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Energy Statement
Demolition of two storey garage/workshop and erection of a single storey dwelling with integral garage on land to the rear of 20 Willow Lane, Cranwell, Sleaford, Lincolnshire NG34 8DQ

Document Reference: 1594-1-ENS JG Rev A

December 2023 (updated May 2024)

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APPENDIX

1. EXECUTIVE SUMMARY

1.1. This Energy Statement is prepared to show how the application for a single dwelling on land within the developed footprint of Cranwell village will comply with the Central Lincolnshire Local Plan relating to energy efficiency in new buildings. It will indicate how the building has been designed to meet best energy efficiency standards and how it complies with relevant planning policies.

1.2. The Local Plan policies addressed are:

Policy S6: Design Principles for Efficient Buildings

Policy S7: Reducing Energy Consumption – Residential Development

1.3. The proposed residential bungalow will be on land within the residential curtilage of 20 Willow Lane, Cranwell NG34 8DQ.

1.4. The scheme has been designed to consider existing site conditions together with the wider local area.

1.5. The route to compliance will be the SAP (Standard Assessment Procedure) route. This will demonstrate compliance with Part L of the Building Regulations, and it will also be used to generate Energy Performance Certificates (EPCs).

1.6. The scheme has an optimised orientation and built form to meet policy objectives and targets at a reduced construction cost in comparison to a design that isn't optimised for energy efficiency.

1.7. The proposed low thermal energy demand is complimented by highly efficient building fabric.

<u>Orientation</u>

1.8. The orientation of the proposed infill development is within the developed footprint of the village and is dictated by the site position in relation to the existing roads and existing building at 20 Willow Drive.

1.9. The proposal is on a corner plot and is orientated accordingly within the existing development.

1.10. The proposal has a north south orientation to allow the majority of solar panels to be positioned on the south facing roof, to maximise solar gain.

Form factor

1.11. A good form factor for a building is one that minimises the heat loss through the external surfaces, while maximising the useful floor area.

1.12. The proposed bungalow is a simply shaped building of compact design which will make it more efficient due to having less exposed external surface area per square metre of internal floor area. It has a low form factor of 3 (Passive house design aims for 3 or less).

Site Geography

1.13. Existing landscaping features do not block or limit incidental sunlight. There is no impact on the natural environment and there is no need to remove existing trees. There are no adverse impacts on locally important wildlife features. The development will have no impact on any designated open spaces.

1.14. Neighbouring buildings have been considered in the building placement and they will not cause significant overshadowing.

1.15. The topography of the site has not impacted adversely on the orientation of the building. However, the building has been orientated to suit the existing street layout.

1.16. To limit the risk of summer overheating, a natural purge ventilation strategy has been incorporated to utilise prevailing winds. Air input is to be provided by ensuring 10mm gap under all internal doors. Purge ventilation to be provided to all habitable rooms by opening lights achieving 1/20 of floor area.

Solar Gains

1.17. The layout of the proposed bungalow is on an east/west axis as dictated by the existing village layout.

1.18. Reducing solar gains to prevent overheating in the summer is important and we will achieve this by using shade and ventilation within the building design, ensuring the building is well insulated and using the most effective and energy efficient form of heating to work alongside the natural warmth of the sun.

1.19. Solar gain can change the heating requirements of an area quickly, therefore an electric underfloor heating system which will be powered by an Air Source Heat Pump is proposed. This is the best responsive

heating solution for use with passive solar gain as they offer quick heat up times and precise temperature control. Radiant floor heaters allow for multi-zone heating where the temperature of individual rooms can be set independently from each other to accommodate for possible heat gains in different parts of the home.

1.20. The building will be well insulated to prevent indirect solar gain into the building and maximise the efficiency of heating and ventilation systems as well as reducing heating bills.

1.21. Control of solar gain will be achieved through design considerations such as deep window reveals to provide better shading and reduce solar heat gain and attention to window aspect.

1.22. To control the indirect (diffuse) radiation, low-E glass will be specified that will also be low shading coefficient glazing.

1.23. Interior shading and glare control devices are to be specified such as venetian blinds or adjustable louvres.

Place making

1.24. The application proposal is to demolish a 2-storey garage/workshop and replace it with a 3 Bedroom single storey detached dwelling with an integral garage in an area of land last used as part of the rear garden of 20 Willow Lane, Cranwell NG34 8DQ. The plot will require a new access to be formed off The Willows.

1.25. Policy S1: The Spatial Strategy and Settlement Hierarchy of the Central Lincolnshire Local Plan (the CLLP) classifies Cranwell as a 'Medium Village'.

1.26. Policy S4: Housing Development in or Adjacent to Villages supports residential development proposals for unallocated sites for up to 10 dwellings and within the developed footprint of the village subject to: preserving or enhancing the settlement's character and appearance; not significantly harming the character and appearance of the surrounding countryside or the rural setting of the village; and be consistent with other policies in the development plan.

1.27. The proposed single storey dwelling will not unacceptably reduce privacy and/or amenity of nearby properties; there is appropriate https://www.3cx.com/ access, off street parking and turning arrangements; development will not impact on the safe flow of traffic;

the proposal is not back land development; there is no impact on the natural environment and the development can include biodiversity enhancements; there are no adverse impacts on locally important heritage assets and/or wildlife features; the development will have no impact on any designated open spaces; the dwelling will be to modern Building Regulation requirements so will meet the demands to respond to climate change and there is adequate capacity for all utilities.

1.28. Consideration within the design stages has been given for the accessibility of the proposal and its safety and connection to the site and local area. This will allow for good mobility throughout the area and will enable the community to engage and interact together.

1.29. The design will include features such as effective external lighting and will maximise natural surveillance. The site will have well defined routes, spaces, and entrances that provide for convenient movement without compromising security.

1.30. Consideration has been given throughout the design phase for access in terms of mobility. The scheme is in accordance with the requirements of Approved Document Part M of the Building Regulations.

2. INFORMATION CHECK LIST

Item	Location and additional comments	Provided?
Completed Energy Efficiency Checklist	Provided alongside application as a separate document.	√
Table format setting out the standards being achieved in the scheme as set out in the Design Guide	Provided in Executive Summary	√
Detailed SAP Calculations	Provided at Appendix B	√
Details of glazing proposed	Provided in Executive Summary and Introduction	√
Details of insulation proposed	Provided in Introduction	√
Details of ventilation proposed	Provided in Executive Summary, Introduction and Conclusion	√
Details of heat supply proposed	Provided in Introduction	√
Details of heat pump and renewables	Shown in Executive Summary and Introduction	√
Orientation plan	Provided in support of Planning Application	√

Introduction

2.1. The application proposes the erection of a 3 Bedroom single storey detached dwelling with an integral garage which will include a charging point for electric vehicles.

2.2. The design, scale and layout of the proposed development reflects and relates well to the street scene and surroundings.

2.3. The design has been formulated with the 'energy efficient design hierarchy' as a basis to ensure all that is feasible and practical for this project has been considered to optimise the energy efficiency of the proposal, while at the same time creating an aesthetically pleasing building that will fit in well with the surrounding area and provide a comfortable and pleasing living space.

Fabric First; Optimising building materials and air tightness

2.4. The Built Fabric Specification;

Air-tightness target	5.01
What **ventilation strategy** will be used in the building/s?	Extract ventilation
Efficiency of MVHR unit (if proposed)	

Complete the below table with the proposed **fabric u-values** of the different building elements.

External walls	0.18
Floor	0.12
Roof	0.07
Windows and doors	1.2

Plot 1 dwelling fabric energy efficiency (SAP), kWh-/m2	39.26

Heat supply

Will units be served by individual, communal of district heating systems?	Individual
What systems will provide **space heating** and **hot water** in the building/s?	ASHP <45
Dwelling primary energy, kWhPE/m2	16

Renewable Energy

Please complete the table below for **renewable energy** provision:

Which technology/technologies will be installed on the site?

Solar PV (Each panel 1.92m2)

Total installed capacity on-site, kWp

5.2

Site wide annual renewable energy generation, kWh/yr

4765.3611

What programme or calculation methodology has been used to calculate the above renewable energy outputs?

SAP

Complete the below as applicable.

Solar photovoltaics	Plot 1
Renewable energy generation intensity, kWh/m2/yr*	49.34
PV panel efficiency rating, W	400
Surface area of roof, m2	96.58
Area of PV panel, m2	24.96
No. storeys to building	1

Indicators (for officer use)

Annual generation per m2 building footprint, kWh/ms(f.p.)*	0.51087182
% of surface area of roof covered by PV	26%

Materials and building techniques will be used that reduce heat and energy need to the proposed dwelling.

Ground Floor

2.5. The ground floor will consist of 65mm screed (incorporating underfloor heating system) on VCL on 130mm Kingspan Kooltherm K103 floor insulation boards, laid on 100mm ground bearing concrete floor slab. 25mm insulation to continue around floor perimeter to avoid thermal bridging. DPM under floor slab on 50mm sand blinding. On min. 150mm well-rammed consolidated hardcore.

The overall floor construction to achieve a U-value of 0.12W/m2K.

External cavity wall

2.6. The external cavity wall construction to consist of 102.5mm Limestone walling with 150mm cavity with 100mm Kingspan Thermawall TW50 PIR rigid cavity board insulation. Inner skin of 100mm Celcon standard blockwork. Wall finish to be 12.5mm plasterboard on dot and dabs with a plaster skim finish.

2.7. External wall cavities to be closed at window reveals, jambs, cills and top of wall with Kingspan Kooltherm Cavity Closers, with insulation to avoid cold bridging.

The overall external wall construction to achieve a U-value of 0.18W/m2K.

Roof

2.8. The roof to consist of roof tiles (as per material specification) on softwood tanalised battens, on Tyvec breathable membrane, on timber roof trusses as per specialist roof manufacturers design.

2.9. Horizontal roof insulation to consist of 1 layer of 150mm Earthwool Loft Roll 44' mineral wool insulations, laid between ceiling joists and 3 layers 150mm Earthwool Loft Roll 44' laid over the ceiling joists.

2.10. Sloping roof insulation to consist of 150mm Kingspan Kooltherm K107 insulation boards tightly fitted between rafters. 82.5mm Kingspan Kooltherm K118 fitted under the rafters with 3mm skim finish.

2.11. Flexible Rockwool insulation to be tightly packed to block cold bridging and retard air infiltration at eaves.

The overall roof construction to achieve U-value of 0.07W/m2K.

External openings

2.12. External openings to consist of UPVC double-glazed units with an argon filled gap and with a soft low-E glass.

2.13. Insulated plasterboard to be used in reveals to abut jambs and to be considered within reveal soffits. Fully insulated and continuous cavity closers to be used around reveals. Window and door frames to be taped to surround openings using air sealing tape.

2.14. Window Energy Rating to be Band A or better.

The window and door openings to achieve U-value of 1.2W/m2K.

2.15. Using highly insulated building materials constructed in a continuous way to limit thermal bridging and heat loss, thus isolating the internal from the external environment. The proposed building will maintain comfortable, consistent indoor temperatures with minimal energy demand.

2.16. The air tightness of the building will be optimised with the thermal elements and continuity of insulation throughout its envelope to enable control of internal temperatures with a minimum of energy use.

Ventilation – Fresh air provision and hot ait purging

2.17. To limit heat losses and maximise building energy efficiency, controlled natural ventilation will deliver fresh air to meet ventilation requirements and prevent moisture or carbon dioxide build-up.

2.18. To ensure good transfer of air through the dwelling there should be an undercut of minimum area of 760mm in all internal doors above floor finish. (Equivalent to an undercut of 10mm for a standard door).

2.19. The highly insulated building fabric will reduce heat loss and minimise heating loads on the colder winter days.

2.20. Natural ventilation purging with a window opening strategy to purge hot air will be used. Cross ventilation where window openings on opposite sides of the building will deliver the greatest flow-rate potential.

2.21. The minimum total area of opening in accordance with Table 1.4 Building Regulations Approved Document F1.

2.22. Hinged or pivot windows with an opening angle of 15 to 30 degrees to have an openable area in excess 1/10 of the floor area of the room.

2.23. External doors and sash hinged or pivot windows with an opening angle of equal to or greater than 30 degrees to have an openable area more than 1/20 of the floor area of the room.

2.24. Purge ventilation should be capable of extracting at least 4 air changes per hour per room directly to the outside.

2.25. The minimum whole dwelling ventilation rate for the supply of air to the habitable rooms to be 0.3 litres per second per m² of internal floor area.

Extract Ventilation

2.26. Overall ventilation free area in accordance with Approved Document Part F, table 5.2a (System 1) - New Dwelling.

2.27. Kitchens to have ducted cooker hood with extractor capacity of 30L/S or wall mounted extractor fan with extract fan ducted to outside air with extract capacity of 60L/S.

2.28. Utility to have a wall mounted extractor fan with extract fan ducted to outside air with capacity of 30L/S.

2.29. Bathrooms to have ventilation provided by opening casements with minimum area of 1/20th of floor area and a mechanical extract fan ducted to outside air with extract capacity of 15 L/S.

2.30. Separate sanitary accommodation (wc) to have opening casement or top hung fan light with minimum opening area of 1/20th of floor area or mechanical extract fan operated by light switch and ducted to outside air with extract capacity of 6 L/S and be fitted with a 15-minute over-run.

2.31. Extractors serving Bathrooms to be operated by light switch to give extract of 15 litres/second and be fitted with 15minute over-run facility.

2.32. Air input to be provided by ensuring 10mm gap under all internal doors. Purge insulation to be provided to all habitable rooms by opening lights achieving 1/20 of floor area.

2.33. The air flow rate of mechanical ventilation should be tested, recorded and reported to building control in compliance with regulation 42.

Embodied Carbon

2.34. The development will, where practical and viable, take opportunities to reduce the development's embodied carbon content, through the careful choice, use and sourcing of materials.

2.35. Repurposing existing assets or materials, using lower emission materials and where practical and viable, using electric construction equipment.

2.36. The proposal is in a location that will not require unusually deep or heavy foundations.

2.37. The use of cast-in-place concrete has been avoided. This results in the heaviest of all structural solutions. Instead, pre-cast concrete beam and block floors will be used.

2.38. Wherever possible timber will be used in place of concrete blocks to construct partitions and non-load-bearing walls.

2.39. Minimum carbon performances of building materials will be specified and the use of recycled materials where reasonably practicable. For example, recycled binders for concrete.

2.40. Wherever possible, low carbon materials will be selected with the intension to use fewer materials without compromising quality and selecting the right building materials with recycled content.

2.41. For example:

Building products will be specified using companies such as Kingspan. Kingspan are partnering with H2 Green Steel and SAAB respectively to utilise low carbon2 steel in their construction materials. Kingspan also aim for a 50% reduction in the embodied carbon intensity of their primary raw materials by 2030.

Heat Supply

2.42. To comply with policies S6, S7 and S8, there will be net zero carbon content of heat supply. There will be no connection to the gas network or use of oil or bottled gas.

2.43. An Air Source Heat Pump below 45°c flow temperature will be installed to provide both underfloor heating and domestic hot water. The make and model will be a MEDIA V12W (12kw) air to water Heat Pump. Chosen for its many benefits including, high performance with A+++ seasonal efficiency. It is easy to install and easy to control. It will provide heating, cooling, and hot water. It has a long-life expectancy with minimal service and maintenance needs.

