ENERGY AND SUSTAINABILITY STATEMENT

150A TOMS LANE

KINGS LANGLEY

WD4 8NZ

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All information provided here is based on plans and information available at the time of writing. Prior to implementation of the options discussed, further detailed study, design, and costing, based on ground surveys, structural analysis, over shading studies, etc., as relevant to each renewable/low carbon source, is necessary.

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1. EXECUTIVE SUMMARY

Development at 150A Toms lane, Kings Langley, WD4 8NZ was investigated to test compliance with Part L Volume 1 of the Building Regulations. The SAP calculations have demonstrated the proposed construction is an efficient building that fully complies with the Part L2021 regulations.

The statement has been prepared to satisfy the planning requirements to grant a permission for the New house at 150A Toms lane, Kings Langley, WD4 8NZ, Additionally, it highlights the energy demand assessment providing information on the proposed energy efficient, passive measures and renewable energy technologies.

The Three Rivers Distric Council (Climate Emergency & Sustainability Startegy) require all development proposals to make the fullest contribution to minimising carbon dioxide emissions in accordance with the energy hierarchy. As per the Climate Emergency & Sustainability Startegy, all developments should be achieve minimum 20% carbon redcution over Part L 2013.

The key results for carbon emissions are as follows:

	Regulated Carbon Dioxide Emissions	
	Tonnes CO_2 per annum	Savings (%)
Baseline	1.90	-
Be Lean	1.50	21%
Be Clean	1.50	0.0
Be Green	0.60	48%
Total Savings	**1.3**	**70%**

Hence this development achieves **69.86%** reduction over the PartL1A target, which is compliant with the planning policy. The development will also accommodate ASHP along with **3.20 kWp** Photovoltaic panel array in order to maximise on-site renewable.

2. INTRODUCTION

This report outlines the calculations for New house at 150A Toms lane, Kings Langley, WD4 8NZ with regards to the following:

- CO_2 emissions
- Building fabric performance
- Building services performance

The purpose of the calculations is to demonstrate compliance with 'Part L 2021' of the Building Regulations which applies to new build dwellings. The site will be designed and constructed to reduce energy demand and carbon dioxide emissions. The target is to minimise the regulated carbon emissions in accordance with the energy hierarchy and achive net zero carbon target.

The approved SAP 10.2 calculation methodology was used to perform the analysis.

To accurately establish the geometry of the building a complete 3D model was created using Google SketchUp (Version 7.0).

Detailed energy analysis could then be completed using SAP 10.2 (Version 2.13.2 ERC V17.44).

