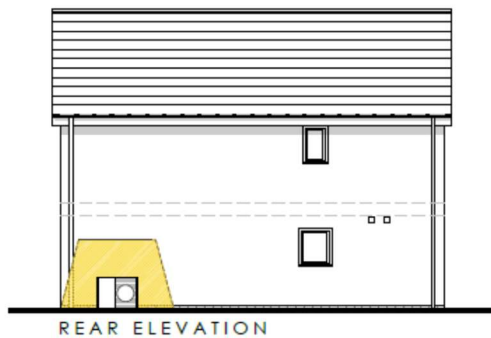


*Vale of Glamorgan council (2023)*



**REPORT ON A TYPICAL NEW BUILD HOME – PROPOSALS ON HOW TO BE COMPLIANT WITH CURRENT REGULATIONS TO MEET NET ZERO.**

**Property Reference: HT 641 (4 Bed, 6 Person House)**

**Project: Vale of Glamorgan Council Net Zero Carbon Buildings**

**Client: Ian Brown**

**Prepared By: Manta Ray Surveying & Solutions**

**Date: 9<sup>TH</sup> May 2026**

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## 1.0 Introduction

The Welsh Government have ambitious targets for every new domestic property to be fully reliant on net zero energy. Moving away from any fossil fuels. This proposal will focus on the provided example 'HT641', a 4-bedroom detached house with an internal area of 110m<sup>2</sup>. It is important to distinguish between achieving the net zero proposals and complying with Part L building regs. We have been tasked with providing M&E (Mechanical and Electrical) proposals rather than the fabric first approach of starting with insulation, windows etc. The goal of this proposal is to reduce the heating demand of the property to where only a fraction of the work is needed to heat the property in comparison to the starting example.

The HT641 example building is a solid baseline, it utilizes a fabric first approach with 550mm external insulated walls which are supported by an ASHP and standard mechanical ventilation. The 2030 Welsh government targets are to hit net zero carbon in operation.

## 2.0 WDQR 2021 & Passivhaus

Before commencing, it would be prudent to compare the standards expected between the WDQR 2021 which is the standard legal baseline for social housing in Wales in comparison to Passivhaus which is a far more rigorous detail which enforces strict targets for airtightness and the total elimination of thermal bridging. While WDQR (Welsh Development Quality Requirements 2021) provides a good foundation for quality, adopting the Passivhaus principles guarantees that the property will meet true net zero goals by minimising the heat demand to a fraction of the traditional standard for new builds. *GOV.WALES* (2026)

## 3.0 Passivhaus Requirements

To hit Net Zero, we will follow the Passivhaus principles. Standard new builds in Wales will reach the minimum U – value required by the government. A Passivhaus detail will aim for far more extreme efficiency in comparison.

Mitchell, R., & Natarajan, S. (2020). Foster, J., Sharpe, T., Poston, A., Morgan, C., & Musau, F. (2016). Passive House Institute GmbH (no date)

### 3.1 Existing Insulation

The provided plans show a wall thickness of 550mm. this is a huge improvement over the standard cavity walls which are generally 300mm wide. As this report is not focussing on the building's fabric, we will assume that these walls are filled with high