2.44. The choice of system will be informed by the building and site context to ensure energy efficiency is maximised, and to minimise energy demand.

2.45. Appropriately sized hot water / thermal stores to buffer demands and allow for optimum operation will be incorporated.

2.46. It will deliver a space heating system optimised for low flow temperatures to deliver maximum heating efficiency for the heat pump.

2.47. Best practice guidance will be followed by CIBSE.

Maximise system efficiency;

Reduce flow rate;

2.48. Absolute demand reduction technologies, such as low flow fixtures and tank insulation will be prioritised.

2.49. Fixtures and fittings will follow the recommended specifications in 'The AECB Good Practice Fittings Standard', as below;

Showers	- 6 to 8 l/mm measured at installation
Basin taps	- 4 to 6 l/min measured at installation (per pillar tap or per mixer outlet)
Kitchen sink taps	- 6 to 8 l/min measured at installation
WCs	- ≤ 6 l full flush when flushed with water supply connected
Baths	- ≤ 180 litres measured to the centre line of overflow

Reduce distribution losses;

2.50. All pipework will be insulated and designed to ensure there are no 'dead legs' containing more than 1 litre. Tapping points (e.g. taps, shower connections) should be clustered near the hot water source. Small bore pipework will be carefully sized based on peak demands, minimising the diameter where possible.

Insulate to minimise losses from hot water tanks;

2.51. The target for hot water tank heat loss will be of less than 1kWh/day equivalent to 0.75W/K.

Occupant Control;

2.52. A non-technical, plain English guide to operating and maintaining energy systems will be provided to building users and operators.

Monitoring;

2.53. Throughout the design phases, a series of assumptions will be relied on regarding occupant behaviour to inform the system design and optimisation of the building.

2.54. In practice, the energy system within the building will be monitored. Post-occupancy monitoring will be used to inform building operators on where certain systems are consuming more energy than expected and guidance will be provided on where to focus to achieve reductions in practice. An example of this would be the use of an electricity SMART meter.

Renewable energy generated.

2.55. The proposal aims to generate enough energy from renewable sources on-site to meet reasonable estimates for all regulated and un-regulated total annual energy demand across the year.

2.56. Total energy demand is indicated in Energy Efficiency Checklist

2.57. Local renewable energy generation will be provided by the incorporation of photovoltaic roof panels. Proposed PV installed will cover 25% roof area. See Energy Statement Checklist.

2.58. As calculated in the associated SAP Calculation, the sum of the energy demand minus the annual energy produced by the PV indicates that the PV generation clearly outweighs the demand.

2.59. To achieve maximum generation potential careful utilisation of space and panel angles will be given consideration by the system designer and installer. The roofs will not be overshadowed by existing buildings or trees.

2.60. DNO should be approached to establish if grid upgrades will be necessary to support the renewable energy integration.

2.61. To maximise on-site consumption, demand shift technologies or storage will be utilised.

2.62. For example, utilising a SMART domestic hot water cylinder which can absorb solar energy throughout the day to provide hot water for the evening.

3. CONCLUSION

3.1. During the design of the project, using the 'Fabric First approach' every consideration has been made to optimise the energy efficiency and airtightness practicably and viably within the proposal.

3.2. It is a small-scale private project and as such the feasibility of various methods and materials must be considered.

3.3. The buildings form, building materials and air tightness have all been optimised, as well as taking into consideration material and build costs for the project.

3.4. Various ventilations systems have been compared. Due to the small-scale nature of the project, it was calculated that the cost of an MVHR system will be beyond the viability of the project. Also, the fan-power energy cost of MVHR systems is often not that effective given the air-flow limits.

3.5. A more suitable and cost-effective ventilation system for this project is to utilise natural ventilation. This will create energy savings through reduced fan energy usage. Expert advice will be obtained to demonstrate that the solution meets the performance standards set out in Appendix B of Approved Document F.

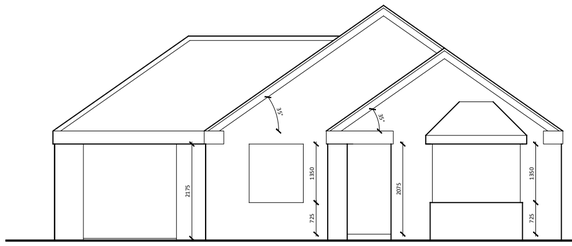
3.6. Sustainable and renewable energy systems have been compared and considered for the most efficient system for the building to create an energy efficient and comfortable and aesthetically please home that fits in with the local surroundings.

3.7. Using highly insulated building materials constructed in a way that minimises heat loss, the buildings will isolate the internal from the external environment to enable control of internal temperatures with a minimum of energy use.

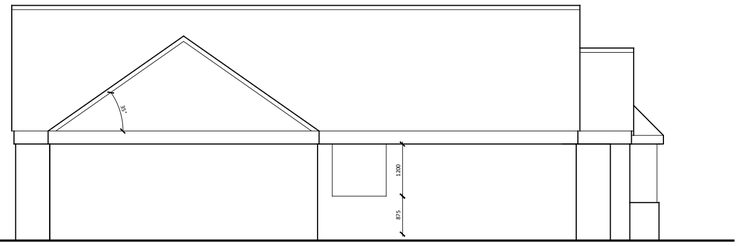
Appendix A

Plans:

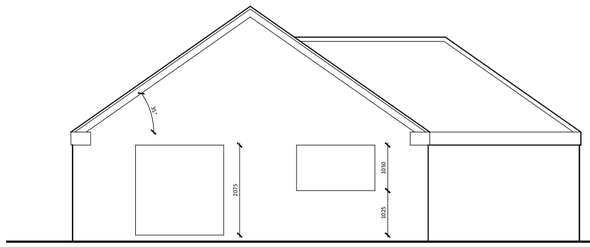
1594-1_PL_GA01



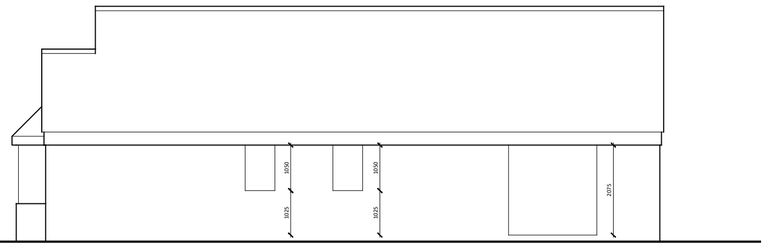
Proposed East Elevation 1:100



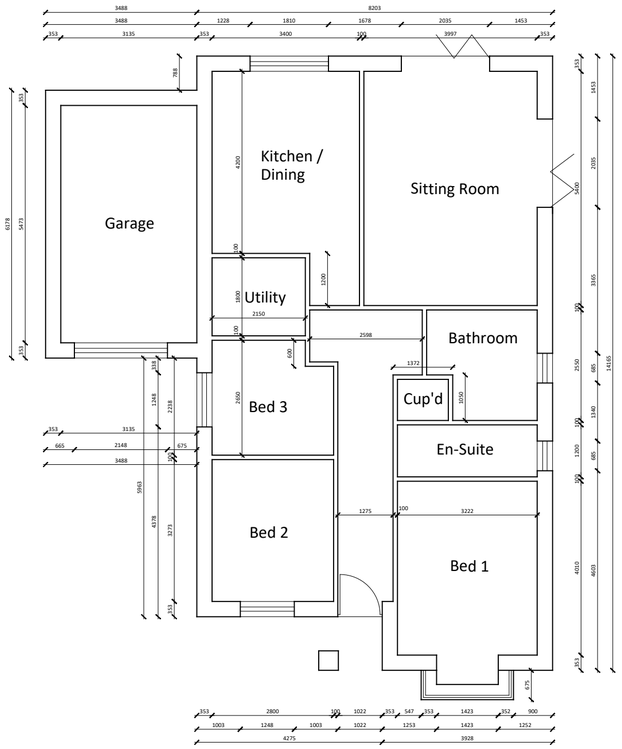
Proposed south Elevation 1:100



Proposed West Elevation 1:100



Proposed North Elevation 1:100



GROUND FLOOR LAYOUT 1:50

PRELIMINARY DRAWING ISSUED FOR COMMENT & SCHEME PROGRESSION ONLY.

Notes

Dimensions
All dimensions shown are for the purposes of obtaining the relevant planning permission only.

CDM 2015
This drawing is for illustrative purposes and/or obtaining the relevant planning permission only. It should not be used for construction and accordingly, risk identification under the Construction (Design & Management) Regulations 2015 has not been undertaken.

0 1 2 3 4 5m

Rev	Description	Date
-	-	-

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Client
Oak Mill Properties Ltd

Project
20 Willow Lane,
Cranwell

Drawing
Approximate Outline of General Layout

Scale @ A2	Date
1: 100	27/11/23

Drawn By	Checked By
JG	PSS

Job Number	Status	Purpose of Issue
1594-1	PL	Planning

Drawing No. **Rev**
1594-1_GA01 -

Appendix B

Full Sap Calculation Printout

Full SAP Calculation Printout

Property Reference	NG34 8DQ	**Issued on Date**	15/02/2024
Assessment Reference	New Planning Application	**Prop Type Ref**	
Property	New dwelling at, 20, Willow Lane, Cranwell, Lincs, NG34 8DG		

SAP Rating	98 A	**DER**	-1.42	**TER**	8.93
Environmental	101 A	**% DER < TER**			115.90
CO_2 Emissions (t/year)	-0.18	**DFEE**	39.26	**TFEE**	43.97
Compliance Check	See BREL	**% DFEE < TFEE**			10.70
% DPER < TPER	80.81	**DPER**	9.25	**TPER**	48.20

Assessor Details	Mr. Jake Eaton	**Assessor ID**	P711-0001
Client			

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	96.5800	(1b)	x 2.4000	(2b) =	231.7920	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.5800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		231.7920	(5)

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2. Ventilation rate

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	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	5 * 10 =	50.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.2157 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0100 (17)
Infiltration rate		0.4662 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4312 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5498	0.5391	0.5283	0.4744	0.4636	0.4097	0.4097	0.3989	0.4312	0.4636	0.4852	0.5067	(22b)
Effective ac	0.6512	0.6453	0.6395	0.6125	0.6075	0.5839	0.5839	0.5796	0.5930	0.6075	0.6177	0.6284	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1			2.5200	1.2000	3.0240			(26)
Opening Type 2 (Uw = 1.20)			17.5500	1.1450	20.0954			(27)
Heatloss Floor 1			96.5800	0.1200	11.5896	75.0000	7243.5000	(28a)
New Cavity Wall	103.8300	20.0700	83.7600	0.1800	15.0768	60.0000	5025.6000	(29a)
External Roof 1	96.5800		96.5800	0.0700	6.7606	9.0000	869.2200	(30)
Total net area of external elements Aum(A, m2)			296.9900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		56.5464			(33)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13138.3200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.0356 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	12.9000	0.2680	3.4572
E3 Sill	11.7000	0.0220	0.2574
E4 Jamb	26.7000	0.0170	0.4539
E5 Ground floor (normal)	43.2600	0.0590	2.5523
E16 Corner (normal)	16.8000	0.0460	0.7728
E10 Eaves (insulation at ceiling level)	26.9200	0.0600	1.6152
E12 Gable (insulation at ceiling level)	10.7200	0.0560	0.6003
E17 Corner (inverted - internal area greater than external area)	7.2000	-0.0880	-0.6336

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.0756 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 65.6220 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.8081	49.3592	48.9191	46.8520	46.4652	44.6648	44.6648	44.3314	45.3583	46.4652	47.2476	48.0656	(38)
Heat transfer coeff	115.4301	114.9811	114.5411	112.4739	112.0872	110.2868	110.2868	109.9534	110.9803	112.0872	112.8696	113.6875	(39)
Average = Sum(39)m / 12 =												112.4721	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1952	1.1905	1.1860	1.1646	1.1606	1.1419	1.1419	1.1385	1.1491	1.1606	1.1687	1.1771	(40)
HLP (average)												1.1645	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.7055 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	78.2805	77.1040	75.3898	72.1099	69.6894	66.9901	65.4558	67.1571	69.0220	71.9202	75.2706	77.9805	(42a)
Hot water usage for baths	30.0460	29.5998	28.9714	27.8128	26.9452	25.9833	25.4636	26.0876	26.7670	27.7964	28.9789	29.9445	(42b)
Hot water usage for other uses	42.3373	40.7978	39.2583	37.7187	36.1792	34.6396	34.6396	36.1792	37.7187	39.2583	40.7978	42.3373	(42c)
Average daily hot water use (litres/day)												138.5178	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	150.6638	147.5016	143.6195	137.6414	132.8138	127.6130	125.5591	129.4239	133.5077	138.9749	145.0473	150.2623	(44)
Energy conte	238.6147	210.0404	220.7378	188.4242	178.7929	156.9151	151.8528	160.2538	164.6284	188.5876	206.6464	235.2745	(45)
Energy content (annual)											Total = Sum(45)m =	2300.7685	
Distribution loss (46)m = 0.15 x (45)m	35.7922	31.5061	33.1107	28.2636	26.8189	23.5373	22.7779	24.0381	24.6943	28.2881	30.9970	35.2912	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.0000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0800	(55)
Total storage loss	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800	(56)
If cylinder contains dedicated solar storage	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	295.3571	261.2916	277.4802	243.3362	235.5353	211.8271	208.5952	216.9962	219.5404	245.3300	261.5584	292.0169	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	295.3571	261.2916	277.4802	243.3362	235.5353	211.8271	208.5952	216.9962	219.5404	245.3300	261.5584	292.0169	(64)
										Total per year (kWh/year) = Sum(64)m =		2968.8645	(64)
12Total per year (kWh/year)												2969	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	124.7333	110.8394	118.7892	106.5807	104.8426	96.1039	95.8850	98.6783	98.6685	108.0993	112.6395	123.6227	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	135.2765	135.2765	135.2765	135.2765	135.2765	135.2765	135.2765	135.2765	135.2765	135.2765	135.2765	135.2765	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	130.3544	144.3210	130.3544	134.6996	130.3544	134.6996	130.3544	130.3544	134.6996	130.3544	134.6996	130.3544	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	250.6773	253.2786	246.7235	232.7686	215.1530	198.5968	187.5362	184.9350	191.4901	205.4450	223.0606	239.6168	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.5277	36.5277	36.5277	36.5277	36.5277	36.5277	36.5277	36.5277	36.5277	36.5277	36.5277	36.5277	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	(71)
Water heating gains (Table 5)	167.6523	164.9396	159.6629	148.0287	140.9174	133.4776	128.8777	132.6321	137.0396	145.2948	156.4438	166.1595	(72)
Total internal gains	612.2670	626.1221	600.3239	579.0798	550.0078	530.3569	510.3513	511.5045	526.8122	544.6771	577.7869	599.7137	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.2700	10.6334	0.6800	0.7500	0.7700	23.5637	(74)
East	3.6000	19.6403	0.6800	0.7500	0.7700	24.9893	(76)
South	1.5000	46.7521	0.6800	0.7500	0.7700	24.7854	(78)
West	6.1800	19.6403	0.6800	0.7500	0.7700	42.8982	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	116.2365	218.4257	346.9328	500.3201	617.3789	636.0205	603.7201	514.1509	400.3798	254.9674	143.0956	96.8880	(83)
Total gains	728.5035	844.5478	947.2567	1079.3999	1167.3867	1166.3774	1114.0714	1025.6555	927.1920	799.6445	720.8825	696.6017	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.6168	31.7403	31.8622	32.4478	32.5598	33.0913	33.0913	33.1916	32.8845	32.5598	32.3341	32.1014	
alpha	3.1078	3.1160	3.1241	3.1632	3.1707	3.2061	3.2061	3.2128	3.1923	3.1707	3.1556	3.1401	
util living area													
	0.9692	0.9509	0.9175	0.8394	0.7156	0.5508	0.4179	0.4660	0.6843	0.8800	0.9516	0.9728	(86)
Living	19.3314	19.5529	19.8817	20.3133	20.6344	20.8215	20.8784	20.8679	20.7328	20.3036	19.7596	19.3107	
Non living	17.9807	18.2618	18.6748	19.2117	19.5812	19.7848	19.8313	19.8278	19.7022	19.2156	18.5390	17.9648	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.1464	19.5529	19.8817	20.3133	20.6344	20.8215	20.8784	20.8679	20.7328	20.3036	19.7596	19.5470	(87)
Th 2	19.9239	19.9276	19.9312	19.9485	19.9517	19.9667	19.9667	19.9695	19.9609	19.9517	19.9452	19.9383	(88)
util rest of house													
	0.9635	0.9420	0.9023	0.8103	0.6657	0.4773	0.3267	0.3717	0.6143	0.8514	0.9413	0.9678	(89)
MIT 2	19.1492	18.2618	18.6748	19.2117	19.5812	19.7848	19.8313	19.8278	19.7022	19.2156	18.5390	18.3204	(90)
Living area fraction										fLA = Living area / (4) =		0.2234	(91)
MIT	19.3720	18.5503	18.9445	19.4579	19.8165	20.0165	20.0653	20.0602	19.9325	19.4587	18.8117	18.5945	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3720	18.5503	18.9445	19.4579	19.8165	20.0165	20.0653	20.0602	19.9325	19.4587	18.8117	18.5945	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9600	0.9274	0.8851	0.7947	0.6587	0.4810	0.3357	0.3804	0.6121	0.8352	0.9270	0.9595	(94)
Useful gains	699.3825	783.2000	838.4390	857.8267	768.9013	561.0831	373.9543	390.1085	567.5731	667.8739	668.2792	668.4020	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1739.7654	1569.5272	1425.4020	1187.4864	909.7578	597.3639	382.1756	402.4557	647.2886	992.9465	1321.8997	1636.4728	(97)
Space heating kWh													
	774.0449	528.4119	436.7004	237.3550	104.7973	0.0000	0.0000	0.0000	0.0000	241.8541	470.6068	720.2447	(98a)
Space heating requirement - total per year (kWh/year)												3514.0150	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	774.0449	528.4119	436.7004	237.3550	104.7973	0.0000	0.0000	0.0000	0.0000	241.8541	470.6068	720.2447	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3514.0150	
Space heating per m2											(98c) / (4) =	36.3845	(99)

