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Brown Street, 40 Residential Dwellings, Brown Street, Littleborough, Energy & Sustainability Statement



TWC Consulting

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Brown Street
40 Residential Dwellings
Brown Street
Littleborough
Energy & Sustainability Statement



**“Reducing CO₂ Emissions
In New-Build Developments”**

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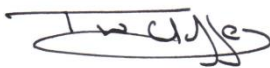
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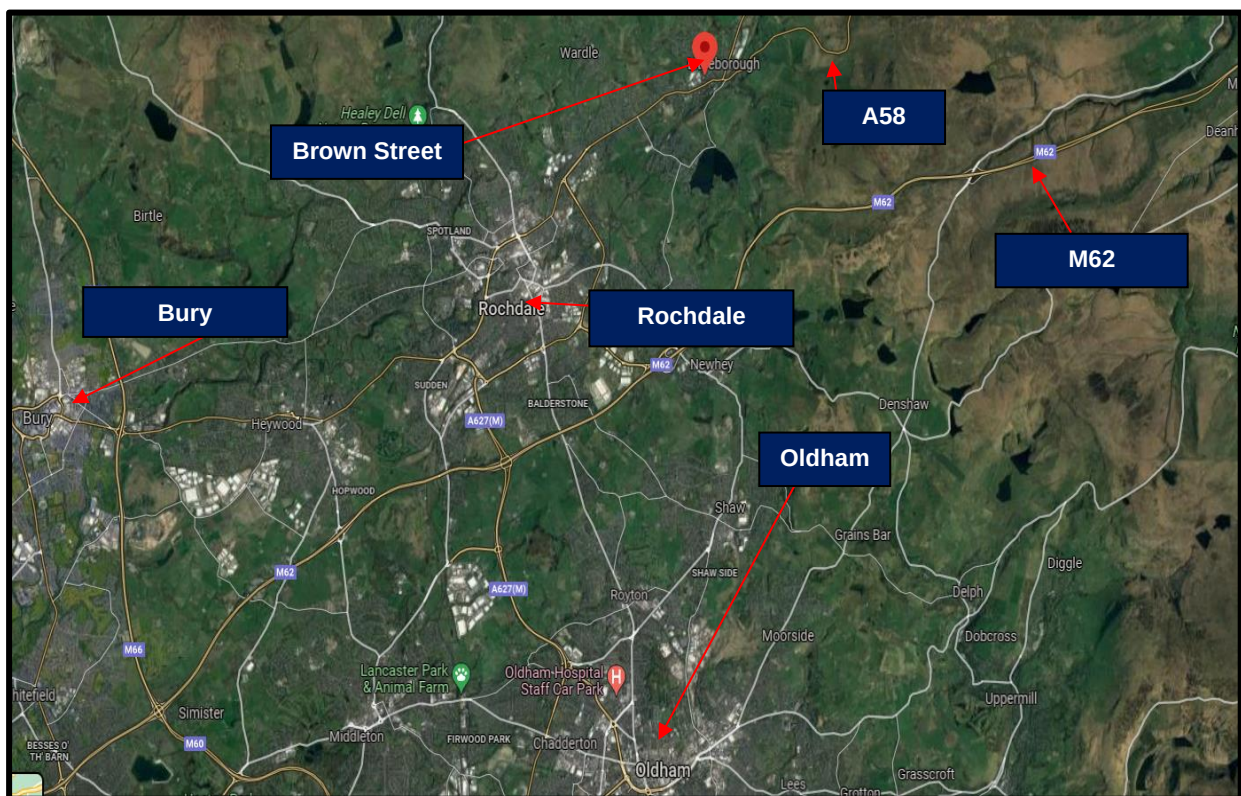
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Executive Summary

Brown Street is a proposed new-build residential development to be constructed within Littleborough. The site is located approximately 3no. miles North East of Rochdale Central, and approximately 7.2no. miles North East of Oldham Centre. The A58 and A664 provide the primary access routes to and from the site with the M62 providing a nearby motorway link. The proposed development is to construct a residential dwelling consisting of one and two bedroom flats.

Brown Street “Area in General”



To meet the challenging demands associated with sustainable development a “fabric first” approach was considered to be the most cost effective and efficient way of delivering an energy saving development that connects local housing needs whilst reducing CO₂ emissions during the life cycle of each dwelling. The materials specified for construction include a mixture of heavyweight elements and lightweight components that offer greater stability in maintaining internal temperatures at comfortable levels for the residents during occupation. The choice of materials selected for the development ensures the fabric is slower to react to changing thermal conditions by acting as a heat sink during warmer periods and resisting high levels of heat loss during cooler periods.

