Department for
Energy Security
& Net Zero

Home Energy Model: Future Homes Standard Consultation Tool User Guide

This guide is to assist users of the consultation tool.

Contents

1. Introduction

Introduction

The energy efficiency requirements for new homes are set through Part L of the Building Regulations. The Future Homes Standard (“FHS”) consultation seeks views on proposed changes to Part L, which will be implemented in 2025.

A dwelling’s compliance with these regulations will be determined using the government’s new Home Energy Model: FHS assessment, which will replace the current approved methodology, SAP 10.2. The Home Energy Model: FHS assessment will estimate the energy use and carbon emissions of the dwelling under certain conditions and compare it to a benchmark Notional Building.

One key aim of the Home Energy Model project has been to delineate between the different functions that were previously served by SAP. This has been addressed through the use of “wrappers”. The Home Energy Model: Future Homes Standard assessment consultation covers the methodology for the first such wrapper to be developed: the FHS assessment wrapper.

The Home Energy Model core engine and FHS assessment wrapper together make up the Home Energy Model: FHS assessment. We are consulting on the Home Energy Model: FHS assessment separately to the Home Energy Model core engine because this material is context specific and relies on a different evidence base to the core model.

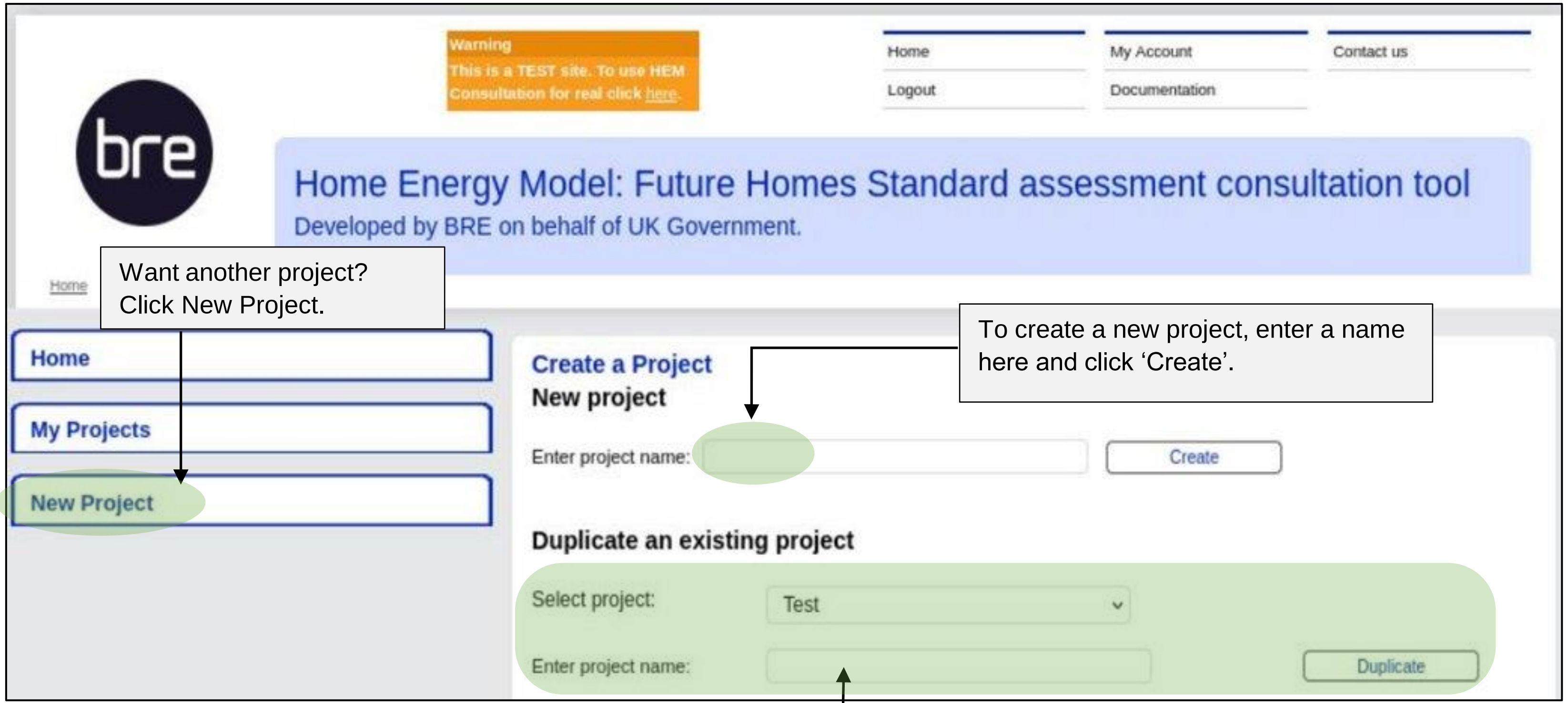
Alongside the three consultations listed above, we have published a Home Energy Model: FHS assessment consultation tool, as a browser-based application. This consultation tool gives the opportunity to interact with the model by providing a demo user interface.

