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Land South of Warren Lane, Long Ashton

Energy Statement

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1 Executive Summary

The proposed development at Land south of Warren Lane, Long Ashton, consists of up to 35 dwellings, allotments and associated access, parking, drainage infrastructure and landscaping. The 35 dwellings are a mix of 1 to 4 bed houses consisting of detached, end of terrace, mid-terrace, semi-detached, and flat typologies.

This report demonstrated how the site and the indicative masterplan can meet the requirements of policy CS1 & CS2 of the North Somerset Core Strategy. This includes the use of renewable technologies to meet 15% of predicted energy use of the development. The policy requirements also stipulate reducing energy demand through passive design and efficient systems and ensuring the development proposals are future proofed and can comply with future changes in energy regulations.

At building level energy efficiency measures are proposed to be incorporated, which include:

- Highly efficient building fabric
- Designs that promote winter solar heat gain while avoiding overheating in the summer
- Thermal mass to avoid overheating
- Highly efficient lighting design, including daylight linking and presence detection in non-residential buildings
- Mixed-mode ventilation, with mechanical ventilation and heat recovery
- Efficient building systems

An assessment of alternative energy technologies has shown that solar technologies as well as heat pumps are the most viable options for the site. Air source heat pumps are able to meet the North Somerset Core Strategy CS2 requirement of 15% of energy demands to be met through onsite renewable technologies alone. Therefore, the use of ASHPs is recommended as this will allow the domestic buildings to improve on the requirements of Part L 2013 and exceed the energy contribution target. This will allow the domestic buildings to improve on the requirements of Part L 2013 by over 11%. The ASHP will provide 93MWh of renewable energy per year, which is equivalent to 36% of the site's total energy demand.

A summary of the total carbon and energy reductions from a Part L 2013 baseline through the recommended energy efficiency and renewable energy measures is shown Table 1—1.

Table 1—1 Impact of energy efficiency and ASHP on site carbon and energy demands

		Baseline	**Site with energy efficiency measures**	**Site with energy efficiency measures and ASHP**
Total CO_2 emissions (tonnes/year)	Heating	34	30	25
	Electricity	70	68	68
	Total	**104**	**98**	**93**
		Reduction	***6%***	***11%***
Total Energy (MWh/year)	Heating	156	141	47
	Electricity	134	131	131

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		Baseline	Site with energy efficiency measures	Site with energy efficiency measures and ASHP
	Total	**290**	**272**	**178**
		Reduction	***6%***	***39%***
Proportion of energy demand provided by renewable energy			***32%***	

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2 Introduction

2.1 Project Description

The proposed development at Land south of Warren Lane, Long Ashton, consists of up to 35 dwellings, allotments and associated access, parking, drainage infrastructure and landscaping.

The 35 dwellings are a mix of 1 to 4 bed houses consisting of detached, end of terrace, mid-terrace, semi-detached, and flat typologies.

2.2 Scope

This report demonstrates how the site and masterplan can meet the energy related requirements of policy CS1 and CS2 of the North Somerset Core Strategy and policy Dm[2] of the Development Management Policies: Site and Policies Plan Part 1.