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	320.9738	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	774.0449	528.4119	436.7004	237.3550	104.7973	0.0000	0.0000	0.0000	0.0000	241.8541	470.6068	720.2447	(98)
Space heating efficiency (main heating system 1)													
	320.9738	320.9738	320.9738	320.9738	320.9738	0.0000	0.0000	0.0000	0.0000	320.9738	320.9738	320.9738	(210)
Space heating fuel (main heating system)													
	241.1552	164.6277	136.0549	73.9484	32.6498	0.0000	0.0000	0.0000	0.0000	75.3501	146.6184	224.3936	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	295.3571	261.2916	277.4802	243.3362	235.5353	211.8271	208.5952	216.9962	219.5404	245.3300	261.5584	292.0169	(64)
Efficiency of water heater												177.9306	(216)
(217)m	177.9306	177.9306	177.9306	177.9306	177.9306	177.9306	177.9306	177.9306	177.9306	177.9306	177.9306	177.9306	(217)
Fuel for water heating, kWh/month													
	165.9957	146.8503	155.9486	136.7591	132.3749	119.0504	117.2341	121.9555	123.3854	137.8796	147.0003	164.1184	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	30.8008	24.7095	22.2482	16.3000	12.5906	10.2866	11.4855	14.9293	19.3917	25.4430	28.7378	31.6568	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-85.1908	-118.3241	-166.6070	-177.3343	-180.1519	-158.4246	-156.1994	-150.5946	-137.5975	-128.2809	-91.5943	-73.3555	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-45.0341	-98.9839	-203.4933	-318.6730	-432.6234	-444.0310	-438.2946	-368.8178	-269.2066	-149.5184	-62.8711	-35.6205	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	1094.7981	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	177.9306	
Water heating fuel used	1668.5522	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(231)
Electricity for lighting (calculated in Appendix L)	248.5799	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-4490.8224	(233)
Wind generation	0.0000	(234)

Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	-1478.8922	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1094.7981	0.1556	170.3127	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1668.5522	0.1409	235.1545	(264)
Space and water heating			405.4672	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	248.5799	0.1443	35.8778	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1623.6548	0.1359	-220.6841	
PV Unit electricity exported	-2867.1677	0.1246	-357.3895	
Total			-578.0736	(269)
Total CO2, kg/year			-136.7286	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			-1.4200	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1094.7981	1.5759	1725.2933	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1668.5522	1.5211	2538.0714	(278)
Space and water heating			4263.3647	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	248.5799	1.5338	381.2802	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1623.6548	1.5024	-2439.4134	
PV Unit electricity exported	-2867.1677	0.4575	-1311.6898	
Total			-3751.1032	(283)
Total Primary energy kWh/year			893.5416	(286)
Dwelling Primary energy Rate (DPER)			9.2500	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	96.5800	(1b)	x 2.4000	(2b) =	231.7920	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.5800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		231.7920	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1294	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3794	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3510	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4475	0.4387	0.4299	0.3861	0.3773	0.3334	0.3334	0.3246	0.3510	0.3773	0.3948	0.4124	(22b)
Effective ac	0.6001	0.5962	0.5924	0.5745	0.5712	0.5556	0.5556	0.5527	0.5616	0.5712	0.5779	0.5850	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.5200	1.0000	2.5200			(26)
TER Opening Type (Uw = 1.20)			17.5500	1.1450	20.0954			(27)
Heatloss Floor 1			96.5800	0.1300	12.5554			(28a)
New Cavity Wall	103.8300	20.0700	83.7600	0.1800	15.0768			(29a)
External Roof 1	96.5800		96.5800	0.1100	10.6238			(30)
Total net area of external elements Aum(A, m2)			296.9900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.8714			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 136.0356 (35)

List of Thermal Bridges

	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	12.9000	0.0500	0.6450
E3 Sill	11.7000	0.0500	0.5850
E4 Jamb	26.7000	0.0500	1.3350
E5 Ground floor (normal)	43.2600	0.1600	6.9216
E16 Corner (normal)	16.8000	0.0900	1.5120
E10 Eaves (insulation at ceiling level)	26.9200	0.0600	1.6152
E12 Gable (insulation at ceiling level)	10.7200	0.0600	0.6432
E17 Corner (inverted - internal area greater than external area)	7.2000	-0.0900	-0.6480

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.6090 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 73.4804 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	45.9041	45.6067	45.3153	43.9461	43.6899	42.4974	42.4974	42.2766	42.9568	43.6899	44.2081	44.7499	(38)
Heat transfer coeff	119.3846	119.0872	118.7957	117.4265	117.1703	115.9779	115.9779	115.7570	116.4372	117.1703	117.6886	118.2303	(39)

Average = Sum(39)m / 12 = 117.4253

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2361	1.2330	1.2300	1.2158	1.2132	1.2008	1.2008	1.1986	1.2056	1.2132	1.2186	1.2242	(40)
HLP (average)												1.2158	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.7055 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	69.5826	68.5369	67.0132	64.0977	61.9461	59.5468	58.1829	59.6952	61.3529	63.9291	66.9072	69.3160	(42a)
Hot water usage for baths	30.0460	29.5998	28.9714	27.8128	26.9452	25.9833	25.4636	26.0876	26.7670	27.7964	28.9789	29.9445	(42b)
Hot water usage for other uses	42.3373	40.7978	39.2583	37.7187	36.1792	34.6396	34.6396	36.1792	37.7187	39.2583	40.7978	42.3373	(42c)

Average daily hot water use (litres/day) 130.4987 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	141.9660	138.9345	135.2428	129.6292	125.0706	120.1696	118.2862	121.9620	125.8386	130.9837	136.6839	141.5978	(44)
Energy conte	224.8394	197.8409	207.8632	177.4559	168.3690	147.7626	143.0569	151.0144	155.1716	177.7437	194.7312	221.7080	(45)
Energy content (annual)										Total = Sum(45)m =		2167.5569	
Distribution loss (46)m = 0.15 x (45)m	33.7259	29.6761	31.1795	26.6184	25.2554	22.1644	21.4585	22.6522	23.2757	26.6616	29.2097	33.2562	(46)

Water storage loss:
Store volume 210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.7016 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.9188 (55)

Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	276.5860	244.5798	259.6098	227.5332	220.1156	197.8399	194.8035	202.7610	205.2490	229.4903	244.8086	273.4545	(62)
WWHRS	-31.8103	-28.1333	-29.4595	-24.3937	-22.7340	-19.4537	-18.2347	-19.3908	-20.1275	-23.7281	-26.8811	-31.2212	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	244.7757	216.4465	230.1503	203.1396	197.3816	178.3863	176.5688	183.3702	185.1215	205.7622	217.9275	242.2334	(64)
									Total per year (kWh/year) = Sum(64)m =			2481.2635	(64)
12Total per year (kWh/year)												2481	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
									Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =			0.0000	(64a)
Heat gains from water heating, kWh/month	116.1564	103.1732	110.5118	99.0660	97.3800	89.1929	88.9637	91.6096	91.6564	100.4971	104.8100	115.1152	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	135.2765	135.2765	135.2765	135.2765	135.2765	135.2765	135.2765	135.2765	135.2765	135.2765	135.2765	135.2765	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	128.9453	142.7608	128.9453	133.2434	128.9453	133.2434	128.9453	128.9453	133.2434	128.9453	133.2434	128.9453	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	250.6773	253.2786	246.7235	232.7686	215.1530	198.5968	187.5362	184.9350	191.4901	205.4450	223.0606	239.6168	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.5277	36.5277	36.5277	36.5277	36.5277	36.5277	36.5277	36.5277	36.5277	36.5277	36.5277	36.5277	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	(71)
Water heating gains (Table 5)	156.1242	153.5315	148.5373	137.5916	130.8871	123.8791	119.5749	123.1311	127.3006	135.0767	145.5694	154.7247	(72)
Total internal gains	602.3297	616.1539	590.7891	570.1866	541.5683	519.3023	499.6393	500.5944	515.6171	536.0499	568.4565	589.8697	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.2700	10.6334	0.6300	0.7000	0.7700	20.3756	(74)
East	3.6000	19.6403	0.6300	0.7000	0.7700	21.6084	(76)
South	1.5000	46.7521	0.6300	0.7000	0.7700	21.4321	(78)
West	6.1800	19.6403	0.6300	0.7000	0.7700	37.0943	(80)

Solar gains	100.5104	188.8740	299.9948	432.6298	533.8512	549.9707	522.0403	444.5893	346.2107	220.4718	123.7356	83.7796	(83)
Total gains	702.8401	805.0279	890.7839	1002.8164	1075.4194	1069.2729	1021.6797	945.1837	861.8278	756.5217	692.1921	673.6493	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	30.5696	30.6459	30.7211	31.0793	31.1472	31.4675	31.4675	31.5275	31.3434	31.1472	31.0101	30.8680	
alpha	3.0380	3.0431	3.0481	3.0720	3.0765	3.0978	3.0978	3.1018	3.0896	3.0765	3.0673	3.0579	
util living area	0.9723	0.9574	0.9305	0.8669	0.7596	0.6059	0.4686	0.5175	0.7284	0.8979	0.9575	0.9755	(86)
MIT	18.7806	19.0563	19.4838	20.0606	20.5351	20.8385	20.9460	20.9258	20.6999	20.0807	19.3437	18.7413	(87)
Th 2	19.8912	19.8937	19.8961	19.9073	19.9095	19.9193	19.9193	19.9212	19.9155	19.9095	19.9052	19.9007	(88)
util rest of house	0.9671	0.9493	0.9170	0.8404	0.7111	0.5273	0.3652	0.4126	0.6582	0.8717	0.9481	0.9708	(89)
MIT 2	17.3230	17.6721	18.2098	18.9244	19.4782	19.8028	19.8932	19.8824	19.6747	18.9660	18.0471	17.2789	(90)
Living area fraction										fLA = Living area / (4) =		0.2234	(91)
MIT	17.6487	17.9814	18.4945	19.1782	19.7144	20.0342	20.1285	20.1156	19.9038	19.2151	18.3368	17.6057	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.6487	17.9814	18.4945	19.1782	19.7144	20.0342	20.1285	20.1156	19.9038	19.2151	18.3368	17.6057	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9517	0.9304	0.8947	0.8193	0.7014	0.5363	0.3861	0.4326	0.6574	0.8508	0.9295	0.9566	(94)
Useful gains	668.9261	748.9619	797.0222	821.5995	754.2761	573.4195	394.4627	408.8809	566.5606	643.6376	643.3983	644.4394	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1593.6293	1557.8230	1424.8891	1206.9379	939.0448	630.2519	409.2242	430.1045	675.7770	1009.4350	1322.4426	1584.9562	(97)
Space heating kWh	687.9792	543.5547	467.1330	277.4436	137.4679	0.0000	0.0000	0.0000	0.0000	272.1533	488.9119	699.7445	(98a)
Space heating requirement - total per year (kWh/year)												3574.3881	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	687.9792	543.5547	467.1330	277.4436	137.4679	0.0000	0.0000	0.0000	0.0000	272.1533	488.9119	699.7445	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3574.3881	
Space heating per m2											(98c) / (4) =	37.0096	(99)