The consultation tool will be of interest to those who want to test out the Home Energy Model: FHS assessment methodology and understand whether different dwelling designs are likely to comply with the proposed Future Homes Standard.

2. Navigating the Website

1. How to make a project and duplicate existing projects

- A project contains the information needed to define the Home Energy Model for a single dwelling.

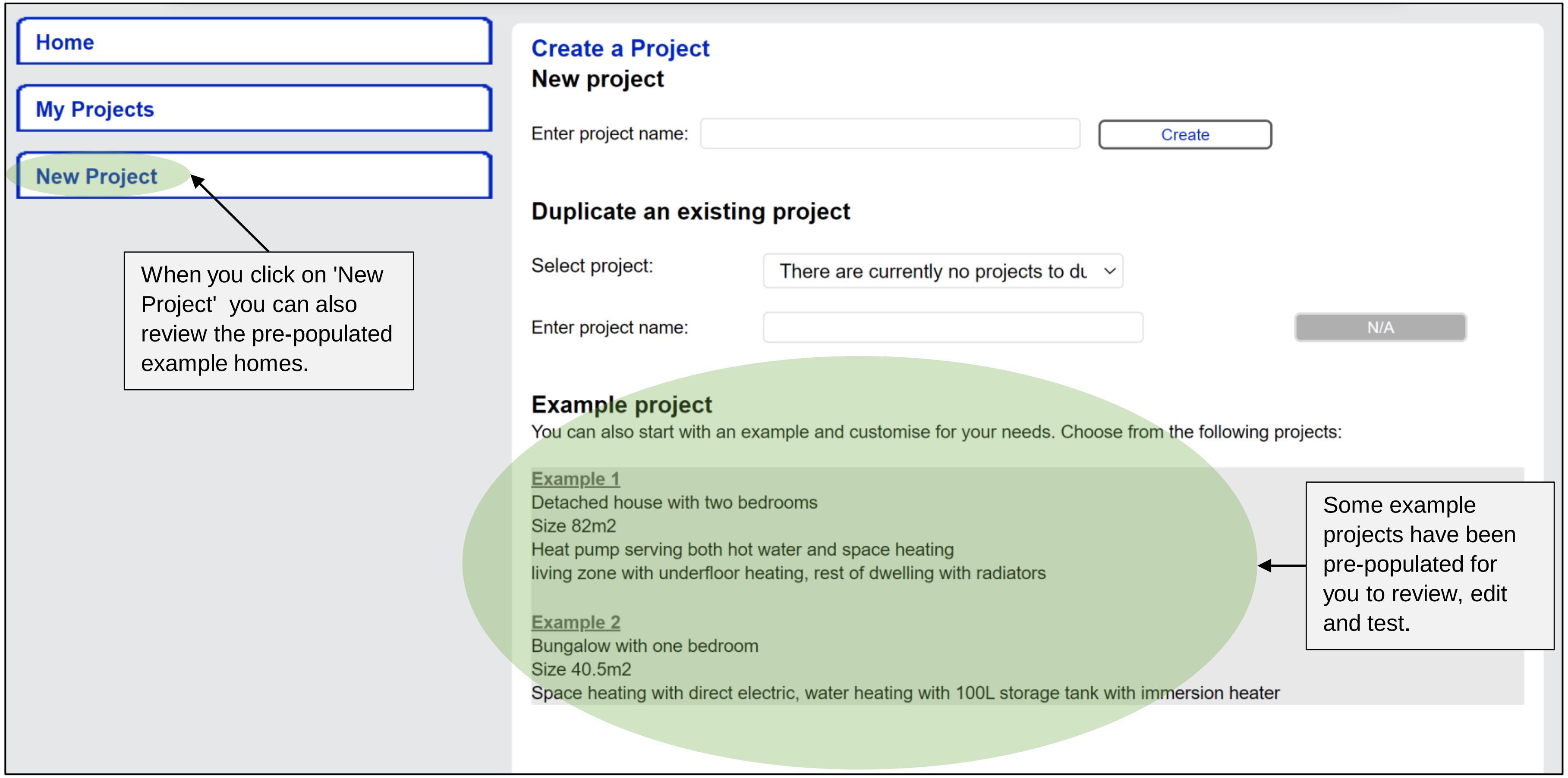


Want another project? Click New Project.

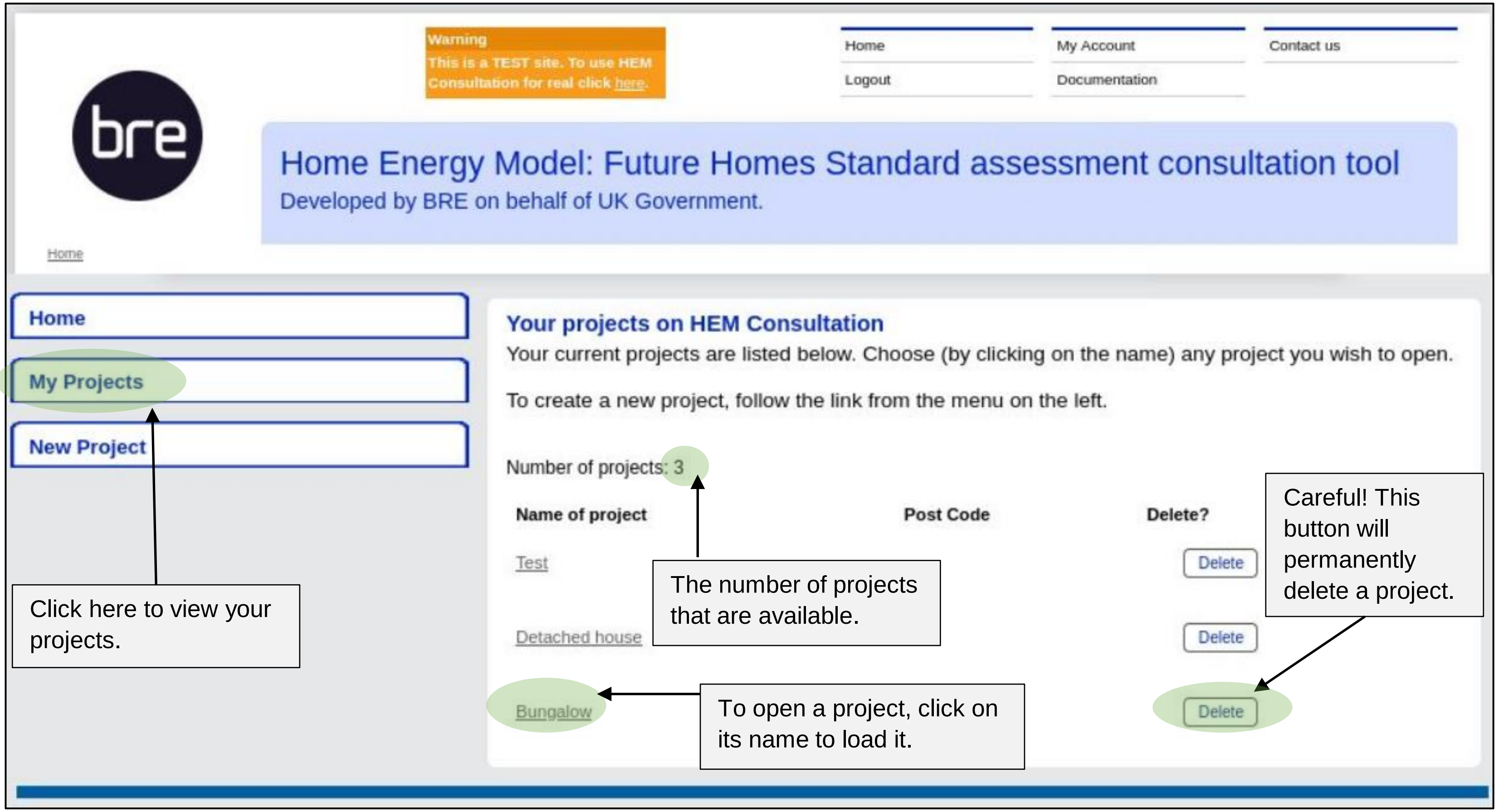
To create a new project, enter a name here and click ‘Create’.