2.3 Energy efficiency approach

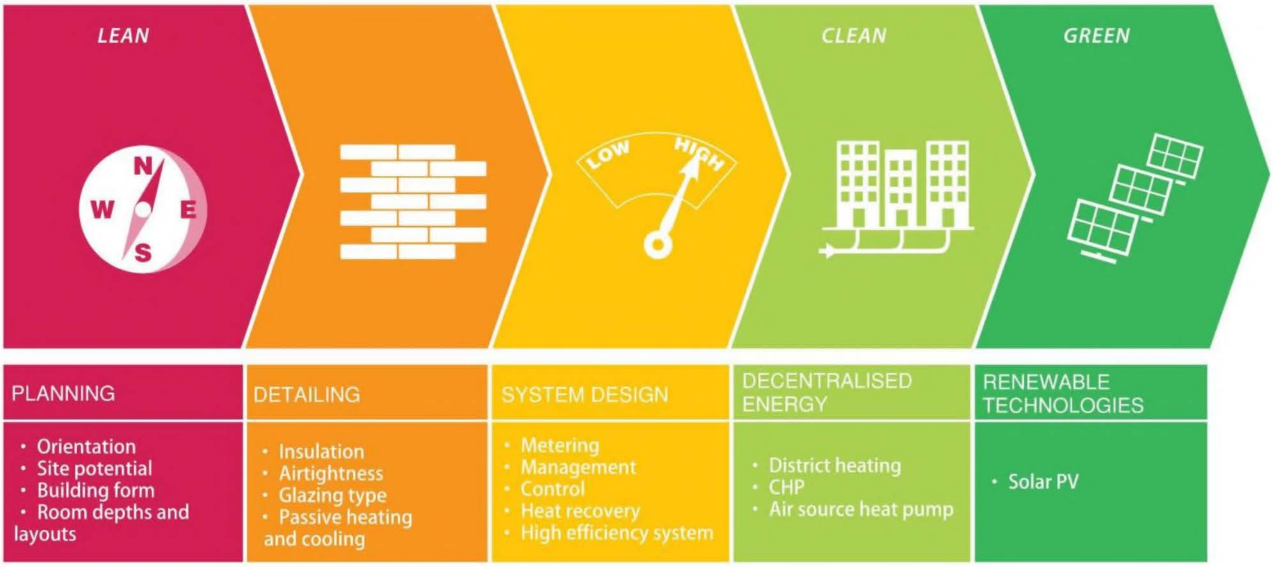

Figure 2—1 The energy hierarchy

The strategy to reduce energy consumption and CO_2 emissions has taken a 'lean, clean, green' approach, as shown in Figure 2—1. The rationale behind this is that it is more feasible and cost effective to first pursue energy reduction through passive design measures such as optimising site layout and fabric efficiency, then system efficiency measures such as low energy lighting before finally considering renewable technologies.

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2.4 Policy Summary

A summary of key national and regional policies related to energy efficiency is provided below.

2.4.1 National Policy

2.4.1.1 Part L of the Building Regulations

The 2013 Building Regulations Part L1A and Part L2A set out minimum legal requirements for energy efficiency in residential (Part L1A) and non-residential (Part L2A) building design.

2.4.1.2 Feed in Tariff and Renewable Heat Incentive

The Feed in Tariff (FIT) and Renewable Heat Incentive (RHI) subsidies for renewable technologies make sustainable electricity and heat generation more financially viable than they would otherwise be.

Following consultations in 2015 and 2018, the FIT scheme's generation tariff and flat rate export tariff closed to new entrants from 31 March 2019 and so will not apply to this development. The government intends to implement a Smart Export Guarantee (SEG). The SEG will be a market-based mechanism, with suppliers free to set prices, in line with government's objective to move towards market pricing. Details of this are yet to be finalised and so have not been considered in this energy statement.

The domestic RHI provides a subsidy per kWh of heat generated for biomass boilers and stoves; air source heat pumps; ground source heat pumps; and solar thermal. The scheme is currently set to close to new applicants in spring 2021.

2.4.1.3 Gas heating ban in new homes

In the Government's 2019 Spring Statement it was announced that gas heating for new homes would be banned from 2025. However, the policy and legislation to implement this has not been developed yet.

2.4.1.4 Zero Carbon Homes policy and Code for Sustainable Homes

The Code for Sustainability Homes scheme was closed except in cases where planning conditions required its use in 2015. The Zero Carbon Homes policy was also removed in 2015. Both these are referenced in North Somerset Council's planning policy and Supplementary Planning Documents but as they have been scrapped at national level it is not possible to apply them to this scheme.

2.4.2 Local policy

2.4.2.1 North Somerset Development Management Policies (2016)

Dm²: Renewable and low carbon energy

The development management policy Dm² supports the use of renewable and low carbon energy generation and local community-based schemes which offer direct benefit to local residents. Its aim is to encourage the most suitable technology for a given location and ensure that schemes do not have an unacceptable adverse impact on the local environment, infrastructure and nearby residents.

They will support proposals for renewable and low carbon energy installations in principle subject to:

- adequate measures being taken to mitigate adverse impacts; and

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- where the environmental, social and economic benefits outweigh any negative impacts.

Their key considerations consist of:

- living conditions, including noise and visual impacts including the cumulative impact on the landscape
- the local natural environment, its resources and characteristics, wildlife and habitats
- local infrastructure resulting from installation and operation of large-scale sites
- any designated or undesignated heritage asset
- the openness of the Green Belt
- the quality and setting of the Mendip Hills Area of Outstanding Natural Beauty (AONB) including both views to and from it
- the safeguarding parameters associated with any identified aerodromes including Bristol Airport.