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												92.3000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	687.9792	543.5547	467.1330	277.4436	137.4679	0.0000	0.0000	0.0000	0.0000	272.1533	488.9119	699.7445	(98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)	745.3729	588.9000	506.1029	300.5890	148.9360	0.0000	0.0000	0.0000	0.0000	294.8573	529.6987	758.1198	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	244.7757	216.4465	230.1503	203.1396	197.3816	178.3863	176.5688	183.3702	185.1215	205.7622	217.9275	242.2334	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.2474	86.0365	85.6130	84.7593	83.2645	79.8000	79.8000	79.8000	79.8000	84.6878	85.8160	86.2972	(217)
Fuel for water heating, kWh/month	283.8066	251.5752	268.8263	239.6663	237.0537	223.5417	221.2642	229.7873	231.9818	242.9656	253.9474	280.6967	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	26.7923	21.4938	19.3527	14.1787	10.9520	8.9479	9.9908	12.9864	16.8680	22.1318	24.9978	27.5369	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-72.6854	-94.6453	-125.7699	-130.3942	-131.9709	-120.1888	-118.6066	-115.9488	-110.3872	-102.5387	-77.0262	-63.7948	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-68.7268	-140.1451	-270.8253	-396.1629	-514.0860	-513.1184	-507.1244	-433.7634	-323.8930	-196.7314	-90.4779	-54.6973	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	3872.5765	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	79.8000	
Water heating fuel used	2965.1127	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	216.2290	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-4773.7085	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	2366.2098	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3872.5765	0.2100	813.2411	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2965.1127	0.2100	622.6737	(264)
Space and water heating			1435.9147	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	216.2290	0.1443	31.2085	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1263.9567	0.1363	-172.3165	
PV Unit electricity exported	-3509.7518	0.1267	-444.6517	
Total			-616.9683	(269)
Total CO2, kg/year			862.0843	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.9300	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3872.5765	1.1300	4376.0115	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2965.1127	1.1300	3350.5774	(278)
Space and water heating			7726.5889	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	216.2290	1.5338	331.6593	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1263.9567	1.5040	-1900.9288	
PV Unit electricity exported	-3509.7518	0.4651	-1632.2994	
Total			-3533.2282	(283)
Total Primary energy kWh/year			4655.1208	(286)
Target Primary Energy Rate (TPER)			48.2000	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF FABRIC ENERGY EFFICIENCY

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	96.5800 (1b)	x	2.4000 (2b)	=	231.7920	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.5800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	231.7920	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1294	(8)
Pressure test		Yes	

Pressure Test Method	Blower Door	
Measured/design AP50	5.0100	(17)
Infiltration rate	0.3799	(18)
Number of sides sheltered	1	(19)
Shelter factor (20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) =	0.3514	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4481	0.4393	0.4305	0.3866	0.3778	0.3339	0.3339	0.3251	0.3514	0.3778	0.3954	0.4129	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000	(23c)
Effective ac	0.6004	0.5965	0.5927	0.5747	0.5714	0.5557	0.5557	0.5528	0.5618	0.5714	0.5782	0.5853	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1			2.5200	1.2000	3.0240			(26)
Opening Type 2 (Uw = 1.20)			17.5500	1.1450	20.0954			(27)
Heatloss Floor 1			96.5800	0.1200	11.5896	75.0000	7243.5000	(28a)
New Cavity Wall	103.8300	20.0700	83.7600	0.1800	15.0768	60.0000	5025.6000	(29a)
External Roof 1	96.5800		96.5800	0.0700	6.7606	9.0000	869.2200	(30)
Total net area of external elements Aum(A, m2)			296.9900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	56.5464			(33)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		13138.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							136.0356	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	12.9000	0.2680	3.4572
E3 Sill	11.7000	0.0220	0.2574
E4 Jamb	26.7000	0.0170	0.4539
E5 Ground floor (normal)	43.2600	0.0590	2.5523
E16 Corner (normal)	16.8000	0.0460	0.7728
E10 Eaves (insulation at ceiling level)	26.9200	0.0600	1.6152
E12 Gable (insulation at ceiling level)	10.7200	0.0560	0.6003
E17 Corner (inverted - internal area greater than external area)	7.2000	-0.0880	-0.6336

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.0756	(36)
Point Thermal bridges (36a) =	0.0000	
Total fabric heat loss (33) + (36) + (36a) =	65.6220	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	45.9243	45.6262	45.3339	43.9611	43.7043	42.5086	42.5086	42.2872	42.9692	43.7043	44.2239	44.7671	(38)
Heat transfer coeff	111.5463	111.2481	110.9559	109.5831	109.3263	108.1306	108.1306	107.9092	108.5912	109.3263	109.8459	110.3891	(39)
Average = Sum(39)m / 12 =												109.5819	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1550	1.1519	1.1488	1.1346	1.1320	1.1196	1.1196	1.1173	1.1244	1.1320	1.1374	1.1430	(40)
HLP (average)												1.1346	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7055	(42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	30.0460	29.5998	28.9714	27.8128	26.9452	25.9833	25.4636	26.0876	26.7670	27.7964	28.9789	29.9445	(42b)
Hot water usage for other uses	42.3373	40.7978	39.2583	37.7187	36.1792	34.6396	34.6396	36.1792	37.7187	39.2583	40.7978	42.3373	(42c)
Average daily hot water use (litres/day)												66.3459	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	72.3834	70.3976	68.2297	65.5315	63.1244	60.6229	60.1033	62.2668	64.4857	67.0546	69.7767	72.2818	(44)
Energy conte	114.6376	100.2452	104.8665	89.7094	84.9776	74.5429	72.6897	77.0993	79.5174	90.9925	99.4096	113.1758	(45)
Energy content (annual)										Total = Sum(45)m =		1101.8635	
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	97.4419	85.2085	89.1365	76.2530	72.2310	63.3615	61.7863	65.5344	67.5898	77.3436	84.4982	96.1994	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	97.4419	85.2085	89.1365	76.2530	72.2310	63.3615	61.7863	65.5344	67.5898	77.3436	84.4982	96.1994	(64)
									Total per year (kWh/year) = Sum(64)m =			936.5840	(64)
12Total per year (kWh/year)												937	(64)
Electric shower(s)	55.7241	49.6506	54.2166	51.7382	52.7091	50.2793	51.9553	52.7091	51.7382	54.2166	53.1971	55.7241	(64a)
						Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =						633.8582	(64a)
Heat gains from water heating, kWh/month	38.2915	33.7148	35.8383	31.9978	31.2350	28.4102	28.4354	29.5609	29.8320	32.8901	34.4238	37.9809	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	135.2765	135.2765	135.2765	135.2765	135.2765	135.2765	135.2765	135.2765	135.2765	135.2765	135.2765	135.2765	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	130.3544	144.3210	130.3544	134.6996	130.3544	134.6996	130.3544	130.3544	134.6996	130.3544	134.6996	130.3544	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	250.6773	253.2786	246.7235	232.7686	215.1530	198.5968	187.5362	184.9350	191.4901	205.4450	223.0606	239.6168	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5277	36.5277	36.5277	36.5277	36.5277	36.5277	36.5277	36.5277	36.5277	36.5277	36.5277	36.5277	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	(71)
Water heating gains (Table 5)													
	51.4671	50.1708	48.1697	44.4414	41.9825	39.4586	38.2196	39.7324	41.4333	44.2071	47.8109	51.0496	(72)
Total internal gains													
	496.0818	511.3533	488.8306	475.4925	451.0729	436.3379	419.6932	418.6047	431.2059	443.5894	469.1540	484.6037	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.2700	10.6334	0.6800	0.7500	0.7700	23.5637	(74)
East	3.6000	19.6403	0.6800	0.7500	0.7700	24.9893	(76)
South	1.5000	46.7521	0.6800	0.7500	0.7700	24.7854	(78)
West	6.1800	19.6403	0.6800	0.7500	0.7700	42.8982	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	116.2365	218.4257	346.9328	500.3201	617.3789	636.0205	603.7201	514.1509	400.3798	254.9674	143.0956	96.8880	(83)
Total gains	612.3183	729.7790	835.7634	975.8126	1068.4518	1072.3584	1023.4134	932.7557	831.5857	698.5568	612.2496	581.4918	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.7177	32.8053	32.8918	33.3038	33.3820	33.7512	33.7512	33.8204	33.6080	33.3820	33.2241	33.0606	
alpha	3.1812	3.1870	3.1928	3.2203	3.2255	3.2501	3.2501	3.2547	3.2405	3.2255	3.2149	3.2040	
util living area													
	0.9803	0.9653	0.9366	0.8645	0.7441	0.5801	0.4434	0.4979	0.7229	0.9081	0.9676	0.9832	(86)
MIT	18.8122	19.1154	19.5660	20.1592	20.6132	20.8775	20.9615	20.9440	20.7411	20.1233	19.3726	18.7695	(87)
Th 2	19.9562	19.9587	19.9611	19.9726	19.9748	19.9849	19.9849	19.9867	19.9810	19.9748	19.9704	19.9659	(88)
util rest of house													
	0.9766	0.9588	0.9244	0.8386	0.6964	0.5061	0.3494	0.4007	0.6555	0.8847	0.9604	0.9799	(89)
MIT 2	17.9662	18.2668	18.7095	19.2841	19.6947	19.9157	19.9701	19.9635	19.8175	19.2651	18.5323	17.9306	(90)
Living area fraction									fLA = Living area / (4) =			0.2234	(91)
MIT	18.1552	18.4564	18.9009	19.4796	19.9000	20.1306	20.1916	20.1826	20.0239	19.4569	18.7201	18.1180	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1552	18.4564	18.9009	19.4796	19.9000	20.1306	20.1916	20.1826	20.0239	19.4569	18.7201	18.1180	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9676	0.9464	0.9088	0.8241	0.6926	0.5173	0.3692	0.4204	0.6587	0.8701	0.9486	0.9719	(94)
Useful gains	592.4621	690.6466	759.5478	804.2108	740.0162	554.7667	377.8602	392.1146	547.7257	607.8479	580.8061	565.1465	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1545.4978	1508.1213	1375.9528	1159.3463	896.4731	598.0265	388.3668	408.1773	643.2829	968.2873	1276.4159	1536.3978	(97)
Space heating kWh													
	709.0585	549.3430	458.6053	255.6976	116.4040	0.0000	0.0000	0.0000	0.0000	268.1669	500.8390	722.6110	(98a)
Space heating requirement - total per year (kWh/year)												3580.7253	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	709.0585	549.3430	458.6053	255.6976	116.4040	0.0000	0.0000	0.0000	0.0000	268.1669	500.8390	722.6110	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3580.7253	
Space heating per m2										(98c) / (4) =		37.0752	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1016.4279	800.1666	820.1100	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8235	0.8796	0.8468	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	837.0003	703.8491	694.4551	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1198.7271	1144.1447	1040.7789	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	260.4433	327.5799	257.6650	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	65.1108	81.8950	64.4162	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												211.4220	(107)
Energy for space heating												37.0752	(99)
Energy for space cooling												2.1891	(108)
Total												39.2643	(109)
Fabric Energy Efficiency (DFEE)												39.3	(109)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	96.5800	(1b)	x 2.4000	(2b) =	231.7920	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.5800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		231.7920	(5)

2. Ventilation rate

	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	3 * 10 =	30.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1294 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3794 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3510 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4475	0.4387	0.4299	0.3861	0.3773	0.3334	0.3334	0.3246	0.3510	0.3773	0.3948	0.4124	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000	(23c)
Effective ac	0.6001	0.5962	0.5924	0.5745	0.5712	0.5556	0.5556	0.5527	0.5616	0.5712	0.5779	0.5850	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.5200	1.0000	2.5200			(26)
TER Opening Type (Uw = 1.20)			17.5500	1.1450	20.0954			(27)
Heatloss Floor 1			96.5800	0.1300	12.5554			(28a)
New Cavity Wall	103.8300	20.0700	83.7600	0.1800	15.0768			(29a)
External Roof 1	96.5800		96.5800	0.1100	10.6238			(30)
Total net area of external elements Aum(A, m2)			296.9900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.8714			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	136.0356	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	12.9000	0.0500	0.6450
E3 Sill	11.7000	0.0500	0.5850
E4 Jamb	26.7000	0.0500	1.3350
E5 Ground floor (normal)	43.2600	0.1600	6.9216
E16 Corner (normal)	16.8000	0.0900	1.5120
E10 Eaves (insulation at ceiling level)	26.9200	0.0600	1.6152
E12 Gable (insulation at ceiling level)	10.7200	0.0600	0.6432
E17 Corner (inverted - internal area greater than external area)	7.2000	-0.0900	-0.6480

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.6090	(36)
Point Thermal bridges (36a) =	0.0000	
Total fabric heat loss (33) + (36) + (36a) =	73.4804	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	45.9041	45.6067	45.3153	43.9461	43.6899	42.4974	42.4974	42.2766	42.9568	43.6899	44.2081	44.7499	(38)
Heat transfer coeff	119.3846	119.0872	118.7957	117.4265	117.1703	115.9779	115.9779	115.7570	116.4372	117.1703	117.6886	118.2303	(39)
Average = Sum(39)m / 12 =												117.4253	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2361	1.2330	1.2300	1.2158	1.2132	1.2008	1.2008	1.1986	1.2056	1.2132	1.2186	1.2242	(40)
HLP (average)												1.2158	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7055	(42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

30.0460	29.5998	28.9714	27.8128	26.9452	25.9833	25.4636	26.0876	26.7670	27.7964	28.9789	29.9445	(42b)

Hot water usage for other uses

	42.3373	40.7978	39.2583	37.7187	36.1792	34.6396	34.6396	36.1792	37.7187	39.2583	40.7978	42.3373 (42c)