To duplicate a project, select the project you want to duplicate, give it a new name in the box below and hit the ‘Duplicate’ button.

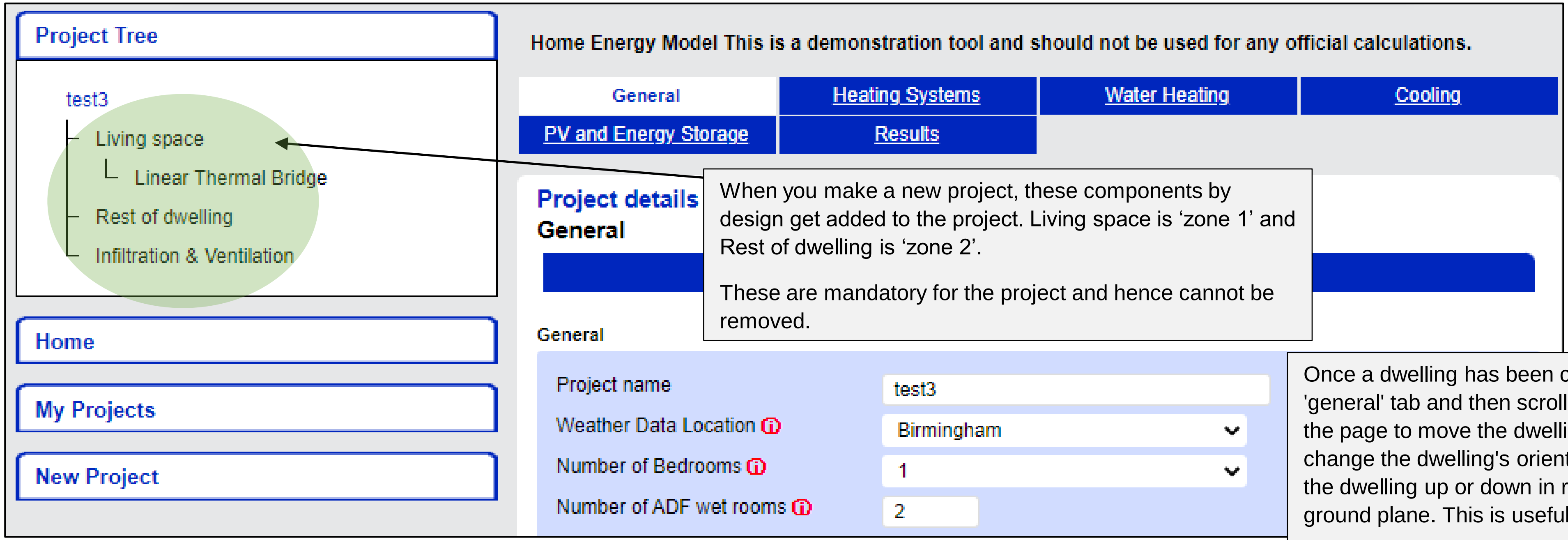
2. Pre-populated example projects



3. How to navigate the project tree



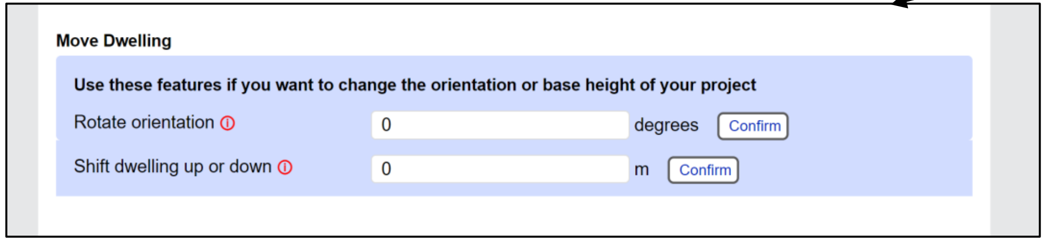