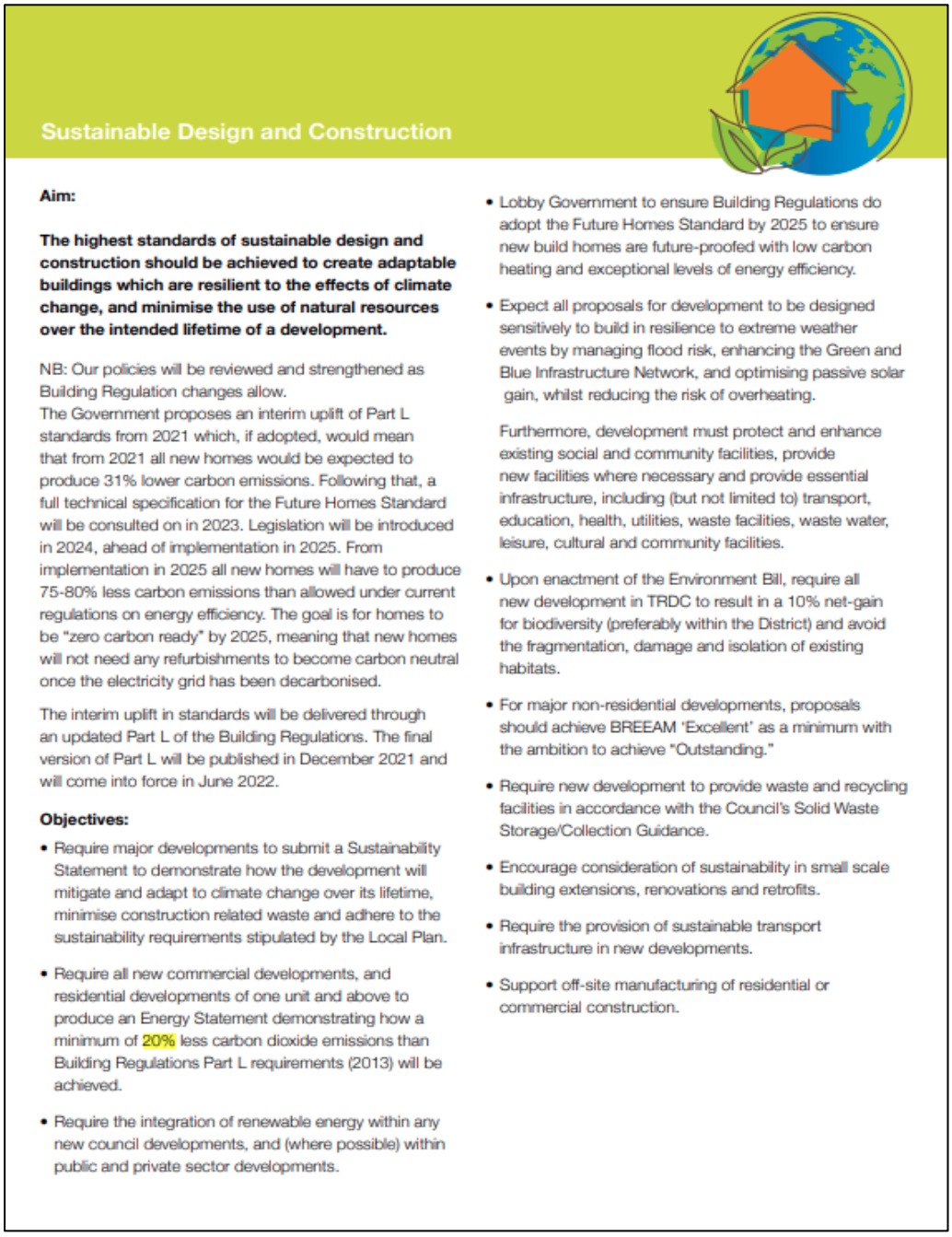
3. PLANNING POLICIES

This Energy Statement addresses local and National planning policies which relate to sustainable design and construction mainly contained within the Three Rivers District Council.

Below are the main policies New House at 150A Toms lane, Kings Langley, WD4 8NZ will needs to adhere to:

3.1 Climate Emergency & Sustainability Strategy

This Energy and sustainability statement is provided to address the following:



Sustainable Design and Construction

Aim:

The highest standards of sustainable design and construction should be achieved to create adaptable buildings which are resilient to the effects of climate change, and minimise the use of natural resources over the intended lifetime of a development.

NB: Our policies will be reviewed and strengthened as Building Regulation changes allow.
The Government proposes an interim uplift of Part L standards from 2021 which, if adopted, would mean that from 2021 all new homes would be expected to produce 31% lower carbon emissions. Following that, a full technical specification for the Future Homes Standard will be consulted on in 2023. Legislation will be introduced in 2024, ahead of implementation in 2025. From implementation in 2025 all new homes will have to produce 75-80% less carbon emissions than allowed under current regulations on energy efficiency. The goal is for homes to be "zero carbon ready" by 2025, meaning that new homes will not need any refurbishments to become carbon neutral once the electricity grid has been decarbonised.

The interim uplift in standards will be delivered through an updated Part L of the Building Regulations. The final version of Part L will be published in December 2021 and will come into force in June 2022.

Objectives:

- Require major developments to submit a Sustainability Statement to demonstrate how the development will mitigate and adapt to climate change over its lifetime, minimise construction related waste and adhere to the sustainability requirements stipulated by the Local Plan.
- Require all new commercial developments, and residential developments of one unit and above to produce an Energy Statement demonstrating how a minimum of 20% less carbon dioxide emissions than Building Regulations Part L requirements (2013) will be achieved.
- Require the integration of renewable energy within any new council developments, and (where possible) within public and private sector developments.
- Lobby Government to ensure Building Regulations do adopt the Future Homes Standard by 2025 to ensure new build homes are future-proofed with low carbon heating and exceptional levels of energy efficiency.
- Expect all proposals for development to be designed sensitively to build in resilience to extreme weather events by managing flood risk, enhancing the Green and Blue Infrastructure Network, and optimising passive solar gain, whilst reducing the risk of overheating.