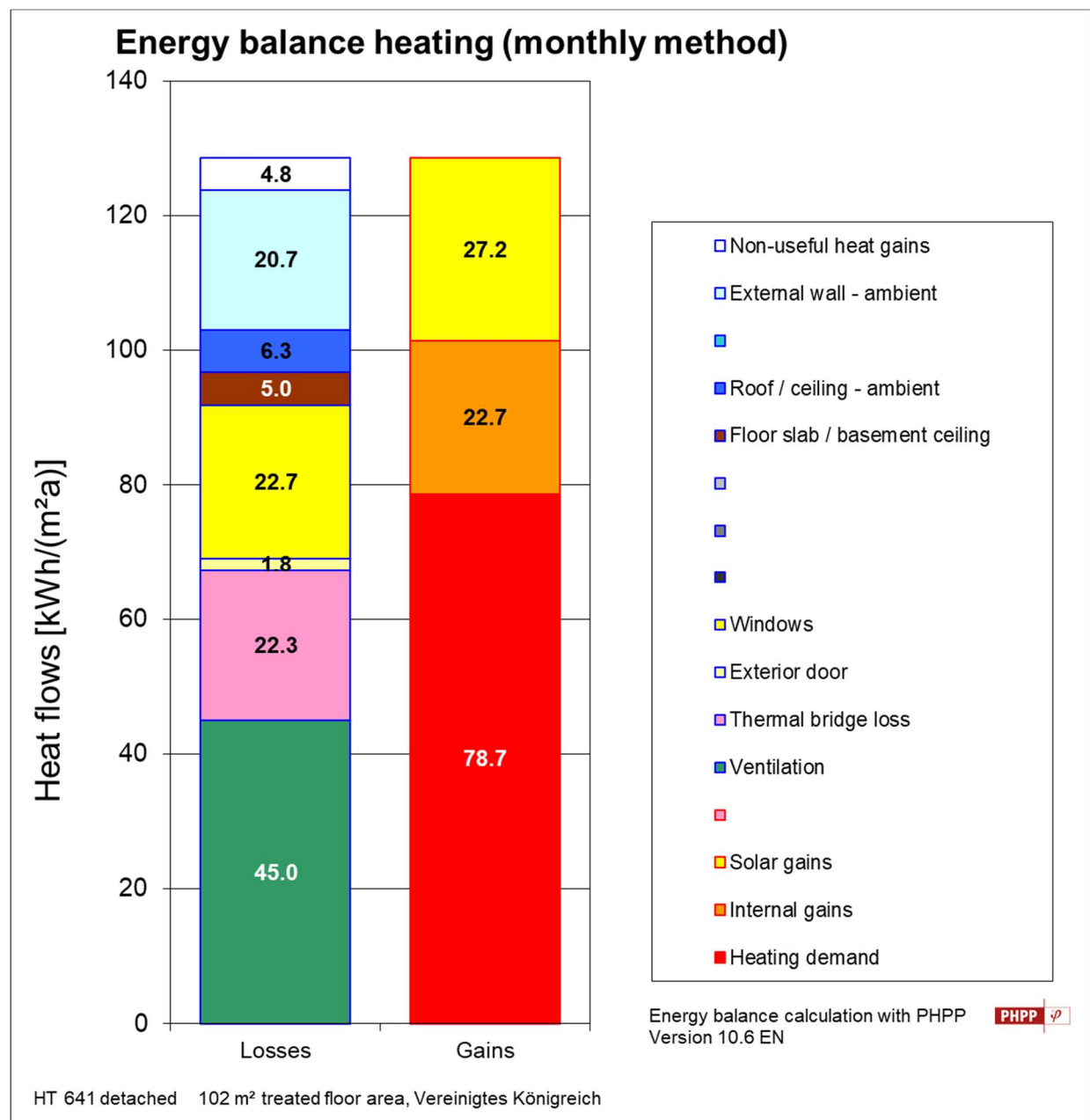
performing, low embodied carbon insulation such as cellulose to achieve the U- value of roughly 0.12W/m2k.

### 3.2 Existing Airtightness

We are going to assume that this property has an airtightness value of 8.0 m3/h-m3 at 50 Pa. To improve this to Passivhaus standard, we are going to propose improving to 0.6 air changes per hour at 50 Pa.

Jain, N., Burman, E. and Mumovic, D. (2024)

### 3.3 Existing Monthly Heating – Baseline PHPP summary



## 4.0 Identification of Existing M&E Systems

The provided drawings specify a modern example of M&E systems:

### 4.1 Existing Heating System

A Vaillant AroTHERM + 3.5kw ASHP. This is generally considered a good performing and reliable air source heat pump (ASHP), unlike a generic gas or oil boiler – these use electricity to pump heat from the outside air into the building. On this plan, it is located at the rear.

We are going to assume that due to the size of the property there is either underfloor heating (UFH) and/or oversized radiators to distribute the heat. The fitted ASHP 5kw capacity is a good capacity for this sized building.

While the ASHP is highly efficient, its coefficient of performance (COP), the ratio of heat produced compared to electricity consumed, is dependant the Welsh weather/climate. As per the attached table below, the COP dramatically changes in accordance with the season. In order for the ASHP to remain net zero compliant, it must operate at a low flow temp of 35 degrees. This is really only feasible if the buildings walls successfully achieve the 0.12 W/m<sup>2</sup>k U-value.

**COP (Coefficient of Performance) = Heat Output / Power (Electrical) Input.**

For this property, 5kw unit has been chosen due to the building being designed to keep the heat in so well that even a larger capacity system would not be necessary. Even when it is -3 degrees externally this system ensures that the house will stay warm while maintaining a high average efficiency (SCOP) of 4.01. From a 'whole life' perspective, even though the upfront costs of purchasing an ASHP is at first very expensive in comparison to a traditional GAS boiler, it will drastically save costs over time due to their being no fuel costs or standing charges taken by providers.

| Typical ASHP performance<br>(Vaillant aroTHERM plus 5kw) |                         |               |
|----------------------------------------------------------|-------------------------|---------------|
| Outside Air Temperature                                  | System Flow Temperature | Estimated COP |
| 7°C<br>(Spring/Autumn)                                   | 35°C                    | 4.5 - 4.8     |
| 2°C (Typical Welsh Winter)                               | 35°C                    | 2.5 - 2.8     |
| - 7°C (Peak Winter/Frost)                                | 35°C                    | 2.0 - 2.3     |

## 4.2 Existing Ventilation

The HT641 example currently houses bog standard mechanical ventilating fans. These are continuously running in the wet rooms to manage moisture levels and air quality.

## 4.3 Existing Hot Water

The ASHP provides domestic hot water (DHW). The system operates by extracting low grade heat from the outside air and through a refrigeration cycle will heat the water stored in a cylinder. While efficient in its own right due to the ASHP, the Vaillant will have to work harder to reach high temperatures which are needed for legionella eradication.