In addition to any adverse impacts, the positive implications of the proposal should be factored in including the creation of local employment, support for the local economy, the contribution to the reduction in greenhouse gas emissions locally and community ownership benefits. Elements of many renewable energy projects will be considered inappropriate in the Green Belt and AONB, due to their adverse impact on the purposes and objectives of these designations.

Proposals are encouraged that:

- maximise the opportunities for community-led renewable and low carbon energy production. Any additional social and economic benefits which might be gained through a community-led approach will be considered; and
- take advantage of the opportunities to integrate district heating and combined heat and power (CHP) into new and existing development. Where practical and viable, major developments will be encouraged to incorporate infrastructure for district heating or CHP to benefit existing areas.

New development will also be required to demonstrate the application of renewable and low carbon energy generation as part of the energy statement for that site.

2.4.2.2 North Somerset Core Strategy (2017)

The January 2017 North Somerset Core Strategy contains two policies relevant to this Energy Statement:

CS1: Addressing climate change and carbon reduction

Key requirements relevant to the energy statement are:

1. development should demonstrate a commitment to reducing carbon emissions, including reducing energy demand through good design, and utilising renewable energy where feasible and viable in line with standards set out in Policy CS2
2. developers are encouraged to incorporate site-wide renewable energy solutions to be delivered in a phased and co-ordinated way with the proposed development

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3. maximise the opportunities for all new homes to contribute to tackling climate change through adherence to emerging national standards such as the Code for Sustainable Homes to ensure they perform well against evolving energy standards and have a reduced carbon footprint; (NB the Code for Sustainable Homes has been withdrawn at national level, see Section 2.4.1.4)

CS2: Delivering sustainable design and construction

Key requirements relevant to the energy statement are:

1. require designs that are energy efficient and designed to reduce their energy demands;
2. require the use of on-site renewable energy sources or by linking with/contributing to available local off-site renewable energy sources to meet a minimum of 10% of predicted energy use for residential development proposals involving one to nine dwellings, and 15% for 10 or more dwellings; and 10% for non-residential developments over 500m² and 15% for 1000m² and above;
3. require as a minimum Code for Sustainable Homes Level 3 for all new dwellings from October 2010, Level 4 from 2013, rising to Level 6 by 2016. Higher standards will be encouraged ahead of this trajectory where scheme viability specifically supports this. BREEAM 'Very Good' will be required on all non-residential developments over 500m² and 'Excellent' over 1000m²; (NB the Code for Sustainable Homes has been withdrawn at national level, see Section 2.4.1.4)

2.4.2.3 Creating Sustainable Buildings and Places in North Somerset Supplementary Planning Document (2015)

This Supplementary Planning Documents (SPD) provides guidance on how to demonstrate that a development achieves the requirements of Core Strategy Policy CS2: Delivering Sustainable Design and Construction. Key requirements relevant to this application are:

- Sustainable Design Principles: Energy efficient designs to reduce energy demand.
- Renewable and low carbon energy generation: 15% predicted energy demand to be met through renewable/ low carbon sources.
- Zero carbon policy (post-2016): This refers to NPPF Paragraph 95. The version of the NPPF referred in the SPD is now superseded and the 2019 NPPF makes no reference to zero carbon buildings policy. There is currently no national zero carbon building policy (as noted in Section 2.4.1.4) and so the development cannot respond to this.

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3 Baseline energy demand assessment

The baseline energy demand is assumed as a building that complies with Part L 2013 without additional energy efficiency and renewable energy measures, against which the proposed designs will be compared.

3.1 Areas used for energy demand assessment

An assessment of the baseline energy demand for development has been carried out using the floor areas and dwelling numbers shown in Table 3—1. These floor areas correspond with the indicative masterplan.

Table 3—1 Area by typology

Typology	Area [m^2]	Number of dwellings
End of Terrace	669	7
Mid Terrace	488	6
Semi-Detached	1,588	18
Flat	216	4
Total	**2,961**	**35**

3.2 Baseline energy demand

Energy consumption benchmarks for Part L 2013 compliant buildings have been used to provide an energy consumption estimate. The building floor areas have been used with the energy consumption benchmarks in the Appendix to estimate the predicted energy consumption of the development. The baseline energy demand for the site is presented in Table 3—2. Space heating makes up approximately 51% of the site energy demand, with domestic hot water making up 49%. Approximately 85% of the electricity consumption is predicted to be unregulated (such as cooking and appliances), which is not covered by Part L of the Building Regulations.