  Furthermore, development must protect and enhance existing social and community facilities, provide new facilities where necessary and provide essential infrastructure, including (but not limited to) transport, education, health, utilities, waste facilities, waste water, leisure, cultural and community facilities.
- Upon enactment of the Environment Bill, require all new development in TRDC to result in a 10% net-gain for biodiversity (preferably within the District) and avoid the fragmentation, damage and isolation of existing habitats.
- For major non-residential developments, proposals should achieve BREEAM 'Excellent' as a minimum with the ambition to achieve "Outstanding."
- Require new development to provide waste and recycling facilities in accordance with the Council's Solid Waste Storage/Collection Guidance.
- Encourage consideration of sustainability in small scale building extensions, renovations and retrofits.
- Require the provision of sustainable transport infrastructure in new developments.
- Support off-site manufacturing of residential or commercial construction.

3.2 DM4 Carbon Dioxide Emissions and On-Site Renewable Energy

DM4 Carbon Dioxide Emissions and On-Site Renewable Energy

a) From 2013, applicants will be required to demonstrate that development will produce 5% less carbon dioxide emissions than Building Regulations Part L requirements (2013) having regard to feasibility and viability. This may be achieved through a combination of energy efficiency measures, incorporation of on-site low carbon and renewable technologies, connection to a local, decentralized, renewable or low carbon energy supply.

In the event of a delay to the revision of Part L of the Building Regulations anticipated in October 2013, applicants will be required to demonstrate that development will produce 10% less carbon emissions than required by Building Regulations Part L 2010 until such a time the revisions are made.

b) From 2016, applications for new residential development will be required to demonstrate that the development will meet a zero carbon standard (as defined by central government). The same standard will be applied for non domestic buildings from 2019.

c) In line with Government policy, the Council will support a range of allowable solutions for dealing with the remaining carbon emissions. This may include payment into a Carbon Offset Fund which will be used to retrofit existing building stock with energy saving measures for the future. The approach will be set out in a further SPD.

4. PART L COMPLIANCE

4.1 Part L1A Criteria

As a new build dwelling, the project will need to comply with Part L Volume 1 of the Building Regulations. This document highlights the minimum energy performance reqquirements for new buildings:

Criterion 1:

"Where a building is erected, it shall not exceed the target CO2 emission rate for the building that has been approved pursuant to regulation 25, applying the methodology of calculation and expression of the energy performance of buildings approved pursuant to regulation 24."

Criterion 2:

"Where a dwelling is erected, it shall not exceed the target fabric energy efficiency rate for the dwelling that has been approved pursuant to regulation 25, applying the methodology of calculation and expression of the energy performance of buildings approved pursuant to regulation 24"

Criterion 3:

"Where a building is erected it must not exceed the target primary energy rate for the building which has been approved pursuant to regulation 25(c), applying the methodology of calculation and expression of the energy performance of buildings approved pursuant to regulation 24."

4.2 Part L Compliance Results based on 2021 building regulations.

The full results summary can be found as below in Appendix 2:

- SAP Input
- Regulation Compliance Report

4.3 Part L 2021 Compliance Conclusion

Results (Table 1) show that an **69.86 %** improvement in carbon emissions over part L2021 can be achieved through the proposed passive and active measures and due to ASHP and introduction of photovoltaic panels, we are able to demonstrate planning reduction target. Therefore, it complies with the current Local Plan requirement.

Fabric Energy Efficiency ($kWh/m^2.annum$)			Carbon emissions ($kgCO_2/m^2.annum$)			Primary Energy ($kWh_{PE}/m^2.annum$)		
TFEE	DFEE	Improvement	TER	DER	Improvement	TPER	DPER	Improvement
42.11	38.26	9.14%	7.40	2.23	69.86%	39.63	27.09	18.91%

Table 1: Fabric energy efficiency, carbon emissions and Primary Energy results using passive and active measures.

5. BASELINE CASE

The baseline CO_2 emissions are calculated from the 'notional' building using the Part L software tools. The 'notional' building consists of standard set of fabric and services parameters which deliver the Target Emissions Rate. This is then used as the Baseline emissions from which savings from 'Be Lean, Be Clean, Be Green' measures are calculated.

Table 2 below shows the regulated baseline figures.

	Carbon Dioxide Emissions (Tonnes CO_2 per annum)
	Regulated
Baseline	1.90

Table 2: Baseline Carbon Emissions for the proposed development.

6. DEMAND REDUCTION (BE LEAN)

6.1 Passive Measures

In this section, a number of passive measures are proposed prior to the implementation of LZC technologies. In general, the "fabric first" approach is being followed so as to lower the energy demand as much as possible, followed the proposal of efficient systems and finally the application of low-carbon and renewable energy systems.

