baseline energy consumption and associated CO₂ emissions for the scheme. The baseline carbon dioxide emissions refers to a Building Regulations 2013 Part L compliant development.

Under Part L, residential areas of the development are to be assessed under the Standard Assessment Procedure (SAP).



7.1 Standard Assessment Procedure (SAP) Energy Modelling

The dwellings on site have been assessed under Part L 2013 using the Government's Standard Assessment Procedure (SAP). The CO₂ reduction requirements have been assessed on an aggregate approach across the site, taking into account the orientation, number, size and type of dwelling.

7.2 Internal gains

Weather data is based on the UK average climatic data provided by SAP for the dwellings.

Solar gains are calculated automatically by the modelling software and are based on the orientation of the building, the transmission coefficients of the glazing and the solar angles. SAP also takes into account shading devices.

Gains from lighting, appliances, cooking and from the occupants are estimated from the floor area.

7.3 Building fabric

All fabric attributes for the baseline case are as per the Part L1A notional building. The table below show the baseline U-values for a Part L1A baseline development.

The air permeability (air leakage index) lies between 3 and 5 m³/hr/m² at 50 Pa depending on the building typology.

Building Element	Part L1A 2013 Notional Building U-value
Roof	0.13 W/m ² k
Wall	0.18 W/m ² k
Floor	0.13 W/m ² k
Glazing	1.40 W/m ² k

Table 3: Part L1A Notional Building U-values

7.4 Building services

All efficiencies for the baseline case match the notional buildings.

7.5 Unregulated Energy Demand

Unregulated emissions relate to any energy consuming activities that are not covered under Building Regulations Parts L1A.

This usually consists of small power (plug-in) devices or any other plant process or equipment.

For BoKlok, this will include:

- Small power – Televisions, computers, laptops and other electrical equipment.
- Kitchen equipment – Cookers, fridges, freezers and dishwashers etc.

7.6 Total Baseline Energy Demand

The total baseline energy demand for the residential development has been approximately calculated for the development.

The total baseline regulated energy demand for the development is approximately **845,125 kWh/yr**.

Table 4: Typical dwelling TER figures

Apartment	Area (m ²)	TER (kgCO ₂ /m ² /yr)	TER (kgCO ₂ /yr)	TER (kWh/yr)
Apartment - 1B2P	55	22.16	1,220	4,480
Apartment - 2B4P	75	17.76	1,330	4,925
House - 2B4P Mid-terrace	82	25.90	2,125	8,325
House - 2B4P End-terrace	82	28.65	2,350	9,165
House - 3B4P Mid-terrace	89	25.43	2,265	7,810
House - 3B4P End-terrace	89	27.69	2,465	8,640

8. ENERGY EFFICIENCY MEASURES FOR DWELLINGS

8.1 Introduction

This section looks at measures to reduce emissions from the new residential element of the development against the notional building baseline. Energy demand reduction provides the greatest opportunity for minimising a building's potential CO₂ emissions.

Design strategies typically include building form and fabric measures (passive design) and energy efficient building services (active design). Focusing on form and fabric in particular at an early stage in the build process is often the most cost-effective way to reduce energy consumption and CO₂ emissions.

8.2 Passive Design

Passive design options are those which utilise building form, massing and glazing ratios to exploit the natural surroundings of the site to help reduce energy demand.

The energy requirements of a residential development can be significantly reduced when the siting and location is appropriate, aiding passive solar gain and natural daylight.

The aim is to have an efficient building fabric, including low thermal transmittance building elements, to reduce heat loss from the building, see Figure 4 for diagram.

Building Element	Proposed Building Fabric
Roof	0.11 W/m ² k
Wall	0.19 W/m ² k
Floor	0.10 W/m ² k
Glazing	1.0 W/m ² k

Table 5: Proposed building fabric - Residential

The air permeability (air leakage index) is 3.9 and 5.0 m³/m²/hr at 50 Pa, for apartments and houses respectively.

Natural ventilation should be utilised where possible with extract ventilation in wet areas, such as kitchens and bathrooms. To enable efficient natural ventilation dwellings should be designed with dual aspect living spaces, where applicable, to allow cross-ventilation through windows and openings in the façade.

Access to natural daylight can be maximised throughout the site at masterplan level through efficient spacing and orientation of buildings. Buildings have been orientated to minimise overshadowing and to allow daylight to penetrate the dwellings, where possible.

Potential for overheating can be assessed against the CIBSE TM59 (2017) criteria.

8.3 Active Design

Active design relates to energy efficiency measures that can be included within the building services specification to reduce energy consumption. All services will be designed to meet at least the minimum recommended performance requirements contained in the UK Government Domestic Services Compliance Guide.