Table 3—2 Baseline energy demand

	Heating (MWh/year)	Electricity (MWh/year)	Total (MWh/year)
Residential	156	134	290

3.3 Baseline CO_2 emissions

Table 3—3 shows the predicted CO_2 emissions which have been calculated using Part L 2013 CO_2 emission factors. The 2013 baseline assumes gas condensing boilers supplying all space heating and hot water and that no renewable technologies are fitted. Emissions associated with electricity use make up the majority of total emissions due to electricity having a higher CO_2 emission factor than gas. Unregulated electricity consumption makes up 57% of the total emissions, which limits potential CO_2 savings through energy efficiency measures as unregulated energy is largely unaffected by building design.

Table 3—3 Baseline CO_2 emissions

	Heating (tonnes/year)	Electricity (tonnes/year)	Total (tonnes/year)
Residential	34	70	103

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4 Energy Efficiency

4.1 Building energy efficiency measures

There are many building level efficiency measures than can be employed to reduce energy demand. Although the building design has not been carried out at this stage, it is recommended that the following measures are incorporated.

Fabric Performance

The performance of the building fabric is paramount in reducing the space heating demand of buildings. It is recommended that the dwellings on site are constructed to the standards detailed in Table 4—1, which are significantly in excess of the Part L 2013 minimum requirements.

Table 4—1 Recommended insulation and air tightness values

Element	Minimum Part L 2013 value	Recommended minimum value
Exposed walls	0.30 W/m^2K	0.15 W/m^2K
Ground floor	0.25 W/m^2K	0.13 W/m^2K
Roofs	0.20 W/m^2K	0.11 W/m^2K
Windows	2.00 W/m^2K	1.40 W/m^2K
Air tightness	10 $m^3/hr/m^2$ @ 50Pa	3 $m^3/hr/m^2$ @ 50Pa
Thermal Bridging y-value	N/A	0.08 W/m^2K

Solar access design

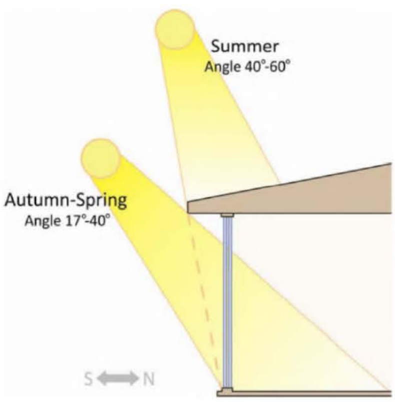

Figure 4—1 Overhand to provide beneficial solar gain

Solar gain is generally beneficial during the winter months as it reduces heating demand and the need for artificial light. However, during the summer months it increases the risk of overheating.

Shading should be provided to windows to allow solar gains to living spaces in winter yet block direct solar gains in peak summer. Overhangs or window reveal depth should be optimised based on the site latitude and the density of the development.

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Thermal mass

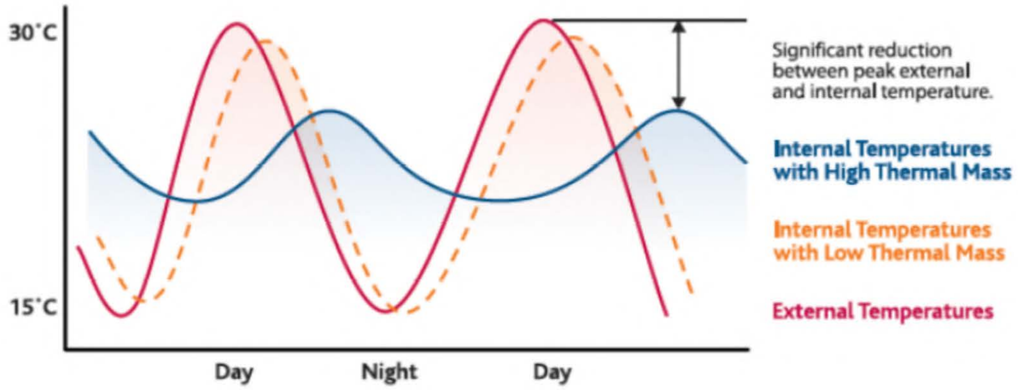

Figure 4—2 Principle of thermal mass

Thermal mass is the ability of a material to absorb, store and release heat; a useful property which helps regulate the temperature in buildings. In the UK, thermal mass can typically keep buildings 4-6°C cooler in peak summer conditions. Thermal mass should be provided where possible to ground floor ceilings within dwellings and where possible to the internal face of external walls. Thermal mass is less beneficial in bedrooms as they are occupied at cooler times of the day.