6.1.1 Fabric

A key component for Part L 2021 is the Fabric Energy Efficiency Standard (FEES), which sets a target figure in kWh/m2 for energy demand in new dwellings. FEES is assessed using Dwelling Fabric Energy Efficiency (DFEE) and Target Fabric Energy Efficiency (TFEE) values and can only be improved through the building fabric.

Table 3 shows how the U-values and airtightness of the development has been improved from the minimum standards set out in Part L.

Element	Targeted value	Part L Notional value	Improvement over Notional value	Part L minimum value	Improvement over minimum value
External Wall U-value ($W/m^2.K$)	0.17	0.18	5.55%	0.26	34.61%
Ground Floor U-value ($W/m^2.K$)	0.11	0.13	15.38%	0.18	38.88%
Roof U-value ($W/m^2.K$)	0.11	0.11	-	0.16	31.25%
Glazing U-value ($W/m^2.K$)	1.3	1.2	-	1.60	18.75%
Airtightness ($m^3/m^2.h$)	4	5	20%	8.00	50%

Table 3: Targeted values compared with Part L 2021 Notional and minimum values.

6.1.2 Thermal bridging

Part L1A 2021 places an increased importance on addressing thermal bridging. Thermal bridging can be minimised through careful detailing or the use of Accredited Construction Details (ACDs). For this assessment, ACDs details have been employed for all junction types.

6.2 Active measures

The following active measures have been used to establish the baseline:

- **Boiler**: High efficiency condensing boiler to match notional Building Spec
- **Heating controls**: Time and temperature zone control by suitable arrangement of plumbing and electrical services.
- **Ventilation**: Whole House Mechnical Ventilation system
- **Lighting**: 90 Lm/w in all areas

6.3 Carbon Emissions Reduction

Table 4 shows the resulting carbon emissions of the development before and after applying the "Be Lean" measures outlined above.

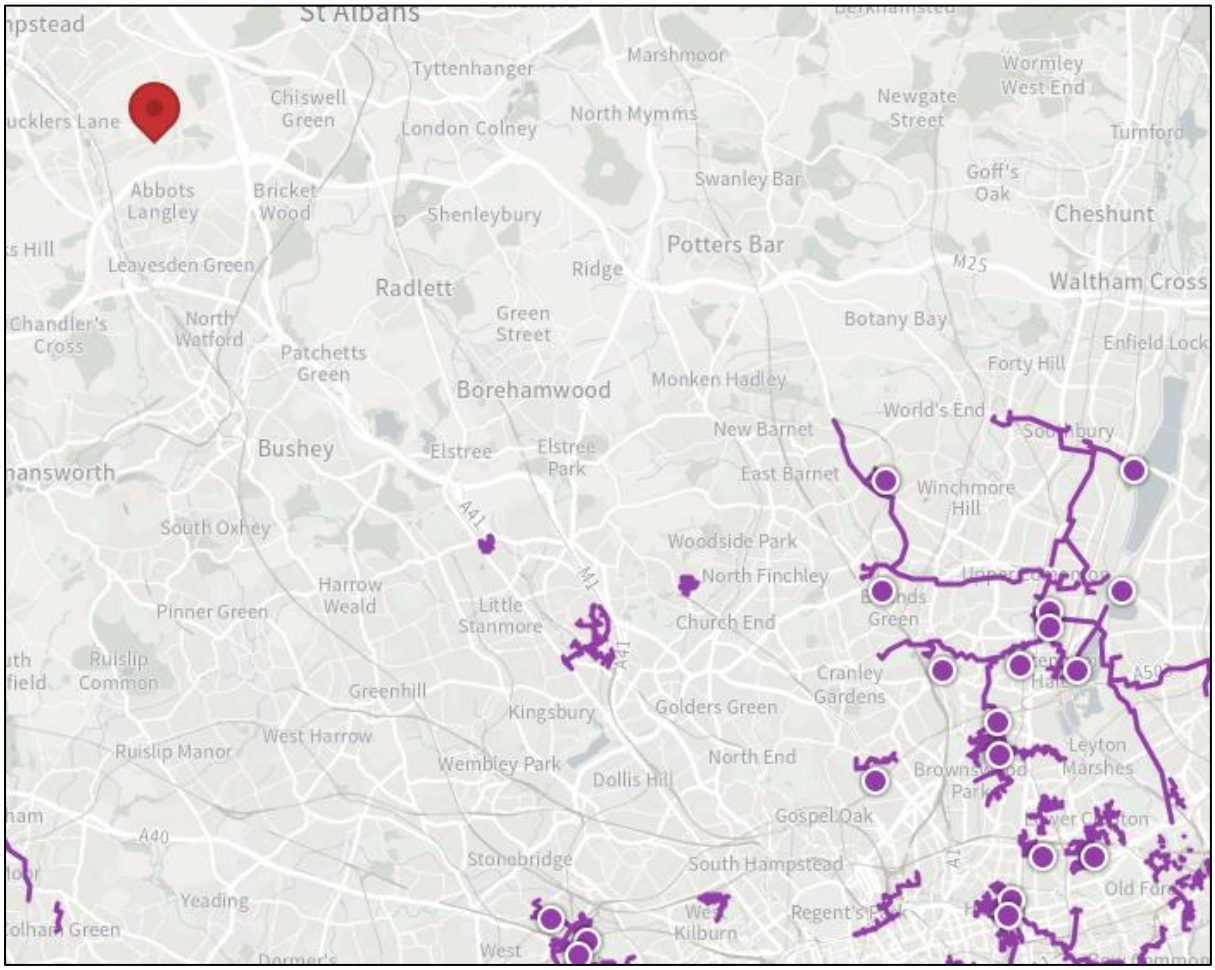
	Regulated Carbon Dioxide Emissions	
	Tonnes CO_2 per annum	Savings (%)
Baseline	1.90	-
Be Lean	1.50	21%