Based on a fabric first approach, the following renewable energy technologies were considered for suitability at the development;

➤ Biomass

Biomass was considered to be a suitable option. However, several issues were identified including a lack of fuel supplies within the local area, excessive transportation costs, high maintenance requirements, excessive storage costs, delivery constraints [via the surrounding roads and intersecting streets] and a low demand for heat-energy given the number of units specified;

➤ Wind power

Wind power was discounted as a realistic option due to associated site constraints and the presence of nearby urban areas, which present significant risks and limitations. An average wind speed of 5.1m/s was confirmed at the site making this technology less viable;

➤ Heat Pumps

Heat pumps were considered viable. However, field trials conducted by the Energy Saving Trust have confirmed mixed results with this technology, therefore a cautious approach is recommended. In addition, as each dwelling is likely to be designed with fixed radiators as the primary source of space heating, the specification of heat pumps would require a re-design as they are more effective with under-floor heating systems;

➤ Solar Energy (Solar Photovoltaic & Solar Thermal)

Solar photovoltaics (PV) panels and solar thermal (hot water) were both considered viable options, although roof plans would require a full review to achieve optimum orientation. With regards solar PV this provides the greatest opportunity for the development, as it can deliver the Part L 2012 [SAP] targets, and Rochdale's Core Strategy, Section G1.

➤ Micro Combined Heat and Power (CHP)

Combined heat and power systems could be used to deliver the building's heat and power requirements, although this technology is relatively new and has yet to reach market maturity. The procurement of micro CHP will bring higher capital costs, which would need to be considered against the available budgets.

Introduction

This energy statement has assessed the need for sustainable building-design and construction at the Brown Street development based on Rochdale's Core Strategy, Section G1 and current Building Regulation requirements Part L 2012.

This statement confirms, the use of a fabric-first approach achieves the sustainability standards set by the above policies, with low carbon energy systems available for enhanced levels of sustainability if required. This approach has been established as the most viable option and one that will contribute to the on-going delivery of sustainable dwellings within the local area and wider communities.

Proposed Site Boundary, Brown Street, Littleborough



1.0 Client's Brief

Acting upon instruction received from Mark Barnes via email dated 09th September 2021, TWC Consulting Ltd were appointed to conduct a review of the development's sustainability objectives, and assess the potential for low carbon technologies. The study assessed a range of building-design options deemed suitable for the development of which a fabric first approach was judged to be the most appropriate strategy in achieving Rochdale's Core Strategy, Section G1 and current Building Regulations, Part L 2012.

2.0 UK Sustainable Development & Legislation

The UK Climate Change Act 2008, the Sustainable Buildings Act 2004, progressive changes to the Building Regulations, Planning Laws and other legislative provisions continue to drive environmental improvement throughout the UK construction industry. These progressive laws and regulations commit designers and developers to reduce the demand for energy in residential dwellings, whilst at the same time lowering carbon emissions. At the forefront of this evolving process is the tightening of the Building Regulations and various Planning Laws which set energy efficiency standards and instruct renewable energy generation at varying levels.

3.0 Sustainable Building-Design

An efficient and cost-effective way of achieving sustainable building-design is through the use and selection of building materials that reduce energy demand during occupation. Sustainable building-design provides a holistic approach on the broader aspects of sustainability, which if implemented as the development progresses can greatly assist with issues such as fuel poverty, rising energy bills and lowering carbon emissions.

Sustainable building-design is at its most effective when considered at the earliest stages of procurement. Factors such as site orientation, solar shading, solar gain, natural ventilation, increased u-values, high levels of thermal mass, dynamic thermal response, admittance factors, green roofs and low energy lighting all have positive impacts on developments and each should be considered within the context of long-term sustainability and environmental objectives.

This can be achieved using innovative building-design specifications and/or a combination of low carbon/renewable technologies where required. SAP software is used to confirm targets have been achieved based on proposed building[s] design[s] and specifications, which are highlighted on the compliance printouts documents as a percentage improvement over the target set by the Building Regulations.

4.0 Construction "A Fabric-First Approach"

All construction materials have properties which define their thermal dynamics. These properties include thermal conductivity (i.e. the amount of heat energy that can flow through a material at a given temperature range), specific heat capacity (the amount of energy required to raise a material element by 10C), and emissivity (the rate at which materials radiate/re-radiate energy). Thermal conductivity and specific heat capacity can be combined to form a single calculation known as thermal diffusivity (the rate at which a material can store heat comparative to the rate it can conduct heat, the greater the temperature range the greater the flow of heat).