Lighting

All lighting in the development should be energy efficient LEDs.

Ventilation

As dwelling design and construction becomes more airtight, there is a need to provide a constant level of guaranteed ventilation, to ensure air quality is not compromised. This can be done passively; however, all heat within exhausted air is then lost.

Mechanical Ventilation with Heat Recovery (MVHR) should be provided to ensure constant low-level background ventilation in the highly airtight buildings. Exhaust air is used to pre-heat incoming fresh air, substantially reducing the energy required to treat incoming air, and maintaining a healthy indoor environment in highly air-tight buildings.

MVHR units should be set to run at a low level of background ventilation, with a boost mode which automatically increases the ventilation rate when required, such as when occupants are cooking or showering. Fully openable windows should be provided to allow rapid ventilation and allow a naturally ventilated approach to be adopted during the summer months.

Heating

With sufficient levels of insulation and passive solar design measures, the space heating demand in winter will be significantly reduced compared to existing building stock.

A low temperature heat distribution system should be provided which at a building level provides the following opportunities:

- Implementing weather compensation systems to reduce the heating system supply temperature as outdoor temperatures increase, improving system efficiency

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- Load compensation to reduce supply temperature in line with the whole building energy demand
- Ability to use renewable heating technologies such as heat pumps.

The very low space heat demand could therefore be served by either an underfloor heating system or radiators depending on the architectural requirements and coordination with floor finishes.

Energy consumption and CO_2 emissions

The energy consumption and CO_2 emissions for the proposed development have been calculated following the application of the energy efficiency measures discussed in this section. Details of the energy consumption benchmarks used can be found in the Appendix of this report. Regulated electric energy makes up only 7% of the total energy consumption. Unregulated electricity consumption has been assumed to remain at the level used in the baseline energy demand assessment as it is not covered by Building Regulations and there is currently no recognised standard for calculating reduction through behaviour change measures. Unregulated electric consumption makes up 41% of the total energy consumption and 86% of the electric consumption. Therefore, including unregulated electrical energy as well as regulated is important to truly understand the demands and energy consumption of the proposed development. The impact of the proposed energy efficiency measures is shown in Table 4—2. There is a 10% reduction in regulated energy consumption. The measures are predicted to result in a 7% reduction in the total site energy demand and a 5% reduction in CO_2 emissions.

Table 4—2 Impact of energy efficiency measures on energy consumption and CO_2 emissions

	Baseline	**Site with energy efficiency measures**
Regulated Energy *MWh/year*	176	159
Reduction		10%
Total Energy consumption (including unregulated) *MWh/year*	290	271
Reduction		7%
Total carbon emissions *tonnesCO_2/year*	103	98
Reduction		5%

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5 Energy Generation

This section reviews the potential low and zero carbon energy generation options for the site. The potential viability of district heating systems has been assessed and the suitability of alternative energy technologies has been appraised.

5.1 District heating viability assessment

The viability of district heating networks is dependent on a number of key factors including:

- Heat density
- Heat load profiles
- Infrastructure costs and other capital costs
- Heat generation cost
- Operation and maintenance costs
- Potential energy sale revenues
- Financial incentives
- Risk.

Heat density is typically used as a starting point for assessing the viability of district heating networks. The lower the heat density, the higher the infrastructure capital cost compared to potential revenues. In addition, pipe heat losses make up a greater proportion of the total heat supply, which affects both the financial viability and environmental benefits.

The report 'The Potential and Costs of District Heating Networks' (Poyry and Faber Maunsell, 2009) was prepared for the UK Department of Energy and Climate change and investigates the viability of district heating to serve the existing building stock within the UK. The report takes a minimum area heat density of 26kWh/m^2/year as the threshold for district heating viability.

The predicted heat density for the development is 7kWh/m^2/year, which is considerably less than the minimum threshold identifies above. Therefore, district heating is not considered viable for the development.

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5.3 Alternative energy technology appraisal

This section appraises the feasibility of alternative energy technologies for the site. The technologies have been considered operating in isolation.