Table 4: Be Lean Reduction in Carbon Emissions.

7. SYSTEM EFFICIENCY (BE CLEAN)

7.1 Local Site CHP

Residential sites typically provide only small electrical baseloads making this technology unsuitable and economically unfeasible to operate. In order for the use of CHP to be viable it is essential that the demand for heat and electricity are simultaneous. This is often a problem in the summer months are the need for heating is reduced, whilst the electricity demand remains fairly constant. Additionally, the installation of a CHP requires large up-front capital investment.



There are no heat networks near the vicinity of the site.

For the above reason connection to a district heating network has been ruled out as an option.

7.2 Carbon Emissions Reduction

Since a district heating connection, or on-site CHP is unviable, no carbon emissions reductions are available using these measures.

8. RENEWABLE ENERGY (BE GREEN)

An initial review was conducted to eliminate any technologies which from the outset have been identified as unviable. This can be found in Appendix 2: Preliminary Appraisal of Renewable Energy Options.

From this study, ASHP and Solar PV has been identified as the most effective technology for the development.

8.1 ASHP

The proposed design uses ASHP serving heating and hot water requirements. At this stage, we have used Mitsubishi ECODAN 11.20 KW system to perform the calculations.

8.2 Solar Photovoltaic

Solar photovoltaic panels provide renewable electricity to a building. To maximise efficiency, panels should be South oriented with an elevation of 10-45°. There must be minimal shading of the panels as shading will reduce performance.

The panels require little maintenance although the inverters (which convert the generated DC power to AC for use in the building) are likely to require replacement every 10-15 years.

For 150A Toms lane, PV panels can be placed on the Pitched roof, South Facing without any significant overshading problems. We have alowed for 08 Panels .i.e 400 W per panel.

A 1.58 kWp PV array has been proposed on the roof, which is equivalent to approximately 8.0 m² of panel area, based on typical PV output per 2.0 m² figures.

It should be noted that a structural review will be required to ensure whether these roofs can support the load of the solar panels.The PV panels can also be located on the West facing roof if required.

8.3 Carbon Emissions Reduction

Table 1 show the reduction in CO_2 emissions associated with each set of measures. With the proposed Solar PV array and ASHP, a total reduction of 69.86 % .