# 5.0 Whole Life Impact of existing tech

To evaluate the whole life impact of the technologies beyond their daily use, we will focus on the recyclability of the ASHP and its 20-year life span. The unit itself contains materials like copper and aluminium which will need to be recycled and R290 refrigerant (this is a high purity propane used as a natural refrigerant with a very low global warming potential (GWP) of 3. This requires professional recovery to avoid any environmental harm. If we are going off the assumption that the walls are filled with cellulose insulation, these will act as a carbon store, balancing the carbon footprint of the mechanical systems which allows for a much more sustainable lifecycle.

## 6.0 Proposed Improvements

### 6.1 Solar Panels

The site layout shows an east & west orientation – we propose installing solar panels (PV = photovoltaic) on both the East and West side. This is obviously due to the sun's trajectory, rising in the East and setting in the West. Providing the property (basis that it is a clear day) with consistent sun light to the panels.

Green2Go (no date)

### 6.2 Excess Electricity

During the day, if the sun is shining consistently and no electricity is being used, this excess energy will be sent back to the grid for little to no profit. In replace of this, we could divert this 'excess' energy into heating the hot water tank. This would in base terms provide hot water for free and turn the tank into a thermal battery.

#### 6.2.1 Smart water tank

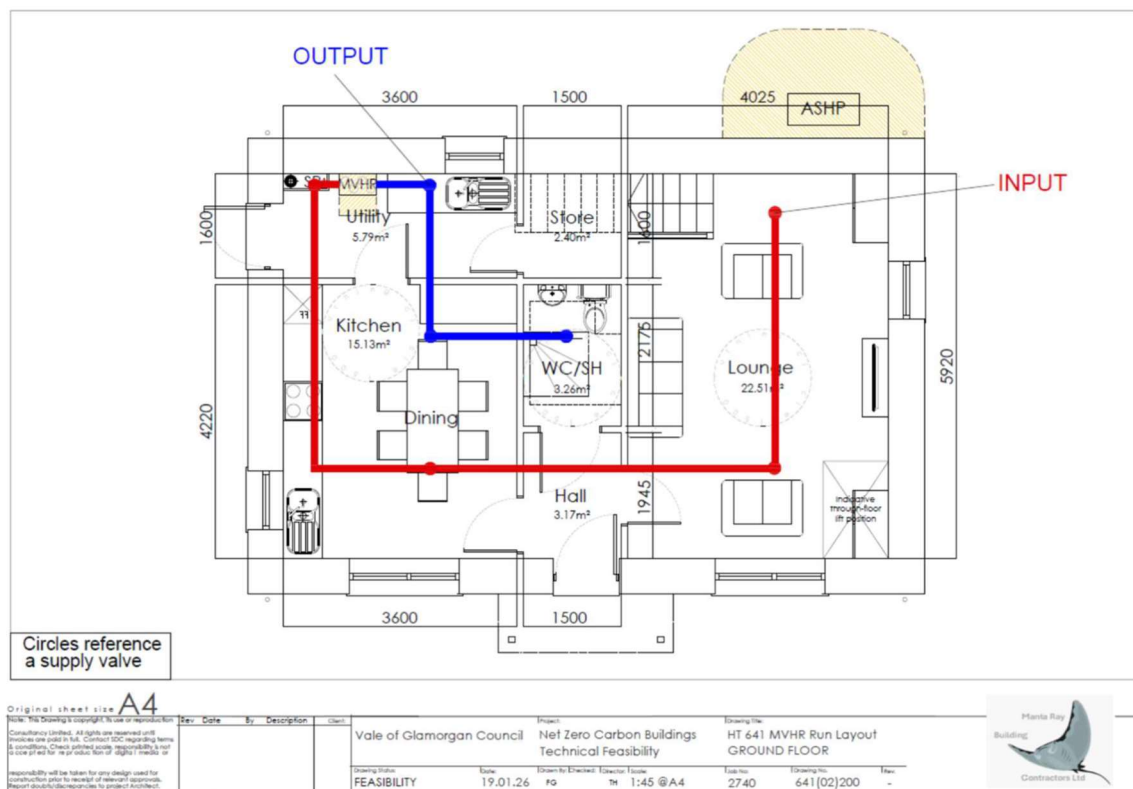
A Mixergy 'smart tank' hot water cylinder (up to 210L). This system only heats up what's needed rather than the entire tank, saving considerable energy. Mixergy (2026)