5.3.1 Solar Thermal

Solar thermal collectors absorb direct solar radiation and transfer it to a circulating fluid, which exchanges the absorbed heat with a hot water store. Solar thermal collectors are less affected by over shadowing than solar PV. Optimum performance for solar thermal is orientated within 30° of south. A large proportion of the roofs in the indicative masterplan are orientated within 30° of south, which shows the site can deploy solar technologies effectively. Solar thermal panels can be installed on east and west facing roofs but a greater area is needed due to the reduced solar radiation. They are particularly applicable to domestic properties, where improving building fabric standards will mean that domestic hot water will form an increasingly high proportion of overall energy demand. Solar thermal panels are typically sized so that they provide all a building's hot water demand during the summer months.

Table 5—1 Solar Thermal Advantages and Disadvantages

Advantages	Disadvantages
Proven and widely used technology	Requirement for additional pipework and storage systems
Can be installed on a building-by-building basis without the need for expensive infrastructure	High capital cost
Provides free energy	Topographic or building shading can reduce suitable areas for deployment and influence performance
Well suited to domestic buildings due to high hot water demand	
Makes use of otherwise unused roof space	

5.3.2 Solar PV

Solar photovoltaic panels convert direct and diffuse energy from the sun into electrical energy. Panels can be installed on singular building bases or on a larger scale as part of a field array. Optimum annual output is achieved with panel's orientated within 30° south at an inclination of between 30° and 40°. However, east or west facing roofs are acceptable as the output better meets typical residential occupancy patterning.

Table 5—2 Solar PV Advantages and Disadvantages

Advantages	Disadvantages
Secure and independent power supply	Diurnal power output
Easily integrated into buildings	Topographic or building shading can reduce suitable areas for deployment and influence performance
Roof application makes use of unexploited area	
Low maintenance and long-life span	
South-West of UK has high levels of solar irradiation	

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5.3.4 Ground Source Heat Pump

Ground Source Heat Pumps convert low grade heat energy in the ground to higher grade heat energy that can be used for space heating with the use of an electrically powered refrigeration cycle. They can also provide cooling by reversing the process. A typical COP for heating with a GSHP system is between 3.5 and 4, a typical cooling COP is between 4 and 5. The COP of the system is dependent on both the ground temperature and the temperature of the heating system. It is preferable to have a low temperature heating system to maximise the COP and therefore it is typically used in conjunction with underfloor heating. Heat pumps cannot efficiently meet the temperatures required for domestic hot water. Therefore, if a heat pump is the only heating system within a building then an electric immersion heater or similar will be required for domestic hot water in order minimise the risk of Legionella. The heat exchanger within the ground can be configured in two ways; A horizontal 'slinky' of pipework or pipework within vertical boreholes. A horizontal system typically has a lower capital cost than vertical systems.

Table 5—3 Ground Source Heat Pump Advantages and Disadvantages

Advantages	Disadvantages
Little visual impact	Expensive to install
Annual CO_2 savings will increase as the electricity grid decarbonises	Ideally requires large areas of ground which will not be built on
	Require low temperature heating systems

5.3.5 Air Source Heat Pumps

Air source heat pumps extract heat from the outside ambient air converting it to a higher grade for delivery to the occupied space via direct air or hot water distribution. Like GSHPs, ASHPs do this with the use of an electrically powered refrigeration cycle. In the UK's mild climate ASHPs typically achieve an annual COP of 2-3, which is dependent on external air temperatures. At low temperatures (<5°C), ASHPs COP can drop to close to 1 due to the frosting of air intakes. They operate best with low temperature heating systems such as underfloor heating. ASHPs can be easily installed on an individual building scale. They are similar in size and look to small air-conditioning units and need to be fitted so that they have direct and consistent external air supply.

Table 5—4 Air Source Heat Pumps Advantages and Disadvantages

Advantages	Disadvantages
Cost efficient method of providing renewable energy	Potential noise issues in areas with sensitive receptors
Annual CO_2 savings will increase as the electricity grid decarbonises	Require low temperature heating systems

5.3.6 Biomass Boilers

Biomass is a solid plant sourced fuel such as wood chip, pellet or log. It can be used to fuel stoves and boilers from household to district scales, providing a secure, cost effective and potentially sustainable source of heat. Small wood burning stoves (often with back boilers) or biomass boilers can be used to meet individual dwellings' heating and hot water demands. Pellet or wood chip biomass boilers can also be used for non-domestic buildings. However, having many small systems is likely to create issues due to the number of separate fuel deliveries required and also could have a more detrimental impact on air quality than the equivalent capacity in one large boiler. In addition, the increased operational and maintenance requirements of the system may not be attractive to many home purchasers.