Average daily hot water use (litres/day) 66.3459 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	72.3834	70.3976	68.2297	65.5315	63.1244	60.6229	60.1033	62.2668	64.4857	67.0546	69.7767	72.2818	(44)
Energy conte	114.6376	100.2452	104.8665	89.7094	84.9776	74.5429	72.6897	77.0993	79.5174	90.9925	99.4096	113.1758	(45)
Energy content (annual)											Total = Sum(45)m =	1101.8635	
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	97.4419	85.2085	89.1365	76.2530	72.2310	63.3615	61.7863	65.5344	67.5898	77.3436	84.4982	96.1994	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	97.4419	85.2085	89.1365	76.2530	72.2310	63.3615	61.7863	65.5344	67.5898	77.3436	84.4982	96.1994	(64)
										Total per year (kWh/year) = Sum(64)m =		936.5840	(64)
12Total per year (kWh/year)												937	(64)
Electric shower(s)	55.7241	49.6506	54.2166	51.7382	52.7091	50.2793	51.9553	52.7091	51.7382	54.2166	53.1971	55.7241	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		633.8582	(64a)
Heat gains from water heating, kWh/month	38.2915	33.7148	35.8383	31.9978	31.2350	28.4102	28.4354	29.5609	29.8320	32.8901	34.4238	37.9809	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	135.2765	135.2765	135.2765	135.2765	135.2765	135.2765	135.2765	135.2765	135.2765	135.2765	135.2765	135.2765	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	128.9453	142.7608	128.9453	133.2434	128.9453	133.2434	128.9453	128.9453	133.2434	128.9453	133.2434	128.9453	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	250.6773	253.2786	246.7235	232.7686	215.1530	198.5968	187.5362	184.9350	191.4901	205.4450	223.0606	239.6168	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.5277	36.5277	36.5277	36.5277	36.5277	36.5277	36.5277	36.5277	36.5277	36.5277	36.5277	36.5277	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	(71)
Water heating gains (Table 5)	51.4671	50.1708	48.1697	44.4414	41.9825	39.4586	38.2196	39.7324	41.4333	44.2071	47.8109	51.0496	(72)
Total internal gains	494.6726	509.7932	487.4215	474.0364	449.6637	434.8818	418.2841	417.1956	429.7498	442.1803	467.6979	483.1946	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.2700	10.6334	0.6300	0.7000	0.7700	20.3756	(74)
East	3.6000	19.6403	0.6300	0.7000	0.7700	21.6084	(76)
South	1.5000	46.7521	0.6300	0.7000	0.7700	21.4321	(78)
West	6.1800	19.6403	0.6300	0.7000	0.7700	37.0943	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	100.5104	188.8740	299.9948	432.6298	533.8512	549.9707	522.0403	444.5893	346.2107	220.4718	123.7356	83.7796	(83)
Total gains	595.1830	698.6671	787.4163	906.6661	983.5149	984.8525	940.3244	861.7849	775.9605	662.6521	591.4335	566.9742	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	30.5696	30.6459	30.7211	31.0793	31.1472	31.4675	31.4675	31.5275	31.3434	31.1472	31.0101	30.8680	
alpha	3.0380	3.0431	3.0481	3.0720	3.0765	3.0978	3.0978	3.1018	3.0896	3.0765	3.0673	3.0579	
util living area	0.9820	0.9700	0.9479	0.8916	0.7919	0.6410	0.5020	0.5563	0.7684	0.9236	0.9714	0.9844	(86)
MIT	18.6131	18.8987	19.3438	19.9567	20.4701	20.8102	20.9346	20.9092	20.6462	19.9661	19.1935	18.5731	(87)
Th 2	19.8912	19.8937	19.8961	19.9073	19.9095	19.9193	19.9193	19.9212	19.9155	19.9095	19.9052	19.9007	(88)
util rest of house	0.9785	0.9642	0.9372	0.8685	0.7462	0.5620	0.3938	0.4473	0.7018	0.9025	0.9647	0.9814	(89)
MIT 2	17.7250	18.0087	18.4481	19.0470	19.5209	19.8108	19.8942	19.8834	19.6891	19.0695	18.3113	17.6917	(90)
Living area fraction										fLA = Living area / (4) =		0.2234	(91)
MIT	17.9234	18.2076	18.6483	19.2503	19.7330	20.0341	20.1267	20.1126	19.9030	19.2699	18.5084	17.8886	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9234	18.2076	18.6483	19.2503	19.7330	20.0341	20.1267	20.1126	19.9030	19.2699	18.5084	17.8886	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9696	0.9520	0.9216	0.8518	0.7379	0.5711	0.4157	0.4680	0.7010	0.8868	0.9531	0.9733	(94)
Useful gains	577.0692	665.1304	725.6519	772.3136	725.6992	562.4221	390.8863	403.3433	543.9174	587.6068	563.6796	551.8553	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1626.4259	1584.7641	1443.1596	1215.3952	941.2270	630.2353	409.0164	429.7553	675.6799	1015.8503	1342.6406	1618.4124	(97)
Space heating kWh	780.7214	617.9939	533.8257	319.0187	160.3527	0.0000	0.0000	0.0000	0.0000	318.6131	560.8519	793.5185	(98a)

Space heating requirement - total per year (kWh/year) 4084.8959
Solar heating kWh

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)

Solar heating contribution - total per year (kWh/year) 0.0000
Space heating kWh

780.7214	617.9939	533.8257	319.0187	160.3527	0.0000	0.0000	0.0000	0.0000	318.6131	560.8519	793.5185	(98c)

Space heating requirement after solar contribution - total per year (kWh/year) 4084.8959
Space heating per m2 (98c) / (4) = 42.2955 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1090.1918	858.2361	879.7534	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7587	0.8257	0.7879	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	827.0940	708.6351	693.1434	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1098.0261	1048.5416	959.3000	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	195.0711	252.8904	198.0205	0.0000	0.0000	0.0000	0.0000	(104)

Cooled fraction fC = cooled area / (4) = 1.0000 (105)

Intermittency factor (Table 10b)													
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	48.7678	63.2226	49.5051	0.0000	0.0000	0.0000	0.0000	(107)

Space cooling requirement 161.4955 (107)
Energy for space heating 42.2955 (99)
Energy for space cooling 1.6721 (108)
Total 43.9676 (109)
Fabric Energy Efficiency (TFEE) 44.0 (109)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF ENERGY RATING

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	96.5800 (1b)	x	2.4000 (2b)	=	231.7920	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.5800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	231.7920	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	5 * 10 =	50.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.2157	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0100	(17)
Infiltration rate		0.4662	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4312	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate													
	0.5498	0.5391	0.5283	0.4744	0.4636	0.4097	0.4097	0.3989	0.4312	0.4636	0.4852	0.5067	(22b)
Effective ac	0.6512	0.6453	0.6395	0.6125	0.6075	0.5839	0.5839	0.5796	0.5930	0.6075	0.6177	0.6284	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1			2.5200	1.2000	3.0240			(26)
Opening Type 2 (Uw = 1.20)			17.5500	1.1450	20.0954			(27)
Heatloss Floor 1			96.5800	0.1200	11.5896	75.0000	7243.5000	(28a)
New Cavity Wall	103.8300	20.0700	83.7600	0.1800	15.0768	60.0000	5025.6000	(29a)
External Roof 1	96.5800		96.5800	0.0700	6.7606	9.0000	869.2200	(30)
Total net area of external elements Aum(A, m2)			296.9900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		56.5464			(33)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 13138.3200 (34)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 136.0356 (35)
List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	12.9000	0.2680	3.4572
E3 Sill	11.7000	0.0220	0.2574
E4 Jamb	26.7000	0.0170	0.4539
E5 Ground floor (normal)	43.2600	0.0590	2.5523
E16 Corner (normal)	16.8000	0.0460	0.7728
E10 Eaves (insulation at ceiling level)	26.9200	0.0600	1.6152
E12 Gable (insulation at ceiling level)	10.7200	0.0560	0.6003
E17 Corner (inverted - internal area greater than external area)	7.2000	-0.0880	-0.6336

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.0756 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 65.6220 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.8081	49.3592	48.9191	46.8520	46.4652	44.6648	44.6648	44.3314	45.3583	46.4652	47.2476	48.0656	(38)
Heat transfer coeff	115.4301	114.9811	114.5411	112.4739	112.0872	110.2868	110.2868	109.9534	110.9803	112.0872	112.8696	113.6875	(39)

Average = Sum(39)m / 12 = 112.4721

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1952	1.1905	1.1860	1.1646	1.1606	1.1419	1.1419	1.1385	1.1491	1.1606	1.1687	1.1771	(40)
HLP (average)												1.1645	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.7055 (42)
Hot water usage for mixer showers

78.2805	77.1040	75.3898	72.1099	69.6894	66.9901	65.4558	67.1571	69.0220	71.9202	75.2706	77.9805	(42a)

Hot water usage for baths

30.0460	29.5998	28.9714	27.8128	26.9452	25.9833	25.4636	26.0876	26.7670	27.7964	28.9789	29.9445	(42b)

Hot water usage for other uses

42.3373	40.7978	39.2583	37.7187	36.1792	34.6396	34.6396	36.1792	37.7187	39.2583	40.7978	42.3373	(42c)

Average daily hot water use (litres/day) 138.5178 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	150.6638	147.5016	143.6195	137.6414	132.8138	127.6130	125.5591	129.4239	133.5077	138.9749	145.0473	150.2623	(44)
Energy conte	238.6147	210.0404	220.7378	188.4242	178.7929	156.9151	151.8528	160.2538	164.6284	188.5876	206.6464	235.2745	(45)
Energy content (annual)										Total = Sum(45)m =		2300.7685	
Distribution loss (46)m = 0.15 x (45)m	35.7922	31.5061	33.1107	28.2636	26.8189	23.5373	22.7779	24.0381	24.6943	28.2881	30.9970	35.2912	(46)

Water storage loss:
Store volume 210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 2.0000 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.0800 (55)
Total storage loss

33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800	(56)

If cylinder contains dedicated solar storage

33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800	(57)
Primary loss 23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

295.3571	261.2916	277.4802	243.3362	235.5353	211.8271	208.5952	216.9962	219.5404	245.3300	261.5584	292.0169	(62)
WWHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter -0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

Output from w/h

295.3571	261.2916	277.4802	243.3362	235.5353	211.8271	208.5952	216.9962	219.5404	245.3300	261.5584	292.0169	(64)

Total per year (kWh/year) = Sum(64)m = 2968.8645 (64)

Electric shower(s)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

124.7333	110.8394	118.7892	106.5807	104.8426	96.1039	95.8850	98.6783	98.6685	108.0993	112.6395	123.6227	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	162.3318	162.3318	162.3318	162.3318	162.3318	162.3318	162.3318	162.3318	162.3318	162.3318	162.3318	162.3318	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	35.1891	31.2546	25.4180	19.2430	14.3844	12.1439	13.1219	17.0564	22.8930	29.0680	33.9266	36.1671	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	374.1453	378.0277	368.2441	347.4158	321.1239	296.4131	279.9048	276.0224	285.8061	306.6343	332.9263	357.6370	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.9387	53.9387	53.9387	53.9387	53.9387	53.9387	53.9387	53.9387	53.9387	53.9387	53.9387	53.9387	(69)
Pumps, fans 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)	
Losses e.g. evaporation (negative values) (Table 5)	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	(71)
Water heating gains (Table 5)	167.6523	164.9396	159.6629	148.0287	140.9174	133.4776	128.8777	132.6321	137.0396	145.2948	156.4438	166.1595	(72)
Total internal gains	685.0359	682.2712	661.3743	622.7368	584.4750	550.0839	529.9538	533.7602	553.7880	589.0463	631.3460	668.0129	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.2700	10.6334	0.6800	0.7500	0.7700	23.5637	(74)
East	3.6000	19.6403	0.6800	0.7500	0.7700	24.9893	(76)
South	1.5000	46.7521	0.6800	0.7500	0.7700	24.7854	(78)
West	6.1800	19.6403	0.6800	0.7500	0.7700	42.8982	(80)

Solar gains	116.2365	218.4257	346.9328	500.3201	617.3789	636.0205	603.7201	514.1509	400.3798	254.9674	143.0956	96.8880	(83)
Total gains	801.2724	900.6969	1008.3071	1123.0570	1201.8539	1186.1044	1133.6739	1047.9111	954.1678	844.0137	774.4416	764.9009	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.6168	31.7403	31.8622	32.4478	32.5598	33.0913	33.0913	33.1916	32.8845	32.5598	32.3341	32.1014	
alpha	3.1078	3.1160	3.1241	3.1632	3.1707	3.2061	3.2061	3.2128	3.1923	3.1707	3.1556	3.1401	
util living area	0.9608	0.9426	0.9053	0.8271	0.7037	0.5437	0.4115	0.4574	0.6722	0.8660	0.9424	0.9653	(86)
Living	19.4134	19.6120	19.9379	20.3429	20.6478	20.8245	20.8796	20.8698	20.7418	20.3389	19.8163	19.3891	
Non living	18.0834	18.3350	18.7427	19.2452	19.5945	19.7872	19.8319	19.8289	19.7100	19.2558	18.6088	18.0633	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.1883	19.6120	19.9379	20.3429	20.6478	20.8245	20.8796	20.8698	20.7418	20.3389	19.8163	19.6144	(87)
Th 2	19.9239	19.9276	19.9312	19.9485	19.9517	19.9667	19.9667	19.9695	19.9609	19.9517	19.9452	19.9383	(88)
util rest of house	0.9537	0.9325	0.8884	0.7967	0.6533	0.4706	0.3213	0.3644	0.6018	0.8353	0.9305	0.9591	(89)
MIT 2	19.1901	18.3350	18.7427	19.2452	19.5945	19.7872	19.8319	19.8289	19.7100	19.2558	18.6088	18.4012	(90)
Living area fraction									fLA = Living area / (4) =			0.2234	(91)
MIT	19.4132	18.6203	19.0097	19.4905	19.8299	20.0190	20.0660	20.0615	19.9406	19.4978	18.8786	18.6723	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4132	18.6203	19.0097	19.4905	19.8299	20.0190	20.0660	20.0615	19.9406	19.4978	18.8786	18.6723	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9498	0.9169	0.8708	0.7817	0.6469	0.4745	0.3303	0.3730	0.6003	0.8194	0.9151	0.9496	(94)
Useful gains	761.0218	825.8507	878.0719	877.8578	777.4747	562.7555	374.4089	390.9150	572.7874	691.6094	708.7289	726.3420	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1744.5149	1577.5805	1432.8782	1191.1507	911.2556	597.6418	382.2530	402.5919	648.1868	997.3289	1329.4436	1645.3163	(97)
Space heating kWh	731.7189	505.1624	412.7759	225.5709	99.5329	0.0000	0.0000	0.0000	0.0000	227.4553	446.9146	683.7168	(98a)
Space heating requirement - total per year (kWh/year)												3332.8477	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	731.7189	505.1624	412.7759	225.5709	99.5329	0.0000	0.0000	0.0000	0.0000	227.4553	446.9146	683.7168	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3332.8477	
Space heating per m2											(98c) / (4) =	34.5087	(99)

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)

Fraction of space heat from main system(s) 1.0000 (202)

Efficiency of main space heating system 1 (in %) 320.9738 (206)

Efficiency of main space heating system 2 (in %) 0.0000 (207)

Efficiency of secondary/supplementary heating system, % 0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	731.7189	505.1624	412.7759	225.5709	99.5329	0.0000	0.0000	0.0000	0.0000	227.4553	446.9146	683.7168	(98)
Space heating efficiency (main heating system 1)	320.9738	320.9738	320.9738	320.9738	320.9738	0.0000	0.0000	0.0000	0.0000	320.9738	320.9738	320.9738	(210)
Space heating fuel (main heating system)	227.9684	157.3843	128.6011	70.2770	31.0097	0.0000	0.0000	0.0000	0.0000	70.8641	139.2371	213.0133	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	295.3571	261.2916	277.4802	243.3362	235.5353	211.8271	208.5952	216.9962	219.5404	245.3300	261.5584	292.0169	(64)
Efficiency of water heater												177.9306	(216)
(217)m	177.9306	177.9306	177.9306	177.9306	177.9306	177.9306	177.9306	177.9306	177.9306	177.9306	177.9306	177.9306	(217)
Fuel for water heating, kWh/month	165.9957	146.8503	155.9486	136.7591	132.3749	119.0504	117.2341	121.9555	123.3854	137.8796	147.0003	164.1184	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	30.8008	24.7095	22.2482	16.3000	12.5906	10.2866	11.4855	14.9293	19.3917	25.4430	28.7378	31.6568	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-84.8552	-117.8820	-165.7660	-176.6401	-179.7259	-158.4246	-156.1994	-150.5946	-137.5975	-127.8099	-91.2804	-73.1132	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-45.3697	-99.4259	-204.3343	-319.3672	-433.0493	-444.0310	-438.2946	-368.8178	-269.2066	-149.9894	-63.1851	-35.8628	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												1038.3551	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												177.9306	