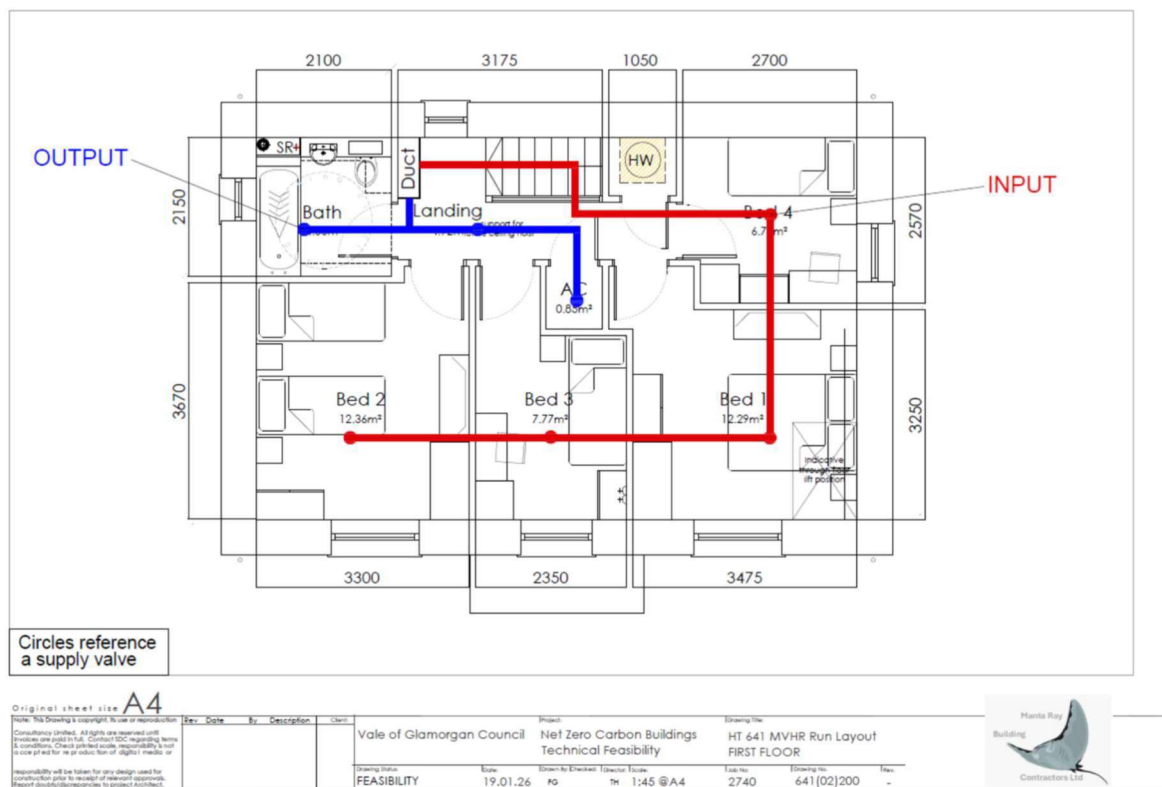
## 6.3 MVHR System

An Envirovent EnergiSava 300 MVHR unit located in the utility room. It sucks out any stale air from the 'wet' rooms (these are considered the kitchens, bathrooms etc). It then uses this to heat up any fresh incoming air and pumps it around the property.

The MVHR unit has an 89% heat recovery efficiency score, this is excellent for saving as much energy as possible, but it will require the tenants keep the windows closed in the winter and the filters changed regularly. These costs must be considered when proposing this.

The first-floor plan shows a dedicated 'duct' space – this is a clever design as MVHR's do generally take a considerable amount of space with the large pipework.





envirovent (2026) Gale, F (2026).

## 6.4 Improve air tightness

The airtightness must be improved to meet 0.6 air changes per hour (ach at 50pa). We will do this by creating a continuous unbroken seal involving a smart vapour control membrane on the inner leaf of the external walls. All junctions will be secured by airtight tape and allow for a pipework to penetrate the external walls from the ASHP etc. these fittings will be covered with rubber grommets which will provide a high-performance leak free seal. Further along on the report a new front and rear door is proposed, with this, an airtight envelope will be created allowing the MVHR system to hit its 89% efficiency rating as no heat will be lost and will all go through the recovery system.

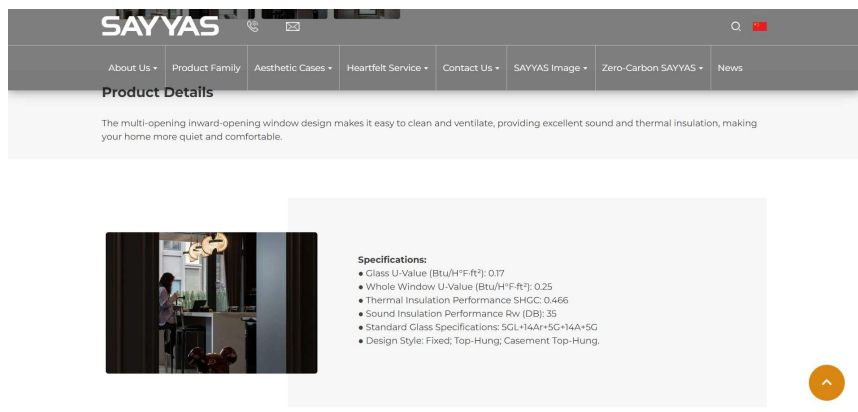
## 6.5 Remove any thermal bridging

To achieve the thermal bridging free target, we must ensure that the insulation layer remains unbroken at every junction. With the 550mm walls, wrapping the insulation around the corners and floor/roof junctions, basically blanketing the building to eliminate any cold spots. Ensuring the window frames are insulated to prevent any heat loss and allowing the ASHP to not lose any of its generated heat by bypassing the insulation. This in whole will protect the building from internal condensation and ensure the building meets true net zero standards.