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For the reasons stated above biomass boilers were ruled out as a feasible alternative energy source for the development.

5.3.7 Combined Heat and Power

Combined Heat and Power (CHP) generation integrates the production of useable heat and electricity for individual building or district use. The use of CHP enables heat otherwise wasted in the process of electricity generation to be used. CHP systems can use a multitude of fuels from gas to biomass with CHP systems offering CO_2 savings on conventional grid energy supply. CHP systems should avoid modulating their output to ensure operational efficiency is maintained and therefore should be designed to meet the heating baseload of the development to maximise running hours and minimise the number of times the CHP turns on and off.

As a district heating network is not viable for the site the only way CHP could be integrated would be at a building scale. Although small scale domestic units are available, they have very low electrical outputs (typically 1kW electrical output for 12kW heat output) and so offer marginal CO_2 savings compared to a modern high efficiency gas boiler but have a much-increased capital and maintenance cost. These issues would be accentuated by the highly insulated and airtight homes proposed. In addition, by the mid-2030s gas CHP will have higher emissions than gas boilers due to the decarbonisation of the electricity grid. Therefore, CHP is not considered viable for the development.

5.3.8 Wind Turbine

Wind turbines are well known as sources of renewable energy. The best location for a wind turbine is in an exposed site with high average wind speeds and the potential to connect to a much larger energy distribution infrastructure. Smaller turbines can be located in many areas but need good exposure to the wind to be economically viable. Wind turbines often attract considerable planning attention and will have to locate sufficiently far from developable land, in particular residential properties, to minimise the impact of noise and shadow flicker. The minimum recommended distance from residential properties to avoid detrimental noise issues for an 11kW turbine is 50-100m, for an 80kW turbine this rise to 100m-150m. Even if an 11kW turbine was placed on the edge of the site it would sterilise around 40% of the site for residential construction. Therefore, a wind turbine is not viable for the development.

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Table 5—5 Energy technology summary

Technology	Comments	Suitability
District heating	The predicted heat density for the development is 7kWh/m^2/year, which is considerably less than the minimum threshold identified by the UK government. Therefore, district heating is not considered viable for the development.	
Solar thermal	Solar thermal could be provided for the development but require more ongoing maintenance from homeowners than using solar PV.	
Solar PV	Solar photovoltaic panels make good use of the development roof area. Easily integrated into buildings and they are relatively low maintenance with a long-life span. Covering 20% of roof area of the development could provide ~15% of the development's energy from renewable sources.	
Ground source heat pumps	GSHPs have very little visual impact and will benefit from an increase in annual CO_2 savings as the electricity grid decarbonises. However, they are fairly expensive to install. Providing heating energy from a GSHP to the development could provide ~30% of the development's energy from renewable sources.	
Air source heat pump	ASHPs can be easily installed on an individual building scale. They are similar in size and look to small air-conditioning units and need to be fitted so that they have direct and consistent external air supply. They are a cost-efficient method of providing renewable energy and will benefit from an increase in annual CO_2 savings as the electricity grid decarbonises. Providing heating energy from an ASHP to the development could provide ~35% of the development's energy from renewable sources.	
Biomass boilers	Many dwelling level biomass boiler could have a detrimental impact on air quality. In addition, the increased operational and maintenance requirements of the system may not be attractive to many home purchasers. Therefore, biomass boilers are ruled out as a feasible alternative energy source for the development.	
CHP	Although small scale domestic units are available they have very low electrical outputs and so offer marginal CO_2 savings compared to a high efficiency gas boiler. By the mid-2030s gas CHP will have higher emissions than gas boilers due to the decarbonisation of the electricity grid. Therefore, CHP is not considered viable for the development.	
Wind turbine	Proximity to residential properties means that it is not a viable option for the development due to noise levels.	

Solar PV, solar thermal, GSHP or an ASHP are deemed as the most appropriate technologies to be used on the site. For this outline planning application, air source heat pumps are proposed as the renewable technology to meet the Policy CS2 requirements. This is because a ASHPs:

- Meet planning policy CS2 by contributing on-site renewable energy to meet a minimum of 15% of predicted energy use
- Will provide annual CO_2 savings that will improve as the electricity grid decarbonises
- Ensure the development can comply with the proposed 2025 requirement for there to be no gas boilers in new dwelling
- Are a cost efficient method of providing renewable energy.