Heavyweight materials such as concrete, stone, brick and block all have high thermal diffusivity values, in contrast to other materials such as fibreboard, timber, steel which have lower values. With the demand for sustainable construction continuing to increase, and the significance of thermal dynamics the choice between building materials is a significant factor in building design. Decisions between construction form over aesthetics is challenging designers as the ability of the fabric to react to changing climatic conditions, whilst reducing carbon emissions dominate. Knowing the thermal diffusivity of materials will assist building designers in creating thermally efficient buildings.

Table1: below outlines the design specifications and options included as a basis for construction at Brown Street

Table1: Brown Street, Construction Materials & Design Details

Element	Specification	Design Details
External walls	0.24Wm ² /K	Brick outer leaf, 125mm Springvale Ecobead blown insulation, Block inner leaf
Party walls	0.00Wm ² /K	Full-fill mineral wool with edge sealing top and bottom of the cavity (i.e. zero heat loss), heated corridor to prevent heat loss
Roof	0.09Wm ² /K	500mm mineral wool insulation within the roof void
Floor	0.15Wm ² /K	Suspended concrete beam and block, with 150mm of Jablite EPD 70, or similar

Windows / doors	1.33Wm ² /K (g-value 0.73)	BFRC DG window units and doors to minimise heat loss
Thermal bridges	0.08Wm ² /K or less	All thermal bridges to be individually measured and insulated to minimise heat loss
Pressure test	Designed q50:	Air tightness of 5m ³ /m ² @50pa.to prevent air convection, all plots to be tested individually
Background ventilation	Cross flow ventilation	Controlled ventilation rates to Part F standards
Extract ventilation	Standard extract fans to all wet rooms	Standard mechanical extract ventilation fans to be installed within all wet rooms including utilities and en-suite facilities
Lighting	At least 45lumens circuit/Watt	100% low energy lighting to be used within all internal areas. External lighting to be fitted with motion sensors
Main heating system	Panel heaters	Electric Panel Heaters w/ programmer, room thermostat & TRV's
Water use	<120litres person, per day	Domestic hot water heated via Immersion heating with 210 litre cylinder per apartment.
Renewables	Photovoltaic Units	500 KWh/yr apportioned to each apartment

At Appendix A (see below) a SAP calculation report has been attached which confirm the construction strategy listed at Table 1: meets the requirement of current Building Regulation requirements Part L 2012. The Part L pass percentage is confirmed at the top of page1, Annex A, as "DER<TER" (i.e. Dwelling Emission Rate has a betterment over the Target Emission Rate by 4.68%)¹. To support this statement further several additional calculations were completed on a range of floors, in varying orientations across the development to ensure each dwelling achieves current Building Regulation requirements Part L 2012.

5.0 Demand for Energy “Brown Street, Littleborough”

The demand for energy at the Brown Street, Littleborough is yet to be confirmed. However, it is anticipated that consumption levels will range between 6,000kWh – 9,000kWh of regulated energy per dwelling, per annum, based on the design proposals and the specifications listed above. This will assist in meeting the carbon emission targets set by Part L of the Building Regulations 2012. Further dwelling specific data can be confirmed as the development progresses using industry recognised software such as Standard Assessment Procedure (SAP), daylight factor measurements, water consumption calculators and pollution mitigation control measures.

6.0 Renewable Energy & Low Carbon Systems

The potential for renewable and low carbon energy systems were considered for Brown Street including; wind power, combined heat & power, biomass (wood), ground/air source heat pumps and solar energy – with several other renewables energy systems deemed unsuitable at this stage². A summary of each system is outlined in the sections below along with their respective advantages and disadvantages.

6.1 Wind Power

Two types of wind power system were considered including large-scale wind turbines and small scale domestic (micro-generation) turbines. Both systems were considered unviable at this stage due to surrounding urban areas and the predicted average wind speeds at the site (confirmed at 5.1m/s). It is anticipated the following restrictions would also impact wind power³;

- Planning consent could be problematic given the sites location and likely objections from local residents;
- Noise level assessments would be required;
- A life cycle maintenance plan would need to be included within cost projections (i.e. the costs of maintaining the turbine(s) and/or associated moving parts over the life cycle of the system);
- Life cycle costs can be relatively high, depending on the quality of the system;

² Tidal power, Hydro, Geothermal, Biogas and Biowaste were not assessed during the study due to site limitations and the unlikelihood of their inclusion.