For residential blocks, the preferred option is for heating and hot water to be provided by a communal gas-fired boiler in combination with an air-source heat pump providing 25% top-up during peak periods, supplying each dwelling via a Heat Interface Unit. All houses will have individual ASHP systems providing heating and hot water.

Hot water delivery should include high levels of insulation and low heat loss storage vessels, where required, coupled with efficient fittings to minimise water consumption and energy consumption.

All dwellings should be provided with energy efficient light fittings (in the form of pendants or downlights) including LEDs.

Living spaces could all be naturally ventilated, depending on the provision of suitable window openings. Natural ventilation should be assessed according to the external acoustic

environment and levels of local air pollution, in addition to its propensity to alleviate risk of overheating in summer.

Low solar gain coefficient (G-value) glazing may be required for south facing rooms to aid the passive cooling strategy. Although MVHR is particularly attractive in winter, where heat

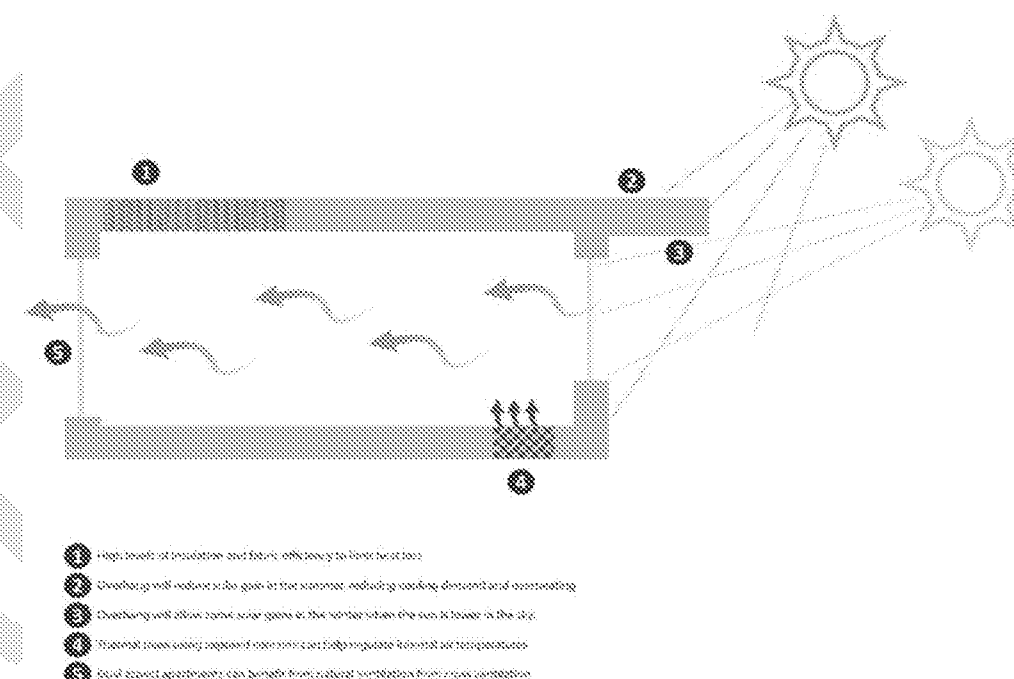


Figure 5: Passive design options (Residential)

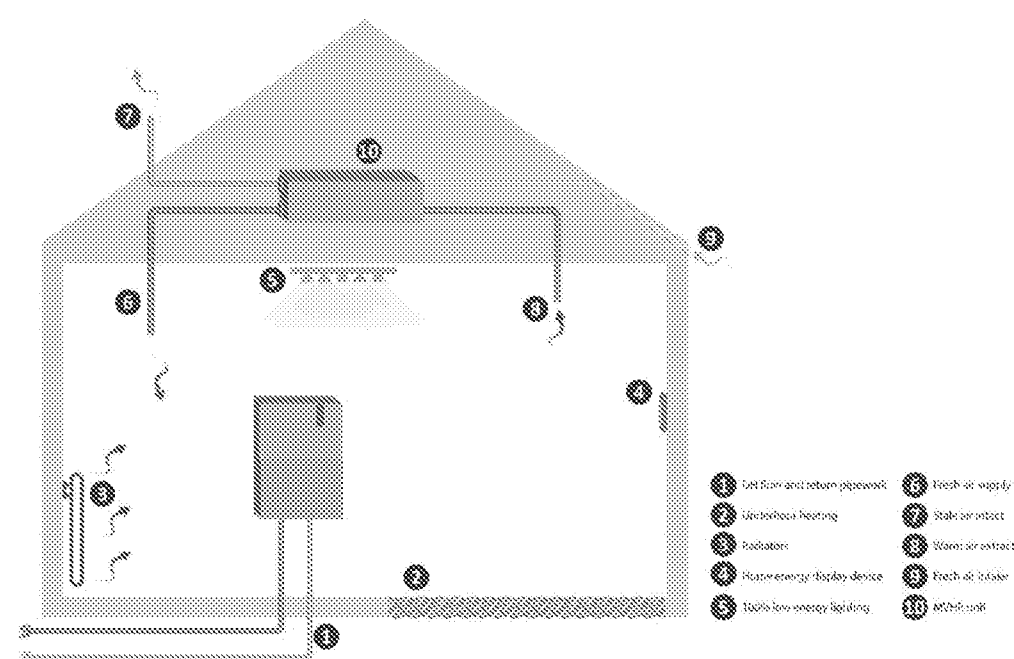


Figure 6: Active design options (Residential)

recovery is utilised, it is not used on Boklok schemes.