- After selecting a project, you should be able to see the interface below.



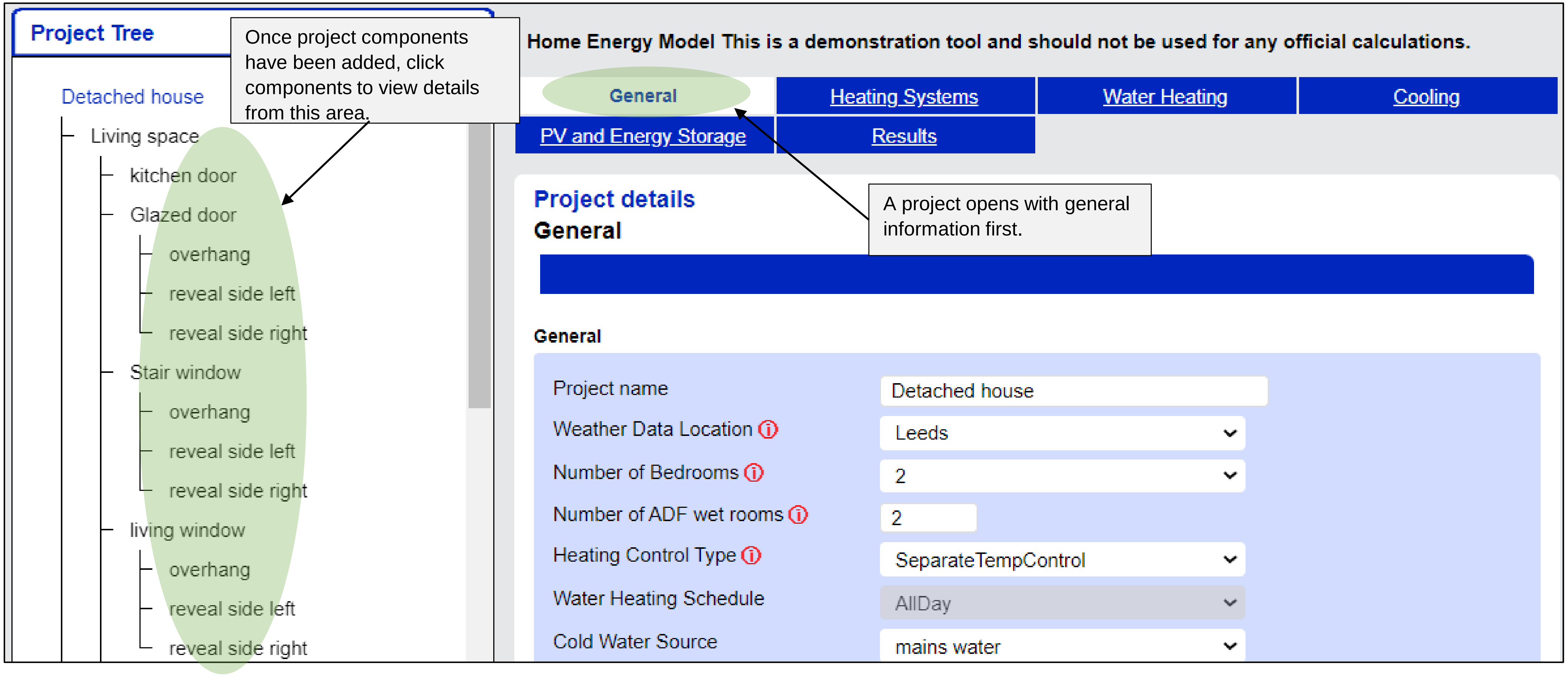
When you make a new project, these components by design get added to the project. Living space is 'zone 1' and Rest of dwelling is 'zone 2'.