³ The BWEA suggests wind speeds of 7m/s or more are required for large scale wind turbines (50kW). The average wind speed at Littleborough is 4.6m/s at a height of 10m, obtained from the <http://www.rensmart.com/Weather/BERR> website.

- Damage to local birds and wildlife must be considered;
- Visual impact is difficult to define without conducting further feasibility studies;
- The system is less durable than other renewable energy systems;
- Energy is only generated when the wind strength is sufficient;
- Payback (in some cases) cannot be guaranteed.

6.2 Biomass Systems

The market for biomass “wood” has grown significantly during the past 3no. years with Scotland seeing a 300% increase in its use. Biomass boilers are being installed throughout the UK, although in some urban locations there is a reluctance to use them due to problems associated with pollution⁴. Biomass systems can operate on a variety of fuel sources, which are governed by the specified boiler/plant. Power outputs range from small-scale systems at 4kW to large-scale district heating systems in excess of 1250kW (i.e. decentralised plant). There are several well-established manufacturers producing biomass boilers including Broag, Hoval and Baxi. Capital costs can vary widely from £1,500 per dwelling for wood stoves to approximately £8,000 per dwelling for district heating network systems.

The following sections outline the advantages and disadvantages of using biomass boilers for Brown Street, Littleborough

6.2.1 Advantages, Biomass

- Chips/pellets can be used to power a wide range of biomass boilers including combined heat and power systems (CHP) and individual wood stoves;
- Biomass generates a financial return via the Renewable Heat Incentive;
- Fuel sources can be locally grown and supplied;
- The payback period can be difficult to define, however 5 – 8 years is often used as a benchmark used, depending on the type of system and the availability of the Renewable Heat Incentive, see www.energysavingtrust.co.uk for further details.

6.2.2 Disadvantages, Biomass

- The supply of fuel can restrict the choice of system (i.e. chips or pellets);
- Pollution needs consideration (at Brown Street, this would require further on-site clarification);
- Noise levels generated by the system(s) must be assessed and managed accordingly;

⁴ See <http://www.building.co.uk/report-highlights-biomass-pollution-fears/3105974.article> for details.

- Maintenance requirements including cleaning, monitoring and running a biomass system are high;
- Substantial storage space is required to accommodate the plant and fuel supplies;
- The cost of transporting the fuel from source to the site can outweigh the benefits of using the system.

6.3 Heat Pumps

Heat pumps are an essential part of the UK's renewable energy mix. Several variations exist which can deliver heat energy to a building as and when it is required⁵. With regards to the Brown Street development heat pumps were considered viable either as standalone system(s), and/or as part of a site-wide energy strategy. However, high-end capital costs, design constraints and maintenance requirements during cold snaps would need further studies. Capital costs can vary widely, with quotes ranging as high as £12,000 per dwelling/unit. A summary of each variation is listed as follows;

- Water to Water Heat Pumps

Heat is extracted from a nearby watercourse, which is transferred to a looped pipework system and then used to generate heat energy for space heating and domestic hot water;

- Air to Water Heat Pumps

Heat is extracted from the outside ambient air temperature and transferred to a storage water supply via a heat exchanger where it is used as a source of heat energy supply when it is required;

- Ground Source Heat Pumps

Heat is taken from below ground level and transferred to a fluid mix (glycol etc.), and thereafter upgraded to provide a suitable source of heat energy.

6.3.1 Advantages, Heat Pumps

- Heat pumps can provide a sustainable and renewable source of heat energy supply;
- Heat pumps can generate constant supplies of heat and/or cooling;

⁵ Heat pumps utilize a system of compression, expansion, latent heat and heat exchangers to generate heat energy. They function in a similar way to a fridge. A coefficient of performance is normally used to confirm the efficiency standards.

- Heat pumps are particularly beneficial when used in conjunction with under-floor heating systems and low surface temperature heat emitters;
- Certain heat pumps receive an income from the Renewable Heat Incentive, see www.energysavingtrust.co.uk for further details;
- Payback periods average between 5 – 7 years depending on the type of system and the availability of the Renewable Heat Incentive.

6.3.2 Disadvantages, Heat Pumps

- Horizontal ground source systems require large areas to generate required levels of heat;
- Vertical ground source heat systems can be expensive to procure and install;
- Efficiency levels are reduced as outside temperatures decrease (i.e. heat pumps need to work harder during colder periods to maintain internal temperatures at comfortable levels)⁶.