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6 Conclusions

The development proposals for the site are capable of meeting the requirement of North Somerset Core Strategy CS1 & CS2 and current national legislation. At building level energy efficiency measures are proposed, which include:

- Highly efficient building fabric
- Designs that promote winter solar heat gain while avoiding overheating in the summer
- Thermal mass to avoid overheating
- Highly efficient lighting design
- Mixed-mode ventilation, with mechanical ventilation and heat recovery
- Efficient building systems

The application of these measures is predicted to reduce total energy demand (regulated and unregulated) by 7% compared to buildings constructed to comply with the minimum requirements of Part L 2013. This would reduce CO_2 emissions by 5%.

An assessment of alternative energy technologies has shown that solar technologies as well as heat pumps are the most viable options for the site. Air source heat pumps are able to exceed the North Somerset Core Strategy CS2 requirement of 15% of energy demands to be met through onsite renewable technologies. Therefore, the use of ASHPs is recommended as this will allow the domestic buildings to improve on the requirements of Part L 2013 and exceed the energy contribution target.

A summary of the total carbon and energy reductions from a Part L 2013 baseline through the recommended energy efficiency and renewable energy measures is shown in Table 6—1. Table 6—2 gives the summary by regulated use only.

Table 6—1 Impact of energy efficiency and ASHP on total site carbon and energy demands

		Baseline	**Site with energy efficiency measures**	**Site with energy efficiency measures and ASHP**
Total CO_2 emissions (tonnes/year)	Heating	34	30	25
	Electricity	70	68	68
	Total	104	98	93
		Reduction	*6%*	*11%*
Total Energy (MWh/year)	Heating	156	141	47
	Electricity	134	131	131
	Total	290	272	178
		Reduction	*6%*	*39%*
Proportion of energy demand provided by renewable energy				*32%*

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Table 6—2 Impact of energy efficiency and ASHP on site regulated carbon and energy demands

		Baseline	Site with energy efficiency measures	Site with energy efficiency measures and ASHP
Total Regulated CO_2 emissions (tonnes/year)	Heating	34	30	25
	Electricity	11	10	10
	Total	45	40	35
		Reduction	*11%*	*22%*
Total Regulated Energy (MWh/year)	Heating	156	141	47
	Electricity	21	19	19
	Total	175	158	65
		Reduction	*10%*	*63%*
Proportion of energy demand provided by renewable energy				*53%*

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Appendix A Key Assumptions

A.1 Energy Consumption Benchmarks

Benchmarks have been used to estimate the total energy demand of the development and are shown in Table A—1. The regulated energy for domestic properties (space heating, domestic hot water, fixed lighting, pumps and fans) has been determined through carrying out SAP calculations of indicative building typologies. The baseline figures represent the minimum standards of fabric efficiency required to pass current building regulations without the need for renewable technologies. The improved values reflect the improved fabric efficiency standards that are proposed for the development.

It should be noted that unregulated electricity use, which is not covered by Building Regulations, makes up a large proportion of energy consumption in non-domestic buildings and has been assumed to remain constant in the improved options.

Table A—1 Energy consumption benchmarks

Building Type	Heating Energy ($kWh/m^2/year$)	Electrical Energy (Regulated only) ($kWh/m^2/year$)	Source
Baseline Detached	47.2	5.8	Regulated energy – SAP Unregulated energy - BREDEM
Baseline End of Terrace	49.0	6.8	As Above
Baseline Mid Terrace	42.2	7.1	As Above
Baseline Semi Detached	49.0	6.8	As Above
Baseline Flat	48.3	7.2	As Above
Improved Detached	42.2	5.2	As Above
Improved End of Terrace	44.4	6.2	As Above
Improved Mid Terrace	37.5	6.3	As Above
Improved Semi Detached	44.4	6.2	As Above
Improved Flat	43.7	6.5	As Above

Table A—2 Technical calculation assumptions

Assumption	Value	Unit
CO_2 emission factor for natural gas	0.216	$kgCO_2/kWh$
CO_2 emission factor for grid electricity	0.519	$kgCO_2/kWh$
O_2 emission factor for grid displaced electricity	0.519	$kgCO_2/kWh$
Gas boiler efficiency	91	%
Solar PV energy generation	130	$kWh/m^2/year$
PV power	0.15	kWp/m^2
ASHP heating efficiency	270	%
GSHP heating efficiency	300	%

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