These are mandatory for the project and hence cannot be removed.

Once a dwelling has been copied, go to the 'general' tab and then scroll to the bottom of the page to move the dwelling. You can change the dwelling's orientation and move the dwelling up or down in relation to the ground plane. This is useful for copying flats.

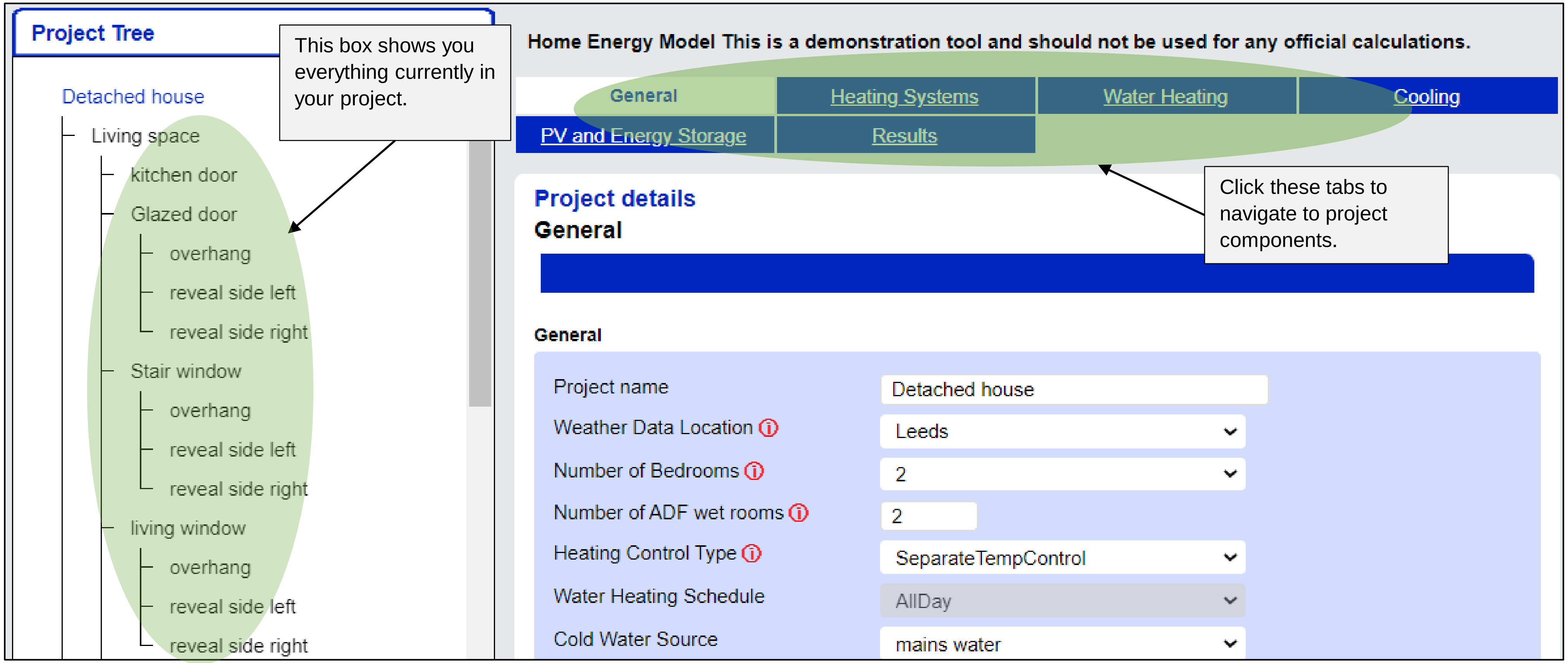


- After selecting a project with added components and their parameters, you should be able to see the interface below.