6.4 Combined Heat and Power (CHP)

CHP is the simultaneous generation of heat and power contained within the same energy system. Products range from small-scale domestic engines which run on simple gas turbines, to large-scale tri-generation systems which provide heating, cooling and power. The heat produced during the generation cycle is recovered and then used as a source of heat-energy within the building. CHP systems can deliver efficiency levels up to 90% efficient in contrast to separate systems which can range as low as 30% to 50%. CHP systems are usually specified on large-scale projects where there is a constant and high demand for power (i.e. hospitals and large office buildings).

Although CHP is fast becoming an available option to designers its inclusion at Brown Street could not be confirmed as suitable due to the low demand for heat and power, and periods of occupation which could not be established. The advantages and disadvantages of specifying a CHP system remain outside the scope of this report.

⁶ Although, not a disadvantage, it is possible for some air source heat pumps to ice/frost up when temperatures drop to between 0°C and 3°C. Therefore, the reliability of recognised units should to be considered prior to specification.

6.5 Solar Energy

Solar energy is an increasingly popular choice of renewable energy that continues to expand due to rising demand for sustainable building-design, funding requirements associated with Code for Sustainable Homes⁷, the availability of the Feed in Tariff, the Renewable Heat Incentive and Planning Conditions. Solar energy is a common choice of renewable energy due to its simplicity in installation, its low maintenance requirements, it is source of renewable energy during daylight hours and it can offer an income/investment from the Feed in Tariff and/or Renewable Heat Incentive.

Solar energy has 2no. variations which are usually termed Solar Thermal (hot water), and Solar Photovoltaic (PV).

6.5.1 Solar Thermal

Solar thermal is a renewable heat energy system also known as “solar hot water”. The system can be confused with solar photovoltaic in that it is similar in appearance and is normally installed on roof areas, however that is where the similarity ends. Solar thermal systems produce heat energy via the absorption of the Sun’s shortwave radiation and external temperatures, which it then transfers to a heat carrying fluid, where-after it is used to deliver space heating and hot water. The panels/collectors are located within close proximity to a thermal store (i.e. a hot water cylinder) in order to reduce heat losses within the pipework. The stored heat energy is used to increase temperatures of incoming mains water before it reaches the boiler system. There are 2no. variations of solar thermal systems known as “evacuated tubes and flat plate collectors”. Evacuated tubes are more efficient, however they are also more expensive. Capital costs can range between £4000 – £6,000 per system. Based on an average cost of £5,500 per dwelling the total uplift could range between £376,000 to £564,000 depending on economies of scale gained from suppliers.

6.5.1.1 Advantages, Solar Thermal

- Solar thermal systems provide a constant source of free heat energy, which can be used to reduce the amount of mains energy required for space heating and domestic hot water;
- The cost of installation is becoming increasingly competitive as the market reaches maturity;

⁷ The Code for Sustainable Homes has now been wound down by the Department for Communities and Local Government, however the standard is still administered by BRE, and is currently being used by several housing organisations as a measure of sustainable buildings.

- Solar thermal offers a return on investment from the Renewable Heat Incentive, although changes to the incentive are currently being reviewed at the time of writing, see www.energysavingtrust.co.uk for further details;
- The payback period can range between 6 – 12 years depending on site variables and the qualifying financial incentive.

6.5.1.2 Disadvantages, Solar Thermal

- Roof mounted systems can increase structural loadings which can lead to additional costs and expensive strengthening works;
- Energy generation is dependent on diurnal temperatures and weather conditions;
- At Brown Street, there are several design limitations due to internal layouts, associated pipe runs and distances from the panels to the locations where the heat energy is required.

6.5.2 Solar Photovoltaic

- Solar Photovoltaic (PV) panels produce electricity when stimulated by direct and diffuse daylight. The panels absorb light from which an electrical charge is generated. PV panels are usually located on roof areas and have wiring from within the panels fixed to an isolation switch, an inverter and a generation meter for use at source or export to the grid. The price of the panels is declining as the market reaches maturity. Although, a cost of approximately £5,500 per dwelling can be considered reasonable depending on the number of panels required.
-

6.5.2.1 Advantages, Solar (PV)

- PV arrays provide a free source of electricity that can be used at source or export to the grid;
- PV arrays are simplistic to install, and wiring is minimal;
- Maintenance requirements are minimal with the majority of PV panels;
- The payback period ranges between 8 – 10 years depending on site parameters;
- The Feed in Tariff provides a return of approximately 4.11 pence for each unit of energy generated, although changes to the incentive are currently being reviewed at the time of writing, see www.energysavingtrust.co.uk for further details.