*What is Thermal Bridging?* (no date)

## 6.6 Upgrade Window frames & glazing

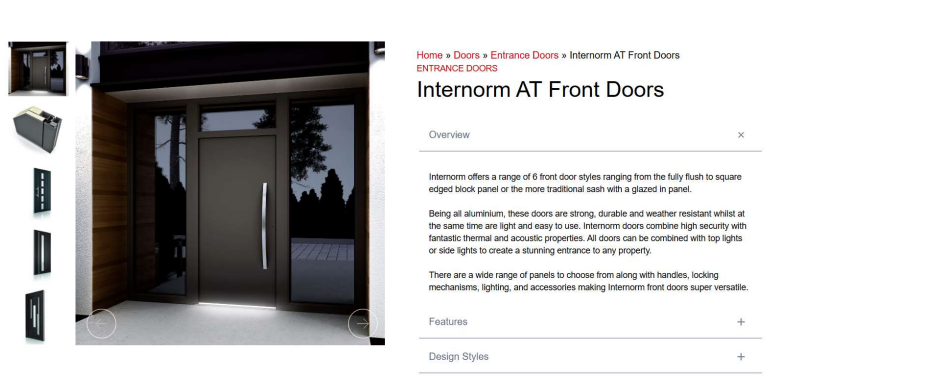
To finalise mitigating the thermal bridging and ensuring the buildings airtightness' is suited for an EnerPHit certification, the installation of 'Harbin Sayyas PAZEN 120' windows throughout the project. These windows are Passivhaus certified and will feature triple low-E glazing with 18mm Argon gas cavity. These will deliver a u-value which will meet the space heating demand of 22kWh/(m2a). By integrating these windows with the EWI system creates a continuous thermal wrap that will eliminate the chance for any cold spots. These windows also provide superior acoustic insulation and long-term protection against weather conditions.