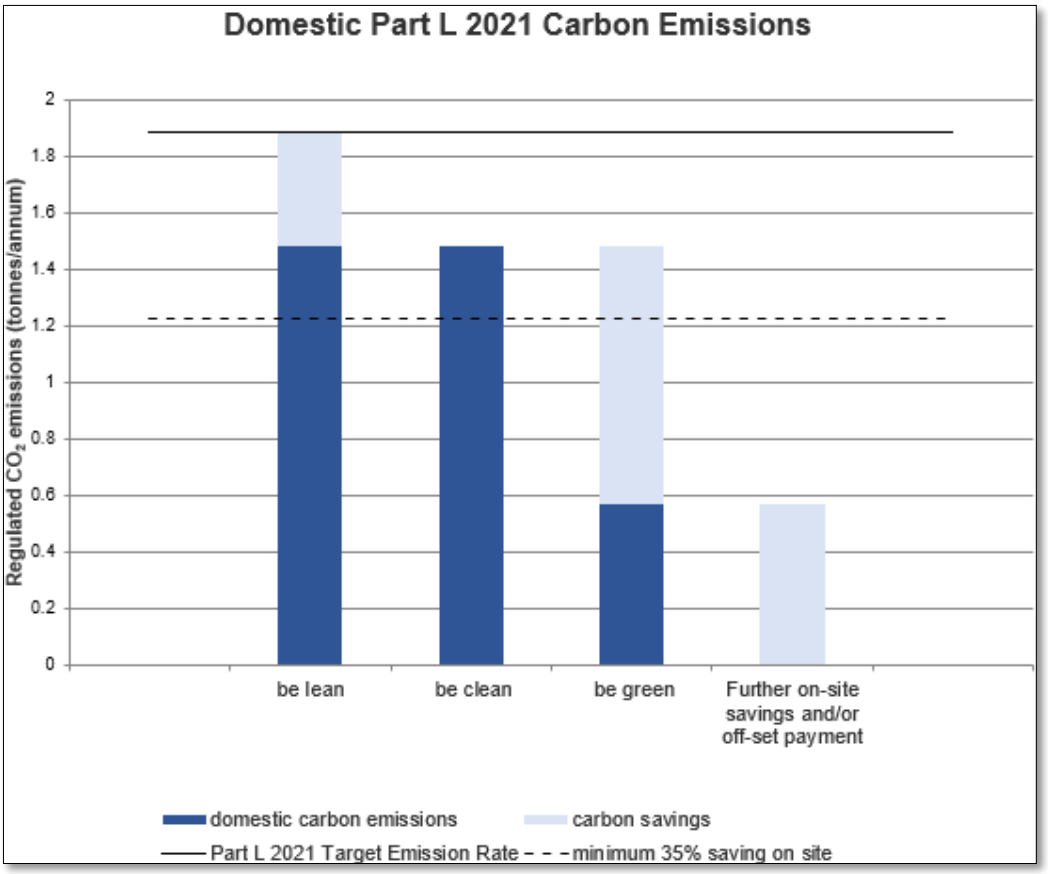
8.4 Carbon Emissions Reduction

Table 4 show the reduction in CO_2 emissions associated with each set of measures. With proposed scheme we are able to achieve 54.35% reduction in carbon emission over part L 2021, Which is more then planning requirement.

The key results for carbon emissions are as follows:

	Regulated Carbon Dioxide Emissions	
	Tonnes CO_2 per annum	Savings (%)
Baseline	1.90	-
Be Lean	1.50	21%
Be Clean	1.50	0.0
Be Green	0.6	48%
Total Savings	**1.30**	**70%**

Table 4: Be Lean, Be Clean, Be Green Reduction in Carbon Emissions.



9. APPENDIX 1: KEY MODELLING INPUTS

9.1 Related Documents

Architectural drawings were used to create the FSAP model of the dwelling.

9.2 SAP Specification

The following input were used in creating the FSAP model:

Construction details		
Floor	Ground floor U-value (W/m^2.k)	0.11
Wall	Wall U-value (W/m^2.k)	0.17
Roof	Pitched roof (Joist) U-value (W/m^2.k)	0.11
	Flat roof U-value (W/m^2.k)	0.11
Doors & Glazing	Door U-value (W/m^2.k)	1.3
	Window U-value (W/m^2.k)	1.3
	Glazing g-value	0.71
	Glazing frame factor	0.70/0.50
Thermal Mass Capacity		Medium
Thermal Bridging		Y Value – 0.035
Ventilation		
Ventilation type		Whole house MVHR – Nuaire MRXBOXAB-ECO3
No. of fans		6
Air permeability (m^3/h.m^2)		4.0
Primary heating details		
Heating system		ASHP – ECODAN 11.2 KW
Heating emitter		Underfloor heating, pipes in screed
Heating fuel		Electricity
ASHP model		Mitsubishi ECODAN 11.2KW
ASHP efficiency		291.0%
Weather/load compensator		No
Heating controls		Time and temperature zone control by suitable arrangement of plumbing and electrical services
Pump in heated space		Yes
interlock		Yes
Delayed start thermostat		No
Water Heating		
Hot water system		From main heating system
Cylinder volume (litre)		150
Cylinder heat loss factor (kWh/day)		2.09
Cylinder in heated space		Yes