Water heating fuel used	1668.5522	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(231)
Electricity for lighting (calculated in Appendix L)	248.5799	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-4490.8224	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	-1535.3352	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1038.3551	16.4900	171.2247	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1668.5522	16.4900	275.1443	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Energy for lighting	248.5799	16.4900	40.9908	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1619.8888	16.4900	-267.1197	
PV Unit electricity exported	-2870.9336	5.5900	-160.4852	
Total			-427.6049	(252)
Total energy cost			59.7550	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.1519	(257)
SAP value		97.5370	
SAP rating (Section 12)		98	(258)
SAP band		A	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1038.3551	0.1556	161.5427	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1668.5522	0.1409	235.1545	(264)
Space and water heating			396.6972	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	248.5799	0.1443	35.8778	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1619.8888	0.1359	-220.1236	
PV Unit electricity exported	-2870.9336	0.1247	-358.0134	
Total			-578.1370	(269)
Total CO2, kg/year			-145.5620	(272)
CO2 emissions per m2			-1.5100	(273)
EI value			101.3777	
EI rating			101	(274)
EI band			A	

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	96.5800	(1b)	x 2.4000	(2b) =	231.7920	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 96.5800						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		231.7920	(5)

2. Ventilation rate

	m3 per hour	
Number of open chimneys	0 * 80 = 0.0000	(6a)
Number of open flues	0 * 20 = 0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000	(6d)
Number of flues attached to other heater	0 * 35 = 0.0000	(6e)
Number of blocked chimneys	0 * 20 = 0.0000	(6f)
Number of intermittent extract fans	5 * 10 = 50.0000	(7a)

Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.2157 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0100 (17)
Infiltration rate		0.4662 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4312 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.0000	4.6000	4.4000	3.9000	4.1000	4.0000	4.2000	4.5000	4.8000	4.9000	(22)
Wind factor	1.3500	1.2750	1.2500	1.1500	1.1000	0.9750	1.0250	1.0000	1.0500	1.1250	1.2000	1.2250	(22a)
Adj infilt rate	0.5822	0.5498	0.5391	0.4959	0.4744	0.4205	0.4420	0.4312	0.4528	0.4852	0.5175	0.5283	(22b)
Effective ac	0.6695	0.6512	0.6453	0.6230	0.6125	0.5884	0.5977	0.5930	0.6025	0.6177	0.6339	0.6395	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1			2.5200	1.2000	3.0240			(26)
Opening Type 2 (Uw = 1.20)			17.5500	1.1450	20.0954			(27)
Heatloss Floor 1			96.5800	0.1200	11.5896	75.0000	7243.5000	(28a)
New Cavity Wall	103.8300	20.0700	83.7600	0.1800	15.0768	60.0000	5025.6000	(29a)
External Roof 1	96.5800		96.5800	0.0700	6.7606	9.0000	869.2200	(30)
Total net area of external elements Aum(A, m2)			296.9900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		56.5464			(33)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13138.3200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.0356 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	12.9000	0.2680	3.4572
E3 Sill	11.7000	0.0220	0.2574
E4 Jamb	26.7000	0.0170	0.4539
E5 Ground floor (normal)	43.2600	0.0590	2.5523
E16 Corner (normal)	16.8000	0.0460	0.7728
E10 Eaves (insulation at ceiling level)	26.9200	0.0600	1.6152
E12 Gable (insulation at ceiling level)	10.7200	0.0560	0.6003
E17 Corner (inverted - internal area greater than external area)	7.2000	-0.0880	-0.6336

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.0756 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	65.6220 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.2084	49.8081	49.3592	47.6521	46.8520	45.0071	45.7184	45.3583	46.0874	47.2476	48.4879	48.9191	(38)
Heat transfer coeff	116.8304	115.4301	114.9811	113.2741	112.4739	110.6291	111.3404	110.9803	111.7093	112.8696	114.1098	114.5411	(39)
Average = Sum(39)m / 12 =												113.2641	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2097	1.1952	1.1905	1.1729	1.1646	1.1455	1.1528	1.1491	1.1567	1.1687	1.1815	1.1860	(40)
HLP (average)												1.1727	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7055 (42)

Hot water usage for mixer showers

78.2805	77.1040	75.3898	72.1099	69.6894	66.9901	65.4558	67.1571	69.0220	71.9202	75.2706	77.9805	(42a)

Hot water usage for baths

30.0460	29.5998	28.9714	27.8128	26.9452	25.9833	25.4636	26.0876	26.7670	27.7964	28.9789	29.9445	(42b)

Hot water usage for other uses

42.3373	40.7978	39.2583	37.7187	36.1792	34.6396	34.6396	36.1792	37.7187	39.2583	40.7978	42.3373	(42c)

Average daily hot water use (litres/day)		138.5178 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	150.6638	147.5016	143.6195	137.6414	132.8138	127.6130	125.5591	129.4239	133.5077	138.9749	145.0473	150.2623	(44)
Energy conte	238.6147	210.0404	220.7378	188.4242	178.7929	156.9151	151.8528	160.2538	164.6284	188.5876	206.6464	235.2745	(45)
Energy content (annual)										Total = Sum(45)m =		2300.7685	

Distribution loss (46)m = 0.15 x (45)m

35.7922	31.5061	33.1107	28.2636	26.8189	23.5373	22.7779	24.0381	24.6943	28.2881	30.9970	35.2912	(46)

Water storage loss:		
Store volume		210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):		2.0000 (48)
Temperature factor from Table 2b		0.5400 (49)
Enter (49) or (54) in (55)		1.0800 (55)

Total storage loss

33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800	(56)

If cylinder contains dedicated solar storage

33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800	(57)
Primary loss 23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

295.3571	261.2916	277.4802	243.3362	235.5353	211.8271	208.5952	216.9962	219.5404	245.3300	261.5584	292.0169	(62)
WWHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter -0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
295.3571	261.2916	277.4802	243.3362	235.5353	211.8271	208.5952	216.9962	219.5404	245.3300	261.5584	292.0169	(64)
									Total per year (kWh/year) = Sum(64)m =		2968.8645	(64)

Electric shower(s)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

	124.7333	110.8394	118.7892	106.5807	104.8426	96.1039	95.8850	98.6783	98.6685	108.0993	112.6395	123.6227	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	162.3318	162.3318	162.3318	162.3318	162.3318	162.3318	162.3318	162.3318	162.3318	162.3318	162.3318	162.3318	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	35.1891	31.2546	25.4180	19.2430	14.3844	12.1439	13.1219	17.0564	22.8930	29.0680	33.9266	36.1671	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	374.1453	378.0277	368.2441	347.4158	321.1239	296.4131	279.9048	276.0224	285.8061	306.6343	332.9263	357.6370	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.9387	53.9387	53.9387	53.9387	53.9387	53.9387	53.9387	53.9387	53.9387	53.9387	53.9387	53.9387	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	(71)
Water heating gains (Table 5)													
	167.6523	164.9396	159.6629	148.0287	140.9174	133.4776	128.8777	132.6321	137.0396	145.2948	156.4438	166.1595	(72)
Total internal gains													
	685.0359	682.2712	661.3743	622.7368	584.4750	550.0839	529.9538	533.7602	553.7880	589.0463	631.3460	668.0129	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.2700	11.7839	0.6800	0.7500	0.7700	26.1132	(74)
East	3.6000	21.8216	0.6800	0.7500	0.7700	27.7646	(76)
South	1.5000	51.3807	0.6800	0.7500	0.7700	27.2392	(78)
West	6.1800	21.8216	0.6800	0.7500	0.7700	47.6626	(80)

Solar gains	128.7797	229.2170	359.8430	528.9735	642.1536	676.6424	638.0680	545.7704	430.1726	276.6772	159.4018	109.9649	(83)
Total gains	813.8156	911.4882	1021.2173	1151.7103	1226.6286	1226.7263	1168.0217	1079.5306	983.9607	865.7236	790.7478	777.9778	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.2379	31.6168	31.7403	32.2186	32.4478	32.9889	32.7782	32.8845	32.6699	32.3341	31.9826	31.8622	
alpha	3.0825	3.1078	3.1160	3.1479	3.1632	3.1993	3.1852	3.1923	3.1780	3.1556	3.1322	3.1241	
util living area													
	0.9595	0.9412	0.9000	0.8121	0.6779	0.4965	0.3616	0.3967	0.6356	0.8518	0.9399	0.9645	(86)
Living	19.4028	19.6155	19.9684	20.3834	20.6831	20.8470	20.8881	20.8832	20.7724	20.3815	19.8147	19.3745	
Non living	18.0617	18.3365	18.7774	19.2869	19.6288	19.8032	19.8279	19.8287	19.7332	19.3004	18.5988	18.0396	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.1829	19.6155	19.9684	20.3834	20.6831	20.8470	20.8881	20.8832	20.7724	20.3815	19.8147	19.6019	(87)
Th 2	19.9123	19.9239	19.9276	19.9418	19.9485	19.9639	19.9579	19.9609	19.9548	19.9452	19.9348	19.9312	(88)
util rest of house													
	0.9522	0.9308	0.8822	0.7793	0.6241	0.4204	0.2693	0.2996	0.5598	0.8179	0.9276	0.9581	(89)
MIT 2	19.1745	18.3365	18.7774	19.2869	19.6288	19.8032	19.8279	19.8287	19.7332	19.3004	18.5988	18.3805	(90)
Living area fraction									fLA = Living area / (4) =			0.2234	(91)
MIT	19.3998	18.6223	19.0435	19.5319	19.8644	20.0364	20.0648	20.0643	19.9654	19.5420	18.8705	18.6534	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3998	18.6223	19.0435	19.5319	19.8644	20.0364	20.0648	20.0643	19.9654	19.5420	18.8705	18.6534	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9482	0.9150	0.8645	0.7650	0.6194	0.4260	0.2790	0.3096	0.5607	0.8026	0.9119	0.9485	(94)
Useful gains	771.6477	834.0080	882.8073	881.0199	759.8339	522.5747	325.8482	334.2031	551.6773	694.7935	721.0687	737.8791	(95)
Ext temp.	4.3000	4.9000	6.7000	9.2000	12.1000	15.1000	17.1000	17.0000	14.5000	10.9000	7.1000	4.1000	(96)
Heat loss rate W													
	1764.1196	1583.9635	1419.2702	1170.3356	873.2904	546.1128	330.0996	340.0817	610.5359	975.4144	1343.1293	1666.9644	(97)
Space heating kWh													
	738.3991	503.9700	399.1284	208.3073	84.4116	0.0000	0.0000	0.0000	0.0000	208.7819	447.8836	691.2395	(98a)
Space heating requirement - total per year (kWh/year)												3282.1214	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	738.3991	503.9700	399.1284	208.3073	84.4116	0.0000	0.0000	0.0000	0.0000	208.7819	447.8836	691.2395	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3282.1214	
Space heating per m2											(98c) / (4) =	33.9834	(99)

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	321.4435	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	738.3991	503.9700	399.1284	208.3073	84.4116	0.0000	0.0000	0.0000	0.0000	208.7819	447.8836	691.2395	(98)
Space heating efficiency (main heating system 1)													
	321.4435	321.4435	321.4435	321.4435	321.4435	0.0000	0.0000	0.0000	0.0000	321.4435	321.4435	321.4435	(210)
Space heating fuel (main heating system)													
	229.7135	156.7834	124.1675	64.8037	26.2602	0.0000	0.0000	0.0000	0.0000	64.9514	139.3351	215.0423	(211)

Space heating efficiency (main heating system 2)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating												
Water heating requirement												
295.3571	261.2916	277.4802	243.3362	235.5353	211.8271	208.5952	216.9962	219.5404	245.3300	261.5584	292.0169	(64)
Efficiency of water heater											177.8446	(216)
(217)m 177.8446	177.8446	177.8446	177.8446	177.8446	177.8446	177.8446	177.8446	177.8446	177.8446	177.8446	177.8446	(217)
Fuel for water heating, kWh/month												
166.0759	146.9213	156.0239	136.8252	132.4388	119.1079	117.2907	122.0145	123.4451	137.9463	147.0713	164.1978	(219)
Space cooling fuel requirement												
(221)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting 30.8008	24.7095	22.2482	16.3000	12.5906	10.2866	11.4855	14.9293	19.3917	25.4430	28.7378	31.6568	(232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m -91.8608	-121.6943	-168.6730	-180.0359	-180.9632	-161.4042	-158.8196	-153.7646	-141.8770	-133.3860	-98.6310	-80.7987	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m -52.2848	-106.0637	-214.5683	-343.4361	-455.3359	-478.5390	-468.4878	-396.6160	-294.4349	-167.6398	-73.2619	-42.7847	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235d)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	1021.0570	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	177.8446	
Water heating fuel used	1669.3587	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(231)
Electricity for lighting (calculated in Appendix L)	248.5799	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-4765.3611	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	-1826.3655	(238)

10a. Fuel costs - using BEDF prices (536)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1021.0570	25.1600	256.8979	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1669.3587	25.1600	420.0106	(247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Energy for lighting	248.5799	25.1600	62.5427	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1671.9082	25.1600	-420.6521	
PV Unit electricity exported	-3093.4529	5.8100	-179.7296	
Total			-600.3817	(252)
Total energy cost			139.0696	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1021.0570	0.1559	159.1844	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1669.3587	0.1409	235.2682	(264)
Space and water heating			394.4526	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	248.5799	0.1443	35.8778	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1671.9082	0.1361	-227.6157	
PV Unit electricity exported	-3093.4529	0.1249	-386.2767	
Total			-613.8924	(269)
Total CO2, kg/year			-183.5620	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1021.0570	1.5771	1610.3489	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1669.3587	1.5211	2539.2981	(278)
Space and water heating			4149.6470	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	248.5799	1.5338	381.2802	(282)

Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1671.9082	1.5032	-2513.2954
PV Unit electricity exported	-3093.4529	0.4583	-1417.7080
Total			-3931.0033 (283)
Total Primary energy kWh/year			599.9238 (286)

SAP 10 EPC IMPROVEMENTS

New Planning Application

Current energy efficiency rating: A 98
Current environmental impact rating: A 101

N Solar water heating — Recommended
U Solar photovoltaic panels — Already installed
V2 Wind turbine — Not applicable

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.7	-£ 68	-42 kg (22.7%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£68	0.43 kg/m²	A 99	A 102
Total Savings	£68	0.43 kg/m²		

Potential energy efficiency rating: A 99
Potential environmental impact rating: A 102

Fuel prices for cost data on this page from database revision number 536 TEST (31 Jan 2024)
Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, East Pennines):

	Current	Potential	Saving
Electricity	£739	£653	£86
Space heating	£257	£277	-£20
Water heating	£420	£313	£107
Lighting	£63	£63	£0
Generated (PV)	-£600	-£582	-£19
Total cost of fuels	£139	£71	£67
Total cost of uses	£140	£71	£68
Delivered energy	-19 kWh/m²	-22 kWh/m²	4 kWh/m²
Carbon dioxide emissions	-0.2 tonnes	-0.2 tonnes	0.0 tonnes
CO2 emissions per m²	-2 kg/m²	-2 kg/m²	0 kg/m²
Primary energy	6 kWh/m²	2 kWh/m²	4 kWh/m²

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	96.5800	(1b)	x 2.4000	(2b) =	231.7920	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.5800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	231.7920	(5)

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2. Ventilation rate

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	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	5 * 10 =	50.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.2157	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0100	(17)
Infiltration rate		0.4662	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4312	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)

Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5498	0.5391	0.5283	0.4744	0.4636	0.4097	0.4097	0.3989	0.4312	0.4636	0.4852	0.5067	(22b)
Effective ac	0.6512	0.6453	0.6395	0.6125	0.6075	0.5839	0.5839	0.5796	0.5930	0.6075	0.6177	0.6284	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1			2.5200	1.2000	3.0240			(26)
Opening Type 2 (Uw = 1.20)			17.5500	1.1450	20.0954			(27)
Heatloss Floor 1			96.5800	0.1200	11.5896	75.0000	7243.5000	(28a)
New Cavity Wall	103.8300	20.0700	83.7600	0.1800	15.0768	60.0000	5025.6000	(29a)
External Roof 1	96.5800		96.5800	0.0700	6.7606	9.0000	869.2200	(30)
Total net area of external elements Aum(A, m2)			296.9900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	56.5464			(33)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13138.3200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.0356 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	12.9000	0.2680	3.4572
E3 Sill	11.7000	0.0220	0.2574
E4 Jamb	26.7000	0.0170	0.4539
E5 Ground floor (normal)	43.2600	0.0590	2.5523
E16 Corner (normal)	16.8000	0.0460	0.7728
E10 Eaves (insulation at ceiling level)	26.9200	0.0600	1.6152
E12 Gable (insulation at ceiling level)	10.7200	0.0560	0.6003
E17 Corner (inverted - internal area greater than external area)	7.2000	-0.0880	-0.6336

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.0756 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	65.6220 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	49.8081	49.3592	48.9191	46.8520	46.4652	44.6648	44.6648	44.3314	45.3583	46.4652	47.2476	48.0656	(38)
Heat transfer coeff	115.4301	114.9811	114.5411	112.4739	112.0872	110.2868	110.2868	109.9534	110.9803	112.0872	112.8696	113.6875	(39)
Average = Sum(39)m / 12 =												112.4721	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1952	1.1905	1.1860	1.1646	1.1606	1.1419	1.1419	1.1385	1.1491	1.1606	1.1687	1.1771	(40)
HLP (average)												1.1645	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.7055	(42)
Hot water usage for mixer showers	78.2805	77.1040	75.3898	72.1099	69.6894	66.9901	65.4558	67.1571	69.0220	71.9202	75.2706	77.9805	(42a)
Hot water usage for baths	30.0460	29.5998	28.9714	27.8128	26.9452	25.9833	25.4636	26.0876	26.7670	27.7964	28.9789	29.9445	(42b)
Hot water usage for other uses	42.3373	40.7978	39.2583	37.7187	36.1792	34.6396	34.6396	36.1792	37.7187	39.2583	40.7978	42.3373	(42c)
Average daily hot water use (litres/day)												138.5178	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	150.6638	147.5016	143.6195	137.6414	132.8138	127.6130	125.5591	129.4239	133.5077	138.9749	145.0473	150.2623	(44)
Energy conte	238.6147	210.0404	220.7378	188.4242	178.7929	156.9151	151.8528	160.2538	164.6284	188.5876	206.6464	235.2745	(45)
Energy content (annual)										Total = Sum(45)m =		2300.7685	
Distribution loss (46)m = 0.15 x (45)m	35.7922	31.5061	33.1107	28.2636	26.8189	23.5373	22.7779	24.0381	24.6943	28.2881	30.9970	35.2912	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.0000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0800	(55)
Total storage loss	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800	(56)
If cylinder contains dedicated solar storage	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	295.3571	261.2916	276.0844	236.5826	222.7410	199.2203	195.5683	204.8998	214.1375	243.9343	261.5584	292.0169	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.8000	(H2)
Collector linear heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0000	(H4)
Collector loop efficiency												0.9000	(H5)
Incidence angle modifier												1.0000	(H6)
Overshading factor												0.8000	(H8)
Overall heat loss coefficient of system												6.5000	(H10)
Heat loss coefficient of collector loop												3.9667	(H11)
Dedicated solar storage volume												75.0000	(H12)
Effective solar volume												75.0000	(H14)
Reference volume												225.0000	(H15)
Storage tank correction coefficient												1.3161	(H16)
Heat delivered to hot water												634.2587	(H24)
Heat delivered to space heating												0.0000	(H29)
Solar input												634.2587	
Solar input	-0.0000	-16.1907	-58.9485	-81.5603	-107.2638	-99.0065	-98.3530	-85.5838	-58.5895	-28.7626	-0.0000	-0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	295.3571	245.1009	217.1359	155.0223	115.4772	100.2138	97.2153	119.3159	155.5480	215.1717	261.5584	292.0169	(64)
										Total per year (kWh/year) = Sum(64)m =		2269.1334	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	124.7333	110.8394	117.6726	101.1778	94.6071	86.0185	85.4634	89.0012	94.3462	106.9827	112.6395	123.6227	(65)

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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	162.3318	162.3318	162.3318	162.3318	162.3318	162.3318	162.3318	162.3318	162.3318	162.3318	162.3318	162.3318	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	35.1891	31.2546	25.4180	19.2430	14.3844	12.1439	13.1219	17.0564	22.8930	29.0680	33.9266	36.1671	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	374.1453	378.0277	368.2441	347.4158	321.1239	296.4131	279.9048	276.0224	285.8061	306.6343	332.9263	357.6370	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.9387	53.9387	53.9387	53.9387	53.9387	53.9387	53.9387	53.9387	53.9387	53.9387	53.9387	53.9387	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	(71)
Water heating gains (Table 5)													
	167.6523	164.9396	158.1621	140.5247	127.1601	119.4701	114.8702	119.6252	131.0364	143.7940	156.4438	166.1595	(72)
Total internal gains													
	685.0359	682.2712	659.8735	615.2328	570.7177	536.0765	515.9463	520.7533	547.7848	587.5455	631.3460	668.0129	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.2700	10.6334	0.6800	0.7500	0.7700	23.5637	(74)
East	3.6000	19.6403	0.6800	0.7500	0.7700	24.9893	(76)
South	1.5000	46.7521	0.6800	0.7500	0.7700	24.7854	(78)
West	6.1800	19.6403	0.6800	0.7500	0.7700	42.8982	(80)

Solar gains	116.2365	218.4257	346.9328	500.3201	617.3789	636.0205	603.7201	514.1509	400.3798	254.9674	143.0956	96.8880	(83)
Total gains	801.2724	900.6969	1006.8063	1115.5530	1188.0966	1172.0970	1119.6664	1034.9042	948.1646	842.5129	774.4416	764.9009	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.6168	31.7403	31.8622	32.4478	32.5598	33.0913	33.0913	33.1916	32.8845	32.5598	32.3341	32.1014	
alpha	3.1078	3.1160	3.1241	3.1632	3.1707	3.2061	3.2061	3.2128	3.1923	3.1707	3.1556	3.1401	
util living area													
	0.9608	0.9426	0.9056	0.8292	0.7084	0.5487	0.4161	0.4624	0.6749	0.8665	0.9424	0.9653	(86)
Living	19.4134	19.6120	19.9366	20.3379	20.6425	20.8224	20.8788	20.8687	20.7398	20.3377	19.8163	19.3891	
Non living	18.0834	18.3350	18.7410	19.2396	19.5893	19.7855	19.8315	19.8283	19.7083	19.2545	18.6088	18.0633	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.1883	19.6120	19.9366	20.3379	20.6425	20.8224	20.8788	20.8687	20.7398	20.3377	19.8163	19.6144	(87)
Th 2	19.9239	19.9276	19.9312	19.9485	19.9517	19.9667	19.9667	19.9695	19.9609	19.9517	19.9452	19.9383	(88)
util rest of house													
	0.9537	0.9325	0.8887	0.7991	0.6582	0.4753	0.3251	0.3686	0.6045	0.8358	0.9305	0.9591	(89)
MIT 2	19.1901	18.3350	18.7410	19.2396	19.5893	19.7855	19.8315	19.8283	19.7083	19.2545	18.6088	18.4012	(90)
Living area fraction										fLA = Living area / (4) =		0.2234	(91)
MIT	19.4132	18.6203	19.0082	19.4850	19.8246	20.0172	20.0655	20.0608	19.9388	19.4965	18.8786	18.6723	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4132	18.6203	19.0082	19.4850	19.8246	20.0172	20.0655	20.0608	19.9388	19.4965	18.8786	18.6723	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9498	0.9169	0.8712	0.7839	0.6516	0.4791	0.3341	0.3773	0.6029	0.8200	0.9151	0.9496	(94)
Useful gains	761.0218	825.8507	877.1220	874.4898	774.1136	561.5763	374.0868	390.4506	571.6564	690.8300	708.7289	726.3420	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1744.5149	1577.5805	1432.6991	1190.5356	910.6692	597.4459	382.1982	402.5134	647.9923	997.1852	1329.4436	1645.3163	(97)
Space heating kWh													
	731.7189	505.1624	413.3494	227.5530	101.5973	0.0000	0.0000	0.0000	0.0000	227.9283	446.9146	683.7168	(98a)
Space heating requirement - total per year (kWh/year)												3337.9407	
Solar heating kWh													
	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	731.7189	505.1624	413.3494	227.5530	101.5973	0.0000	0.0000	0.0000	0.0000	227.9283	446.9146	683.7168	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3337.9407	
Space heating per m2											(98c) / (4) =	34.5614	(99)

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)

Fraction of space heat from main system(s) 1.0000 (202)

Efficiency of main space heating system 1 (in %) 320.9738 (206)

Efficiency of main space heating system 2 (in %) 0.0000 (207)

Efficiency of secondary/supplementary heating system, % 0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	731.7189	505.1624	413.3494	227.5530	101.5973	0.0000	0.0000	0.0000	0.0000	227.9283	446.9146	683.7168	(98)
Space heating efficiency (main heating system 1)													
	320.9738	320.9738	320.9738	320.9738	320.9738	0.0000	0.0000	0.0000	0.0000	320.9738	320.9738	320.9738	(210)
Space heating fuel (main heating system)													
	227.9684	157.3843	128.7798	70.8946	31.6528	0.0000	0.0000	0.0000	0.0000	71.0115	139.2371	213.0133	(211)
Space heating efficiency (main heating system 2)													

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating												
Water heating requirement												
	295.3571	245.1009	217.1359	155.0223	115.4772	100.2138	97.2153	119.3159	155.5480	215.1717	261.5584	292.0169 (64)
Efficiency of water heater												177.9306 (216)
(217)m	177.9306	177.9306	177.9306	177.9306	177.9306	177.9306	177.9306	177.9306	177.9306	177.9306	177.9306	177.9306 (217)
Fuel for water heating, kWh/month												
	165.9957	137.7509	122.0341	87.1251	64.9002	56.3219	54.6367	67.0576	87.4206	120.9301	147.0003	164.1184 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	6.7945	6.1370	6.7945	6.5753	6.7945	6.5753	6.7945	6.7945	6.5753	6.7945	6.5753	6.7945 (231)
Lighting	30.8008	24.7095	22.2482	16.3000	12.5906	10.2866	11.4855	14.9293	19.3917	25.4430	28.7378	31.6568 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-85.0291	-117.6994	-162.6276	-168.2251	-163.0787	-140.3993	-138.2584	-137.0785	-131.2334	-126.7414	-91.5603	-73.2585 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	-45.1958	-99.6085	-207.4727	-327.7821	-449.6965	-462.0564	-456.2356	-382.3339	-275.5707	-151.0579	-62.9052	-35.7175 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)

Annual totals kWh/year	
Space heating fuel - main system 1	1039.9418 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	177.9306
Water heating fuel used	1275.2915 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
pump for solar water heating	80.0000 (230g)
Total electricity for the above, kWh/year	80.0000 (231)
Electricity for lighting (calculated in Appendix L)	248.5799 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-4490.8224 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	-1847.0092 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1039.9418	16.4900	171.4864	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1275.2915	16.4900	210.2956	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	80.0000	16.4900	13.1920	(249)
Energy for lighting	248.5799	16.4900	40.9908	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1535.1896	16.4900	-253.1528	
PV Unit electricity exported	-2955.6329	5.5900	-165.2199	
Total			-418.3726	(252)
Total energy cost			17.5922	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.0447 (257)
SAP value		99.2749
SAP rating (Section 12)		99 (258)
SAP band		A

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1039.9418	0.1556	161.7633	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1275.2915	0.1452	185.1883	(264)
Space and water heating			346.9515	(265)
Pumps, fans and electric keep-hot	80.0000	0.1387	11.0970	(267)
Energy for lighting	248.5799	0.1443	35.8778	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1535.1896	0.1366	-209.7177	
PV Unit electricity exported	-2955.6329	0.1244	-367.5880	
Total			-577.3057	(269)
Total CO2, kg/year			-183.3794	(272)
CO2 emissions per m2			-1.9000	(273)
EI value			101.7356	
EI rating			102	(274)

EI band A

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	96.5800 (1b)	x	2.4000 (2b)	=	231.7920	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.5800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	231.7920	(5)

2. Ventilation rate

	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	5 * 10 =	50.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.2157 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0100 (17)
Infiltration rate		0.4662 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4312 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.0000	4.6000	4.4000	3.9000	4.1000	4.0000	4.2000	4.5000	4.8000	4.9000	(22)
Wind factor	1.3500	1.2750	1.2500	1.1500	1.1000	0.9750	1.0250	1.0000	1.0500	1.1250	1.2000	1.2250	(22a)
Adj infilt rate	0.5822	0.5498	0.5391	0.4959	0.4744	0.4205	0.4420	0.4312	0.4528	0.4852	0.5175	0.5283	(22b)
Effective ac	0.6695	0.6512	0.6453	0.6230	0.6125	0.5884	0.5977	0.5930	0.6025	0.6177	0.6339	0.6395	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1			2.5200	1.2000	3.0240			(26)
Opening Type 2 (Uw = 1.20)			17.5500	1.1450	20.0954			(27)
Heatloss Floor 1			96.5800	0.1200	11.5896	75.0000	7243.5000	(28a)
New Cavity Wall	103.8300	20.0700	83.7600	0.1800	15.0768	60.0000	5025.6000	(29a)
External Roof 1	96.5800		96.5800	0.0700	6.7606	9.0000	869.2200	(30)
Total net area of external elements Aum(A, m2)			296.9900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		56.5464			(33)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13138.3200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.0356 (35)

List of Thermal Bridges

	Length	Psi-value	Total	
K1 Element				
E2 Other lintels (including other steel lintels)	12.9000	0.2680	3.4572	
E3 Sill	11.7000	0.0220	0.2574	
E4 Jamb	26.7000	0.0170	0.4539	
E5 Ground floor (normal)	43.2600	0.0590	2.5523	
E16 Corner (normal)	16.8000	0.0460	0.7728	
E10 Eaves (insulation at ceiling level)	26.9200	0.0600	1.6152	
E12 Gable (insulation at ceiling level)	10.7200	0.0560	0.6003	
E17 Corner (inverted - internal area greater than external area)	7.2000	-0.0880	-0.6336	