6.5.2.2 Disadvantages, Solar (PV)

- Energy generation can be limited by the site's orientation and efficiencies of the installed panels;
- Energy generation is dependent on diurnal weather conditions and temperatures;
- An increase in structural roof loadings can be expected. This can lead to additional and expensive strengthening works;
- PV panels do not produce energy during hours of darkness.

7.0 Conclusions and Recommendations

It is conclusion and recommendation of this report the design and specifications outlined above meet the requirements for sustainability as required by Rochdale's Core Strategy, Section G1 and current Building Regulation requirements, Part L 2012. A mixture of sustainable building-design, a fabric first approach and renewable/low carbon energy systems will deliver thermally efficient accommodation that will reduce demand for energy, resist heat-loss through conduction and maintain internal temperatures at comfortable levels for the occupants.

Appendix A – SAP Calculation Report

SUMMARY FOR INPUT DATA						Design SAP elmhurst energy	
Calculation Type: New Build (As Designed)							
Property Reference	Brown Street GF Example				Issued on Date	09/09/2021	
Assessment Reference	001	Prop Type Ref	001				
Property							
SAP Rating	78 C	DER	28.51	TER	29.91		
Environmental	84 B	% DER<TER	4.68				
CO ₂ Emissions (t/year)	1.01	DFEE	37.30	TFEE	43.61		
General Requirements Compliance	Pass	% DFEE<TFEE	14.47				
Assessor Details	Mr. Steven Johnson, Steven Johnson, Tel: 0795607219, steven.johnson@twcconsulting.com				Assessor ID	Z708-0001	
Client							
SUMMARY FOR INPUT DATA FOR: New Build (As Designed)							
Orientation	North West						
Property Tenure	Owner-occupied						
Transaction Type	New dwelling						
Terrain Type	Urban						
1.0 Property Type	Flat, Mid-Terrace						
2.0 Number of Storeys	1						
3.0 Date Built	2019						
4.0 Sheltered Sides	2						
5.0 Sunlight/Shade	Average or unknown						
6.0 Measurements							
	Ground Floor:	Heat Loss Perimeter	8.12 m	Internal Floor Area	41.90 m ²	Average Storey Height	3.00 m
7.0 Living Area	20.22		m ²				
8.0 Thermal Mass Parameter	Simple calculation - Medium						
Thermal Mass	250.00		kJ/m ² K				
9.0 External Walls							
Description	Type	U-Value (W/m ² K)	Gross Area (m ²)	Nett Area (m ²)			
External Wall 1	Cavity Wall	0.24	24.36	16.27			

Appendix B – SAP Calculation Report

SUMMARY FOR INPUT DATA						Design SAP elmhurst energy	
Calculation Type: New Build (As Designed)							
Property Reference	Brown Street FF Example				Issued on Date	09/09/2021	
Assessment Reference	012		Prop Type Ref	012			
Property							
SAP Rating	76 C	DER	29.97	TER	30.04		
Environmental	82 B	% DER<TER	0.24				
CO ₂ Emissions (t/year)	1.15	DFEE	41.95	TFEE	46.38		
General Requirements Compliance	Pass	% DFEE<TFEE	9.56				
Assessor Details	Mr. Steven Johnson, Steven Johnson, Tel: 0795607219, steven.johnson@twcconsulting.com				Assessor ID	Z708-0001	
Client							
SUMMARY FOR INPUT DATA FOR: New Build (As Designed)							
Orientation	South East						
Property Tenure	Owner-occupied						
Transaction Type	New dwelling						
Terrain Type	Urban						
1.0 Property Type	Flat, End-Terrace						
2.0 Number of Storeys	1						
3.0 Date Built	2019						
4.0 Sheltered Sides	2						
5.0 Sunlight/Shade	Average or unknown						
6.0 Measurements							
	Ground Floor:		Heat Loss Perimeter	Internal Floor Area	Average Storey Height		
			13.26 m	43.31 m ²	3.00 m		
7.0 Living Area	21.64		m ²				
8.0 Thermal Mass Parameter	Simple calculation - Low						
Thermal Mass	100.00		kJ/m ² K				
9.0 External Walls							
Description	Type		U-Value (W/m ² K)	Gross Area (m ²)	Nett Area (m ²)		
External Wall 1	Cavity Wall		0.24	39.78	29.31		