Cylinder stat	Yes
Primary pipework insulated	Fully insulated primary pipework
Water heating timed separately	Yes
Lighting	
Percentage of low energy lights	100% - 90 Lm/w
PV Panel Parameters	
Collector Power (kWp)	3.20
Panel Area (m^2)	8 (approximately)
Tilt of Panel (^{0})	30
Panel Orientation (^{0})	South

10. APPENDIX 2: SAP REPORTS

10.1 BREL

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Fri 23 Feb 2024 15:43:13

Project Information			
Assessed By	Zahid Ashraf	Building Type	House, Detached
OCDEA Registration	EES/027335	Assessment Date	2024-02-23

Dwelling Details			
Assessment Type	As designed	Total Floor Area	255 m^2
Site Reference	150a Toms Lane - ASHP	Plot Reference	027 - ASHP Updated
Address	152a Toms Lane, WD4 8NZ		

Client Details	
Name	Client
Company	Company
Address	Address, Town, AA11 1AA

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*7.4 kgCO_2/m^2*	
Dwelling carbon dioxide emission rate	2.23 kgCO_2/m^2	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*39.63 kWh$_{PE}$/m^2*	
Dwelling primary energy	27.09 kWh$_{PE}$/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*42.1 kWh/m^2*	
Dwelling fabric energy efficiency	38.3 kWh/m^2	OK

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.17	Walls (1) (0.17)	OK
Party walls	*0.2*	N/A	N/A	**N/A**
Curtain walls	*1.6*	N/A	N/A	**N/A**
Floors	*0.18*	0.11	Floor (0.11)	OK
Roofs	*0.16*	0.11	Roof (1) (0.11)	OK
Windows, doors, and roof windows	*1.6*	1.3	N Entrance (1.3)	OK
Rooflights	*2.2*	1.3	S Roof light, South (1.3)	OK

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	104.49	0.17
Exposed wall: Walls (2)	76.18	0.17
Ground floor: Floor, Floor	150.32	0.11
Exposed roof: Roof (1)	43.5	0.11
Exposed roof: Roof (2)	104.56	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
N Entrance , Windows	3.84	North	0.7	1.3
GF N Window, Windows	6	North	0.7	1.3
GF E Window, Windows	0.72	East	0.7	1.3
GF S Window, Windows	18.88	South	0.7	1.3
FF N Window, Windows	7.8	North	0.7	1.3
FF E Window, Windows	1.08	East	0.7	1.3
FF S Window, Windows	7.68	South	0.7	1.3
FF W Window, Windows	0.72	West	0.7	1.3
S Roof light, Roof Light	5.23	South	0.7	1.3

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))
Building part **1 - Main Dwelling**: Thermal bridging calculated from linear thermal transmittances for each junction

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.083	
External wall	E4: Jamb	Calculated by person with suitable expertise	0.016 **(!)**	
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.063	
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.001 **(!)**	
External wall	E11: Eaves (insulation at rafter level)	Calculated by person with suitable expertise	0.02 **(!)**	
External wall	E13: Gable (insulation at rafter level)	Calculated by person with suitable expertise	0.038 **(!)**	
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.035 **(!)**	
External wall	E3: Sill	Calculated by person with suitable expertise	0.021 **(!)**	
Roof	R1: Head of roof window	SAP table default	0.24	
Roof	R2: Sill of roof window	SAP table default	0.24	
Roof	R3: Jamb of roof window	SAP table default	0.24	
Roof	R4: Ridge (vaulted ceiling)	SAP table default	0.12	
External wall	E24: Eaves (insulation at ceiling level - inverted)	SAP table default	0.15	
External wall	E10: Eaves (insulation at ceiling level)	SAP table default	0.12	

3 Air permeability (better than typically expected values are flagged with a subsequent (!))		
Maximum permitted air permeability at 50Pa	*8 m^3/hm^2*	
Dwelling air permeability at 50Pa	4 m^3/hm^2, Design value	OK
Air permeability test certificate reference		