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.0756 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	65.6220 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	51.2084	49.8081	49.3592	47.6521	46.8520	45.0071	45.7184	45.3583	46.0874	47.2476	48.4879	48.9191	(38)
Heat transfer coeff	116.8304	115.4301	114.9811	113.2741	112.4739	110.6291	111.3404	110.9803	111.7093	112.8696	114.1098	114.5411	(39)
Average = Sum(39)m / 12 =												113.2641	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2097	1.1952	1.1905	1.1729	1.1646	1.1455	1.1528	1.1491	1.1567	1.1687	1.1815	1.1860	(40)
HLP (average)												1.1727	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.7055	(42)
Hot water usage for mixer showers													
	78.2805	77.1040	75.3898	72.1099	69.6894	66.9901	65.4558	67.1571	69.0220	71.9202	75.2706	77.9805	(42a)
Hot water usage for baths													
	30.0460	29.5998	28.9714	27.8128	26.9452	25.9833	25.4636	26.0876	26.7670	27.7964	28.9789	29.9445	(42b)
Hot water usage for other uses													
	42.3373	40.7978	39.2583	37.7187	36.1792	34.6396	34.6396	36.1792	37.7187	39.2583	40.7978	42.3373	(42c)
Average daily hot water use (litres/day)												138.5178	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	150.6638	147.5016	143.6195	137.6414	132.8138	127.6130	125.5591	129.4239	133.5077	138.9749	145.0473	150.2623	(44)
Energy conte	238.6147	210.0404	220.7378	188.4242	178.7929	156.9151	151.8528	160.2538	164.6284	188.5876	206.6464	235.2745	(45)
Energy content (annual)											Total = Sum(45)m =	2300.7685	
Distribution loss (46)m = 0.15 x (45)m													
	35.7922	31.5061	33.1107	28.2636	26.8189	23.5373	22.7779	24.0381	24.6943	28.2881	30.9970	35.2912	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.0000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0800	(55)
Total storage loss													
	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800	(56)
If cylinder contains dedicated solar storage													
	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	295.3571	261.2916	276.0844	236.5826	222.7410	199.2203	195.5683	204.8998	214.1375	243.9343	261.5584	292.0169	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.8000	(H2)
Collector linear heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0000	(H4)
Collector loop efficiency												0.9000	(H5)
Incidence angle modifier												1.0000	(H6)
Overshading factor												0.8000	(H8)
Overall heat loss coefficient of system												6.5000	(H10)
Heat loss coefficient of collector loop												3.9667	(H11)
Dedicated solar storage volume												75.0000	(H12)
Effective solar volume												75.0000	(H14)
Reference volume												225.0000	(H15)
Storage tank correction coefficient												1.3161	(H16)
Heat delivered to hot water												689.1444	(H24)
Heat delivered to space heating												0.0000	(H29)
Solar input												689.1444	
Solar input	-0.0000	-18.8631	-62.6010	-88.0076	-112.5043	-106.6308	-105.1872	-92.7729	-65.7960	-35.2996	-1.4819	-0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	295.3571	242.4285	213.4834	148.5750	110.2367	92.5895	90.3811	112.1269	148.3415	208.6347	260.0765	292.0169	(64)
										Total per year (kWh/year) = Sum(64)m =		2214.2477	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
						Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =						0.0000	(64a)
Heat gains from water heating, kWh/month													
	124.7333	110.8394	117.6726	101.1778	94.6071	86.0185	85.4634	89.0012	94.3462	106.9827	112.6395	123.6227	(65)

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5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	162.3318	162.3318	162.3318	162.3318	162.3318	162.3318	162.3318	162.3318	162.3318	162.3318	162.3318	162.3318	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	35.1891	31.2546	25.4180	19.2430	14.3844	12.1439	13.1219	17.0564	22.8930	29.0680	33.9266	36.1671	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	374.1453	378.0277	368.2441	347.4158	321.1239	296.4131	279.9048	276.0224	285.8061	306.6343	332.9263	357.6370	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.9387	53.9387	53.9387	53.9387	53.9387	53.9387	53.9387	53.9387	53.9387	53.9387	53.9387	53.9387	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	-108.2212	(71)
Water heating gains (Table 5)													
	167.6523	164.9396	158.1621	140.5247	127.1601	119.4701	114.8702	119.6252	131.0364	143.7940	156.4438	166.1595	(72)
Total internal gains													
	685.0359	682.2712	659.8735	615.2328	570.7177	536.0765	515.9463	520.7533	547.7848	587.5455	631.3460	668.0129	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.2700	11.7839	0.6800	0.7500	0.7700	26.1132	(74)
East	3.6000	21.8216	0.6800	0.7500	0.7700	27.7646	(76)
South	1.5000	51.3807	0.6800	0.7500	0.7700	27.2392	(78)
West	6.1800	21.8216	0.6800	0.7500	0.7700	47.6626	(80)

Solar gains	128.7797	229.2170	359.8430	528.9735	642.1536	676.6424	638.0680	545.7704	430.1726	276.6772	159.4018	109.9649	(83)
Total gains	813.8156	911.4882	1019.7165	1144.2063	1212.8713	1212.7188	1154.0143	1066.5237	977.9575	864.2228	790.7478	777.9778	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.2379	31.6168	31.7403	32.2186	32.4478	32.9889	32.7782	32.8845	32.6699	32.3341	31.9826	31.8622	
alpha	3.0825	3.1078	3.1160	3.1479	3.1632	3.1993	3.1852	3.1923	3.1780	3.1556	3.1322	3.1241	
util living area													
	0.9595	0.9412	0.9003	0.8143	0.6826	0.5012	0.3657	0.4010	0.6382	0.8523	0.9399	0.9645	(86)

Living	19.4028	19.6155	19.9671	20.3788	20.6785	20.8454	20.8876	20.8826	20.7708	20.3804	19.8147	19.3745	
Non living	18.0617	18.3365	18.7758	19.2817	19.6243	19.8021	19.8277	19.8284	19.7319	19.2992	18.5988	18.0396	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.1829	19.6155	19.9671	20.3788	20.6785	20.8454	20.8876	20.8826	20.7708	20.3804	19.8147	19.6019	(87)
Th 2	19.9123	19.9239	19.9276	19.9418	19.9485	19.9639	19.9579	19.9609	19.9548	19.9452	19.9348	19.9312	(88)
util rest of house													
	0.9522	0.9308	0.8825	0.7817	0.6290	0.4247	0.2724	0.3031	0.5625	0.8184	0.9276	0.9581	(89)
MIT 2	19.1745	18.3365	18.7758	19.2817	19.6243	19.8021	19.8277	19.8284	19.7319	19.2992	18.5988	18.3805	(90)
Living area fraction										fLA = Living area / (4) =		0.2234	(91)
MIT	19.3998	18.6223	19.0420	19.5268	19.8599	20.0352	20.0645	20.0640	19.9640	19.5408	18.8705	18.6534	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3998	18.6223	19.0420	19.5268	19.8599	20.0352	20.0645	20.0640	19.9640	19.5408	18.8705	18.6534	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9482	0.9150	0.8648	0.7672	0.6241	0.4302	0.2822	0.3131	0.5632	0.8031	0.9119	0.9485	(94)
Useful gains	771.6477	834.0080	881.8785	877.8675	756.9138	521.7655	325.6722	333.9641	550.7737	694.0624	721.0687	737.8791	(95)
Ext temp.	4.3000	4.9000	6.7000	9.2000	12.1000	15.1000	17.1000	17.0000	14.5000	10.9000	7.1000	4.1000	(96)
Heat loss rate W													
	1764.1196	1583.9635	1419.0947	1169.7598	872.7841	545.9786	330.0686	340.0401	610.3813	975.2795	1343.1293	1666.9644	(97)
Space heating kWh													
	738.3991	503.9700	399.6889	210.1624	86.2075	0.0000	0.0000	0.0000	0.0000	209.2255	447.8836	691.2395	(98a)
Space heating requirement - total per year (kWh/year)												3286.7765	
Solar heating kWh													
	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	738.3991	503.9700	399.6889	210.1624	86.2075	0.0000	0.0000	0.0000	0.0000	209.2255	447.8836	691.2395	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3286.7765	
Space heating per m2											(98c) / (4) =	34.0316	(99)

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												321.4435	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	738.3991	503.9700	399.6889	210.1624	86.2075	0.0000	0.0000	0.0000	0.0000	209.2255	447.8836	691.2395	(98)
Space heating efficiency (main heating system 1)													
	321.4435	321.4435	321.4435	321.4435	321.4435	0.0000	0.0000	0.0000	0.0000	321.4435	321.4435	321.4435	(210)
Space heating fuel (main heating system)													
	229.7135	156.7834	124.3419	65.3808	26.8189	0.0000	0.0000	0.0000	0.0000	65.0893	139.3351	215.0423	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	295.3571	242.4285	213.4834	148.5750	110.2367	92.5895	90.3811	112.1269	148.3415	208.6347	260.0765	292.0169	(64)
Efficiency of water heater												177.8446	(216)
(217)m	177.8446	177.8446	177.8446	177.8446	177.8446	177.8446	177.8446	177.8446	177.8446	177.8446	177.8446	177.8446	(217)
Fuel for water heating, kWh/month													
	166.0759	136.3148	120.0393	83.5420	61.9848	52.0620	50.8202	63.0477	83.4107	117.3129	146.2381	164.1978	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	6.7945	6.1370	6.7945	6.5753	6.7945	6.5753	6.7945	6.7945	6.5753	6.7945	6.5753	6.7945	(231)
Lighting	30.8008	24.7095	22.2482	16.3000	12.5906	10.2866	11.4855	14.9293	19.3917	25.4430	28.7378	31.6568	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-92.0583	-121.4021	-165.1260	-170.2568	-162.6531	-140.9438	-138.7105	-138.2914	-134.1001	-131.7588	-98.9101	-80.9691	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-52.0873	-106.3559	-218.1153	-353.2152	-473.6459	-498.9994	-488.5969	-412.0892	-302.2118	-169.2670	-72.9827	-42.6143	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	1022.5052	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	177.8446	
Water heating fuel used	1245.0462	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
pump for solar water heating	80.0000	(230g)
Total electricity for the above, kWh/year	80.0000	(231)
Electricity for lighting (calculated in Appendix L)	248.5799	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-4765.3611	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	-2169.2298	(238)

10a. Fuel costs - using BEDF prices (536)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1022.5052	25.1600	257.2623	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1245.0462	25.1600	313.2536	(247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	80.0000	25.1600	20.1280	(249)
Energy for lighting	248.5799	25.1600	62.5427	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1575.1800	25.1600	-396.3153	
PV Unit electricity exported	-3190.1811	5.8100	-185.3495	
Total			-581.6648	(252)
Total energy cost			71.5218	(255)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1022.5052	0.1559	159.3861	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1245.0462	0.1456	181.3019	(264)
Space and water heating			340.6881	(265)
Pumps, fans and electric keep-hot	80.0000	0.1387	11.0970	(267)
Energy for lighting	248.5799	0.1443	35.8778	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1575.1800	0.1370	-215.7226	
PV Unit electricity exported	-3190.1811	0.1245	-397.2296	
Total			-612.9522	(269)
Total CO2, kg/year			-225.2893	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1022.5052	1.5771	1612.5436	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1245.0462	1.5387	1915.6925	(278)
Space and water heating			3528.2362	(279)
Pumps, fans and electric keep-hot	80.0000	1.5128	121.0240	(281)
Energy for lighting	248.5799	1.5338	381.2802	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1575.1800	1.5063	-2372.6867	
PV Unit electricity exported	-3190.1811	0.4570	-1457.8375	
Total			-3830.5241	(283)
Total Primary energy kWh/year			200.0162	(286)

Appendix C

Predicted Energy Assessment

Predicted Energy Assessment

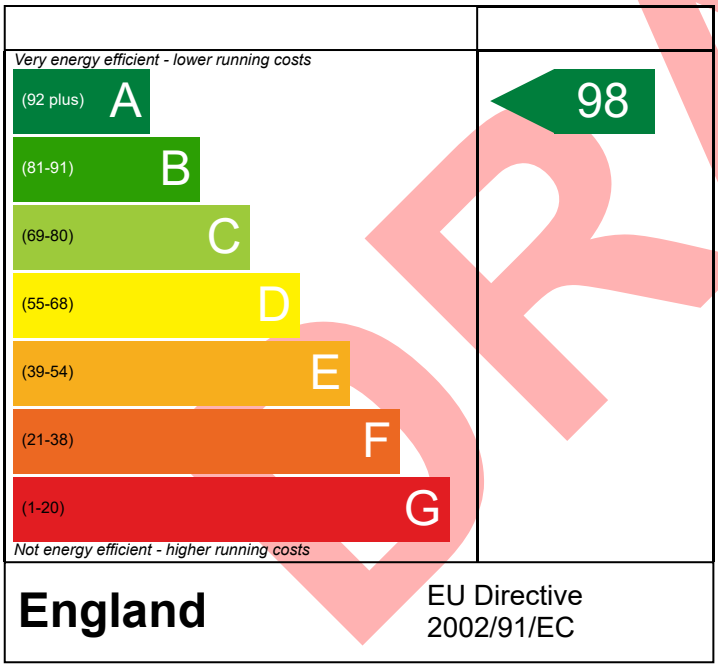
New dwelling at, 20, Willow Lane, Cranwell, Lincs, NG34 8DG

Dwelling type:	Bungalow, Detached
Date of assessment:	15/02/2024
Produced by:	Jake Eaton
Total floor area:	96.58 m²
DRRN:	

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

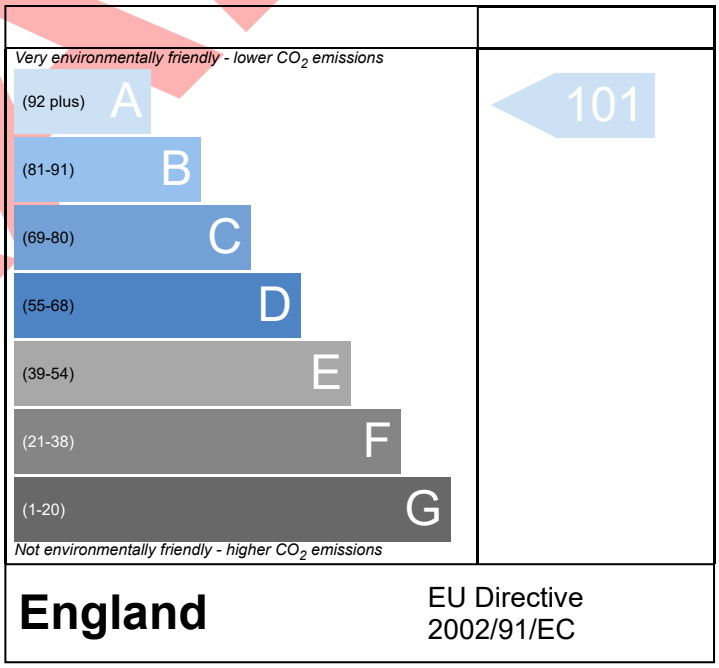
The energy performance has been assessed using the Government approved SAP 10 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

Environmental Impact (CO_2) Rating



The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO_2) emissions. The higher the rating the less impact it has on the environment.

rdc
Robert Doughty
Consultancy

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