Residual Carbon Emissions and Renewable Energy

9.1 Introduction

In order to achieve the on-site energy reduction requirement set out by the Arun District Council, the development will need to utilise energy from renewable or low carbon sources.

9.2 Renewable Energy Options

A number of site wide energy generation technologies could be given initial consideration:

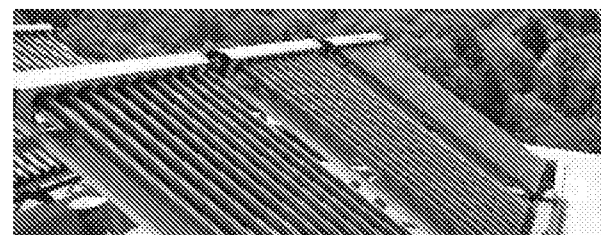
- Solar Thermal Hot Water;
- Wind turbines;
- Photovoltaics;
- Combined Heat and Power; and
- Air Source Heat Pumps (ASHP).

9.2.1 Solar Thermal Hot Water

Solar water heating systems use the energy from the sun to heat water. The systems use heat collectors, generally mounted on the roof in which a fluid is heated by the sun. This fluid is used to heat up water that is stored in either separate hot water storage vessel or a twin coil hot water storage inside the building. The anticipated life span of a SHW system is 30 years.

SHW can work well in conjunction with other renewable technologies, but is unlikely to work well with future potential connection to district heating as both will be sized to provide the base load heating and hot water.

Solar thermal could be explored for Boklok, but thermal storage and the suitability for the tenants will need to be considered. Specifically, for the Littlehampton Academy site, the feasibility of connecting a solar thermal system to individual flats would be unviable.



9.2.2 Wind Turbines

Wind turbines work by converting the kinetic energy in wind into mechanical energy that is then converted to electricity. They are available in a range of sizes and designs and can either be free standing, mounted on a building or integrated into a building structure.

Roof-mounted turbines could be explored for Boklok, although consideration for potential noise and aesthetic impact. Specifically, as the Littlehampton Academy site is situated within a suburban area of Littlehampton, and the impacts will affect residential developments, the use of wind turbines will be expected to be refused.



9.2.3 Solar Photovoltaics

PV panels work by converting the energy from sunlight into usable electricity via photovoltaic cells placed on the roof of buildings. These can be integrated into the roof itself or traditional "bolt-on" panels.

These can vary in efficiency with the most efficient panel having an efficiency of 21%, while most perform at around 15-18%.

PV panels have a low visual impact, have limited effects on the environment, and can be combined with battery storage if desired. They can also work well in conjunction with future district heating systems.

Battery storage is the technology of charging medium-scale battery storage from PVs. This could be utilised to provide the peak electricity usage of a household, as it will consume all generated energy during off-peak times (mid-day).

Solar PV, either with or without the addition of battery storage, could be explored for Boklok, as it is a very reliable and sustainable technology.

Although, there will need to be consideration into whether the energy generated by PV will be beneficial to the tenants, as the site will likely be not used during peak sunlight hours.



9.2.4 Combined Heat and Power

Combined Heat and Power Units are essentially small electricity power stations. They generate electricity and are more efficient than power stations because the heat generated as a by-

product of electricity generation is used to provide hot water to buildings.

To be considered as a renewable energy, CHP must be powered by a biomass system. A biomass system uses woodchips, pellets, or other natural products to burn in a large boiler system. However, this system is unsustainable for Boklok developments.

9.2.5 Air Source Heat Pump

ASHPs work by using refrigerant at low temperatures to extract the heat from external air. The refrigerant is then compressed to increase its temperature, the high temperature is then passed onto the water serving heating and hot water circuits in the dwelling.

ASHPs use a small amount of electricity to run the compressor but do not need a heat source installed as the heat is taken from the surrounding air.

For Boklok, ASHPs are proposed for the development as the lead heating source with backup boilers to be provided for the coldest months and provide resilience in the heating system.

9.3 Residual Energy Demand

The residual carbon emissions refer to the site wide CO₂ emissions rate, after the implementation of energy efficiency measures.