Sayyas Windows, 2026

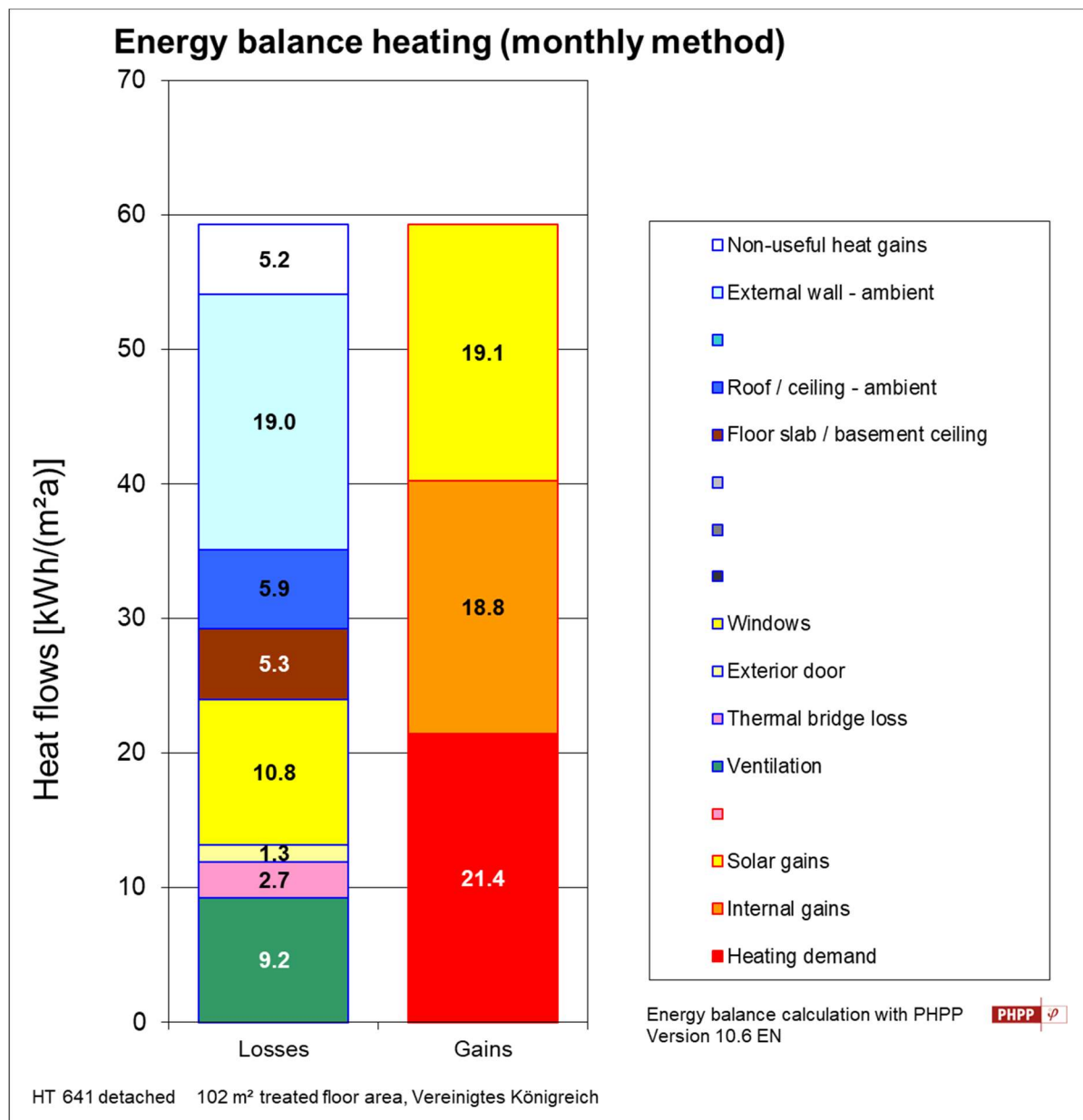
## 6.7 Upgrade Doors

To retrofit the front door to Passivhaus standard, an 'Internorm AT 410' is a certified high-performance door available in the UK. While standard doors in Welsh newbuilds provide a U-value of roughly 1.4 W/m3k, the AT 410 achieves an exceptional value of 0.75. this is comfortably past the Passivhaus requirement of 0.80W/m3k. the door is a 90mm thick high density insulated core with a triple seal gasket which ensures the door meets airtightness requirements and prevents draughts and heat loss.



(Infinitewindows, 2026)

## 7.0 Monthly Heating Demand following proposed upgrades



## 8.0 Financial justification

The monetary justification for the proposed upgrades lies on the balance between the initial investment and the long-term operational gain. While the addition of the M&E specifications results in a roughly 15% increase in expenditure during the construction phase in comparison to the standard HT641 specification, however, this is offset by the projected reduction of utility costs. The projection shows annual savings of up to £1000

compared to the standard new build. When viewed from a ‘whole life’ approach, over a 60-year period these savings far outweigh the upfront costs providing a clear argument to fit the proposed systems.

This justification lies between the balance of the initial capital investment and the long-term operational gains. While the proposed upgrades result in a 15% increase during the construction phase compared to the standard new builds – this is as mentioned previously offset by the savings provided. The investment in triple glazing and the 0.6 ACH airtightness target offer performance benefits that will last the lifetime of the building with little to no maintenance. This ensures that the building remains compliant with aspirational standard such as LETI.

## 8.1 Total cost of works

| COST OF WORKS   |                                                             |                                                                                |                      |                                                                 |
|-----------------|-------------------------------------------------------------|--------------------------------------------------------------------------------|----------------------|-----------------------------------------------------------------|
| Element         | Baseline Specification (Part L)                             | Proposed Upgrade (Net Zero)                                                    | Cost Uplift (Est. £) | Justification & Performance Impact                              |
| Building Fabric | Standard cavity wall/timber frame insulation.               | 550mm wall zone with high-density insulation and continuous airtight membrane. | £3,250.00            | Ensures thermal-bridge-free construction and reduces heat loss. |
| Airtightness    | Target: 5.0 to 8.0 m <sup>3</sup> /h·m <sup>2</sup> @ 50Pa. | Target: 0.6 ACH @ 50Pa using specialist tapes and grommets.                    | £1,150.00            | Essential for MVHR efficiency and eliminating drafts.           |
| Glazing         | Double glazed units (U-value ~1.2-1.4).                     | Triple Glazed (e.g., Sanyas PAZEN 120 or Internorm AT 410).                    | £9,400.00            | Provides superior thermal comfort and solar gain control.       |
| Ventilation     | Natural ventilation with dMEV background fans.              | Centralized MVHR (EnviroVent energiSava 200).                                  | £4,200.00            | Recovers up to 89% of heat from extract air; prevents mold.     |
| Water Heating   | Standard basic cylinder.                                    | Mixergy Smart Tank solar diversion.                                            | £1,450.00            | Smart stratification allows for "thermal battery" storage.      |
| Renewables      | Minimal or no Solar PV.                                     | 4.5 kWp Solar PV Array (East/West orientation).                                | £6,500.00            | Maximizes self-consumption and reduces grid dependency.         |
| TOTALS          | Baseline Construction Cost                                  | Revised Net Zero Cost                                                          | £25,950.00           | Total capital expenditure (CapEx) uplift.                       |

## 9.0 Conclusion

To conclude, this proposal outlines a shift on how to hit Passivehaus standard for the HT641 property. Prioritizing hitting 0.6 air changes per hour airtightness target and for total removal of any thermal bridging. By integrating a high performing MVHR with an 89% recovery rate and an ASHP, together provide a significant reduction in heating demand. Accompanied by both east and west facing solar PV panels and a mixergy smart water tank which can be utilized as a thermal battery holding hot water. While these upgrades pose an uplift in initial costs, the benefits far outweigh the debt and allow for a vastly reduced whole life carbon footprint over a 60-year cycle.