4 Space heating	
Main heating system 1: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	290.6%
Emitter type	Both radiators and underfloor
Flow temperature	45°C
System type	Heat Pump
Manufacturer	Mitsubishi Electric Europe B.V.
Model	Ecodan 11.2kW
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	150 litres
Declared heat loss	2.09 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls	
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	

Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	90 lm/W	**OK**
External lights control	N/A	

8 Mechanical ventilation		
System type: Balanced whole-house mechanical ventilation with heat recovery		
Maximum permitted specific fan power	*1.5 W/(l/s)*	
Specific fan power	1.11 W/(l/s)	**OK**
Minimum permitted heat recovery efficiency	*73%*	
Heat recovery efficiency	87%	**OK**
Manufacturer/Model	MRXBOXAB-ECO3, MRXBOXAB-ECO3C	
Commissioning		

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	3.2 kWp
Orientation	South
Pitch	30°
Overshading	None or very little
Manufacturer	8 KWP
MCS certificate	

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

12 Declarations	
a. Assessor Declaration	
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.	
Signed: Name:	Assessor ID: Date:
b. Client Declaration	
N/A	

11. APPENDIX 3: PRELIMINARY APPRAISAL OF RENEWABLE ENERGY OPTIONS

This appendix summarises the preliminary analysis of renewable energy options, and identifies which should be assessed in further detail, and which should be discounted because of clear technical reasons or other obstacles.

LZC Technology	Basic Technical Information	Technical, Environmental & Economic implications / Considerations	Suited Application	Site Specific Comment	Detailed Analysis?
Solar thermal	Solar collectors (flat plate or tube) transfer energy into transfer liquid to a closed loop twin coil hot water cylinder	+ Government grants available (RHIs) +/- Can meet a significant proportion of the DHW demand - Efficiency effected by site factors – shading, orientation and roof/ground space -Requires considerable hot water demand all year round to be finically beneficial	Domestic and commercial applications with high annual hot water load; leisure centres, canteens, washrooms	The site does not have a large enough hot water demand to propose solar thermal	No
Wind turbine	Turbine/generator converts wind energy to electrical power.	+ Government grants available (FITs) + Allows on site generation of renewable electricity - Can create structural, vibrations and noise implications - Not suited for urban environments - Costs can be high in relation to the actual amount of electricity generated - Potential for additional planning issues	Large sized turbines in non-urban or offshore locations will be more effective	Significant planning uses for free standing turbine. Roof mounted turbines generally ineffective. Detailed study of site wind conditions would be required.	No
Solar Photo-voltaic	Converts sunlight to DC electrical power which then using an inverter to convert to DC.	+ Government grants available (FITs) + Allows on site generation of renewable electricity + Generally payback between 7-12 years + Low maintenance requirements - Efficiency effected by site factors – shading, orientation and roof/ground space	Wide range of building types particularly buildings with limited solar shading and south facing roof	This technology is appropriate for the dwelling on the basis that: There is a demand for electricity. Maintenance requirements are very low. No complex plant to accommodate.	Yes
Air source heat pump	Air Source Heat Pumps (ASHP) capture heat from the outside air and transfer the heat directly to the air inside the building or transferring the heat to a liquid medium that can be pumped around the building	+Lower installation cost that ground source heat pump + Can provide heating and cooling + Government grants available (RHIs) -COP is not as good during the heating season when the outside air temperature is often less than the ground temperature -Can restrict distribution strategies -Carbon saving are less clear cut	Wide range of building types particularly building designed to have low temperature heat emitters.	The house residence has enough space for the outdoor unit, where acoustics and aesthetics are unlikely to be an issue. ASHP will be installed 12 -13 meter at the rear of the property, hence won't require sound report.	Yes
Ground Source Heat Pump	Ground Source Heat Pumps (GSHP) capture heat from the ground and transfer the heat to a liquid medium that can be pumped around the building	+ COP is much better than air source heat pumps + Government grants available (RHIs) -Requires area for ground collector or borehole -High initial capital cost - Can restrict distribution strategies -Carbon saving are less clear cut	Suits building designed to have low temperature heat emitters with sufficient space for necessary ground works	Not considered suitable for the residence house due to high capital cost.	No
Biomass	Uses biomass as a fuel source for space heating and hot water	+ Government grants available (RHIs) + Renewable source of heating - Requires large fuel storage capacity - Generally a large capital cost	Building/site with sufficient access and storage facilities and a capable maintenance team	There is insufficient storage space and very limited access for regular deliveries to warrant further investigation.	No