The baseline energy demand for the site is approximately **845,125 kWh/yr**. After Energy Efficiency Measures (fabric improvements), the energy demand is approximately **744,750 kWh/yr**.

A final site energy demand, after Energy Efficiency Measures and renewable technologies, is **544,345 kWh/yr** (27% reduction).

Energy Summary

10.1 Overview

This report has provided a detailed assessment of the reduction of energy demand for the BoKlok development in the Littlehampton.

The purpose of this report is to inform the Arun District Council, of an energy assessment for the BoKlok development.

After analysis of anticipating CO₂ emissions under Building Regulations Part L1A using SAP, and having undergone a lean design process to reduce the demand for energy, it is proposed that the development will utilise a community boiler/ASHP system to provide heating and hot water to each apartment, providing **27%** reduction on BER.

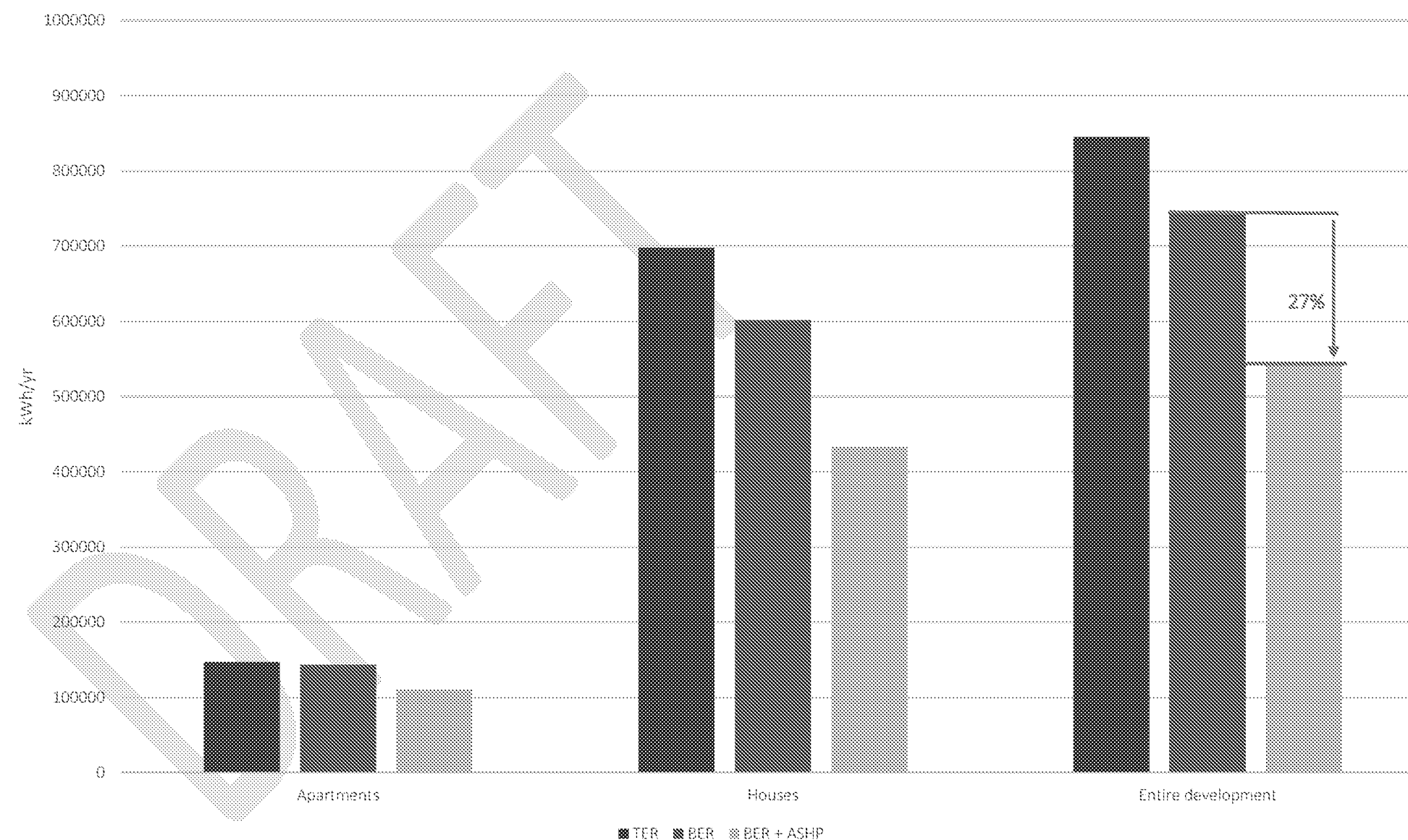


Figure 7: Estimated Target Energy Demand, Building Energy Demand, Building Energy Demand with the inclusion ASHP for the apartment block, houses and entire development