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Vagtholm, R. *et al.* (2023b) 'Evolution and current state of building materials, construction methods, and building regulations in the U.K.: Implications for Sustainable Building Practices,' *Buildings*, 13(6), p. 1480.

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11.0 Appendix

AREA SCHEDULE

WQGR 2021 Area Requirements

2 Person 3-Bed House

110.2m²

Measured GIA:

110.4m²

WQGR 2021 General Storage Requirements

2 Person 3-Bed House

2.0m³

CP Store

2.0m³

Along Chubboid (AC)

0.0m³

Cumulative Total:

2.0m³

MEP & PLANT PROVISIONS

Information presented indicatively for coordination with all-including manufacturer & model specification - TBC by relevant specialist consultant / subcontractor. All revisions to the plant specification must be reported for coordination.

CONSTRUCTIONS

External walls: 100mm  
Internal walls: 100mm  
Intermediate floor: 100mm

Constructional thicknesses are indicative only & must be coordinated with fabric requirements for acoustic, fire & thermal performance on a site-by-site basis. All TBC by the constructional preferences of the appointed contractor.

A3

|                               |                               |                                  |
|-------------------------------|-------------------------------|----------------------------------|
| Drawn by: J. Smith            | Check by: M. Jones            | Approved by: P. Brown            |
| Drawn on: 15/01/2024          | Check on: 16/01/2024          | Approved on: 17/01/2024          |
| Drawn at: 1:100               | Check at: 1:100               | Approved at: 1:100               |
| Drawn for: HT 641 Floor Plans | Check for: HT 641 Floor Plans | Approved for: HT 641 Floor Plans |
| Drawn by: J. Smith            | Check by: M. Jones            | Approved by: P. Brown            |
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LOW CARBON PLANT

ASHP

Volant ecoHEAT plus 5.0i  
dimensions: 750x1100x600mm (hwd)

MVHR

envisant energyplus 200  
dimensions: 647x732x22mm (hwd)  
Volume flow: 40.0m³/h  
Heat recovery: 89.0%  
Specific fan power: 0.7W/m³/s

Hot Water Cylinder

Menergy cylinder 180 / 210,  
dimensions: 1250 / 580x540mm (h/d)  
Menergy 210, for HT 421

Note: Information presented indicatively for coordination with all-including manufacturer & model specification - TBC by relevant specialist consultant / subcontractor. All revisions to



AREA SCHEDULE

WQGR 2021 Area Requirements

2 Person 3-Bed House

110.2m²

Measured GIA:

110.4m²

WQGR 2021 General Storage Requirements

2 Person 3-Bed House

2.0m³

CP Store

2.0m³

Along Chubboid (AC)

0.0m³

Cumulative Total:

2.0m³

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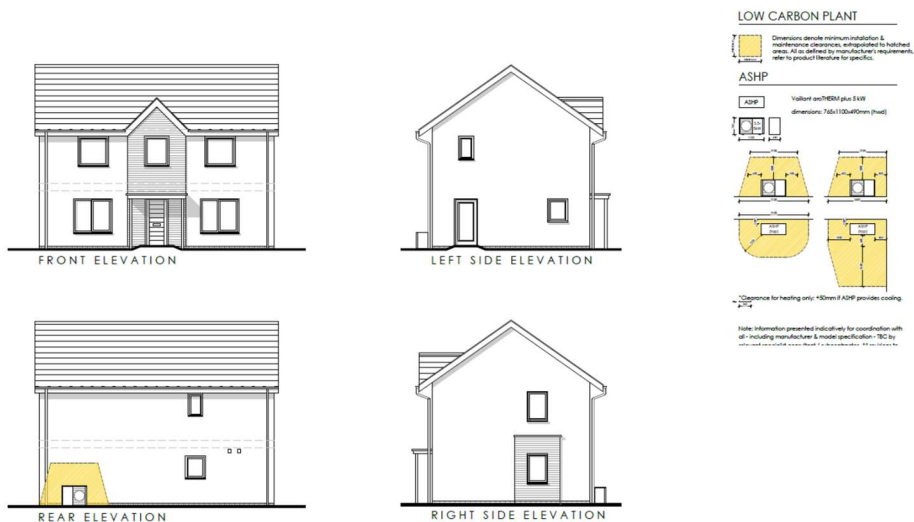
External walls: 100mm  
Internal walls: 100mm  
Intermediate floor: 100mm

Constructional thicknesses are indicative only & must be coordinated with fabric requirements for acoustic, fire & thermal performance on a site-by-site basis. All TBC by the constructional preferences of the appointed contractor.