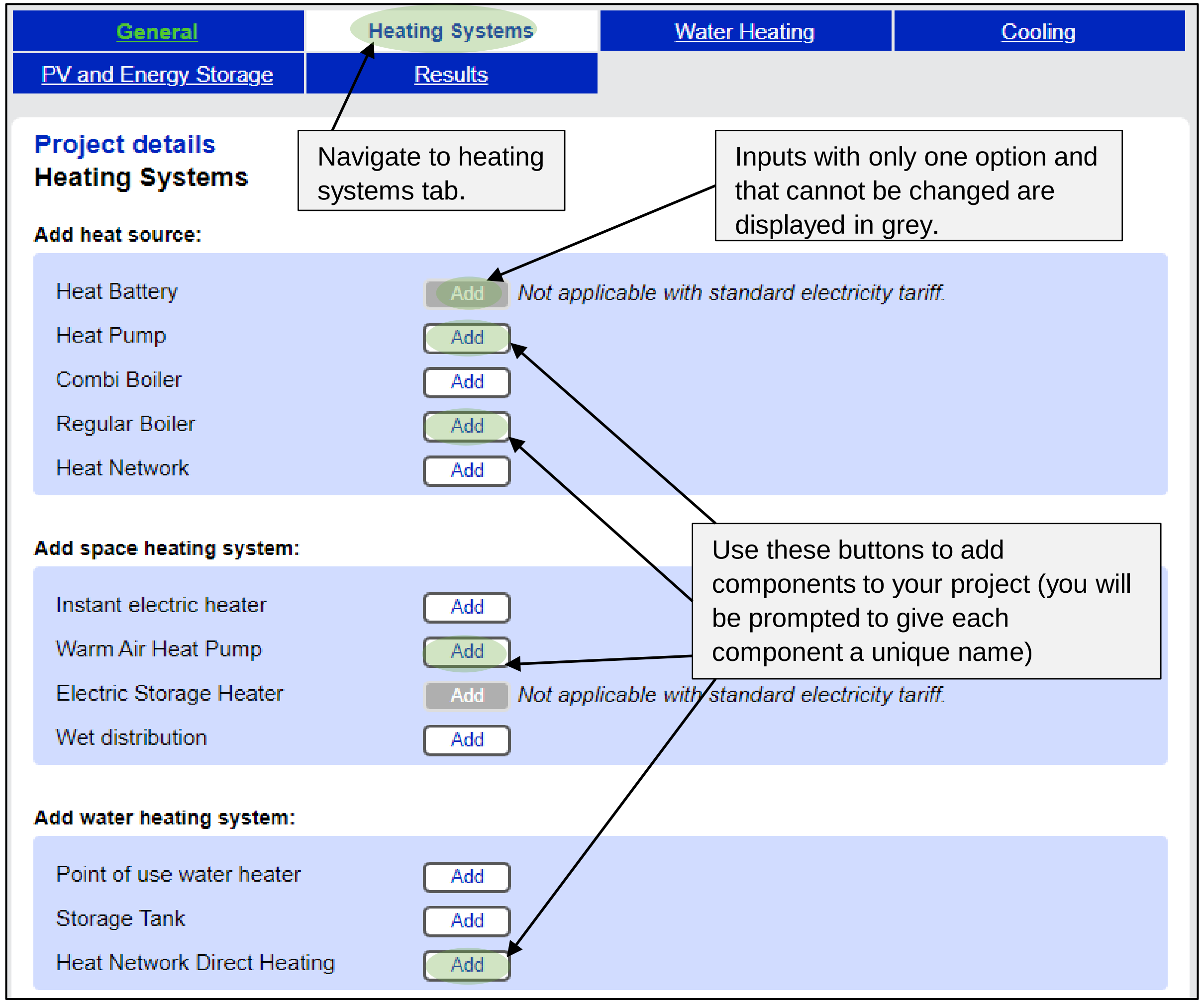
4. How to Add, delete, and copy inputs

- This section explains how to add, delete, and copy components.