A3

|                               |                               |                                  |
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| Drawn for: HT 641 Floor Plans | Check for: HT 641 Floor Plans | Approved for: HT 641 Floor Plans |





### 2.1.1 AD: L (Wales) 2025

Initial proposals sought to establish and use the fabric parameters for [Approved Document L \(Wales\) 2025](#). However, engagement with Welsh Government revealed the emerging legislation is still in its infancy and such detail has not been developed. Fabric u-values are therefore from [Approved Document L \(Wales\) Volume 1 - Dwellings 2022 Appendix E](#) with the ventilation strategy adjusted to MEV to align with [The Future Homes and Buildings Standard: 2023 consultation](#) for England.

| Building Fabric                  |                                                       |
|----------------------------------|-------------------------------------------------------|
| Air permeability                 | 5.00 m <sup>3</sup> /m <sup>2</sup> /hr               |
| Thermal bridges                  | 0.200 W/mK                                            |
| Doors & Windows                  |                                                       |
| Frames U <sub>f</sub>            | 1.400 W/m <sup>2</sup> K uPVC                         |
| Installation thermal bridging    | 0.040 W/mK                                            |
| Glazing U <sub>g</sub>           | 1.120 W/m <sup>2</sup> K double low-e glazing 16mm Ar |
| Glazing g-value                  | 0.64                                                  |
| Glazing edge                     | 0.040 W/mK                                            |
| Ventilation Strategy             |                                                       |
| Ventilation rate                 | 30m <sup>3</sup> per person per hour via MEV          |
| Ventilation unit                 | MEV                                                   |
| Heat recovery efficiency         | N/A (extract only)                                    |
| Ducting                          |                                                       |
| Duct insulation (inlet/ exhaust) |                                                       |
| Heating                          |                                                       |
| ASHP                             | Generic                                               |
| SCOP                             | 3.30                                                  |
| Controls                         | On/off                                                |

Appendix E currently establishes the minimum performance specification for grant-funded social housing built in Wales. Using this as the baseline responds to the Welsh Government aspiration to align market and social housing performance requirements.

## 2.2.4 Twin Stud Cellulose

| Construction                                                                 | Size (mm) |
|------------------------------------------------------------------------------|-----------|
| <b>Foundations</b>                                                           |           |
| Concrete trench fill                                                         | 600x600   |
| <b>Ground Floor</b>                                                          |           |
| Chipboard floor finish                                                       | 22        |
| SJL45 STEICOjoist fully filled with Warmcel cellulose insulation             | 390       |
| <b>External Walls</b>                                                        |           |
| Plasterboard with skim                                                       | 15        |
| Battens to form service zone                                                 | 38x47     |
| SMARTPLY ProPassiv OSB as airtightness & vapour control layer                | 12,5      |
| Timber studs fully filled with Warmcel cellulose insulation                  | 292       |
| Panelvent sheathing board                                                    | 12        |
| Ventilated cavity                                                            | 50        |
| Brickwork                                                                    | 103       |
| <b>Party Walls</b>                                                           |           |
| Plasterboard (12,5x2) with skim finish                                       | 25        |
| SMARTPLY ProPassiv OSB as airtightness & vapour control layer                | 12,5      |
| Timber studs fully filled with Warmcel cellulose insulation                  | 89        |
| OSB                                                                          | 9         |
| Cavity fully filled with Warmcel cellulose insulation                        | 60        |
| OSB                                                                          | 9         |
| Timber studs fully filled with Warmcel cellulose insulation                  | 89        |
| SMARTPLY ProPassiv OSB as airtightness & vapour control layer                | 12,5      |
| Plasterboard (12,5x2) with skim finish                                       | 25        |
| <b>Internal Walls</b>                                                        |           |
| Plasterboard with skim finish                                                | 12,5      |
| Timber studs fully filled with Warmcel cellulose insulation                  | 89        |
| Plasterboard with skim finish                                                | 12,5      |
| <b>Intermediate Floor</b>                                                    |           |
| Chipboard floor finish                                                       | 22        |
| SJL45 STEICOjoist partially filled with Warmcel cellulose insulation (100mm) | 300       |
| Plasterboard with skim                                                       | 12,5      |
| <b>Separating Floor</b>                                                      |           |
| Cellecta Screedboard 28                                                      | 28        |
| OSB deck (min. 600kg/m³)                                                     | 18        |
| 253mm metal web joists partially filled with mineral wool quilt (100mm)      | 253       |
| Resilient bars (16mm) with plasterboard (2x15mm) with joints taped           | 16+30     |
| Metal suspended ceiling system (150mm) with plasterboard with skim           | 150+15    |
| <b>Roof</b>                                                                  |           |
| Plasterboard with skim                                                       | 15        |
| Battens to form service zone                                                 | 38x47     |
| SMARTPLY ProPassiv OSB as airtightness & vapour control layer                | 12,5      |
| Timber ceiling chord fully filled with Warmcel cellulose insulation          | 100       |
| Warmcel cellulose insulation                                                 | 215       |
| Ventilated attic                                                             |           |
| Timber trusses overlaid with breather membrane                               | 100x38    |
| Tile battens                                                                 | 25x38     |
| Welsh slate                                                                  |           |