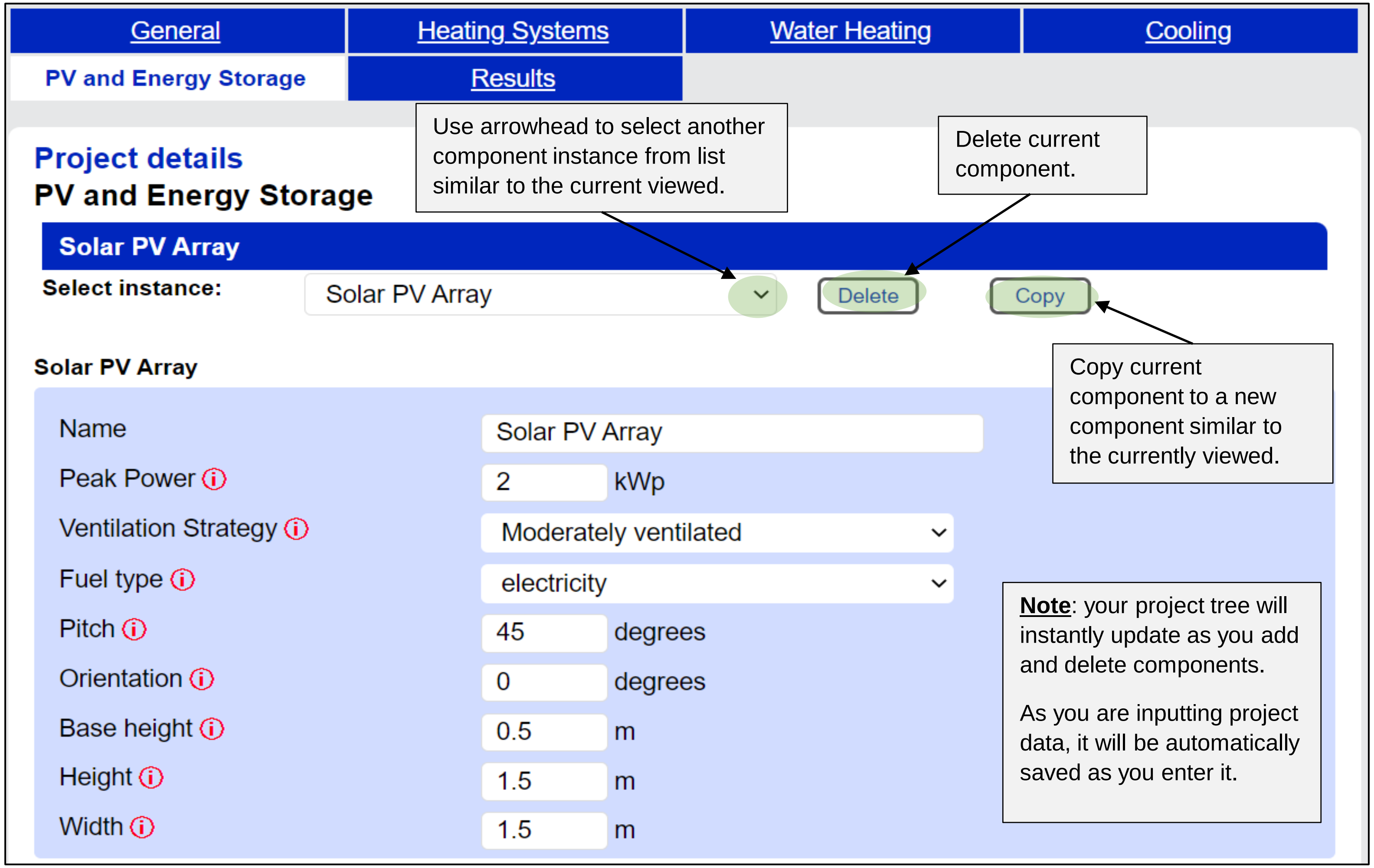
i. Add components

- Example using Heating Systems.



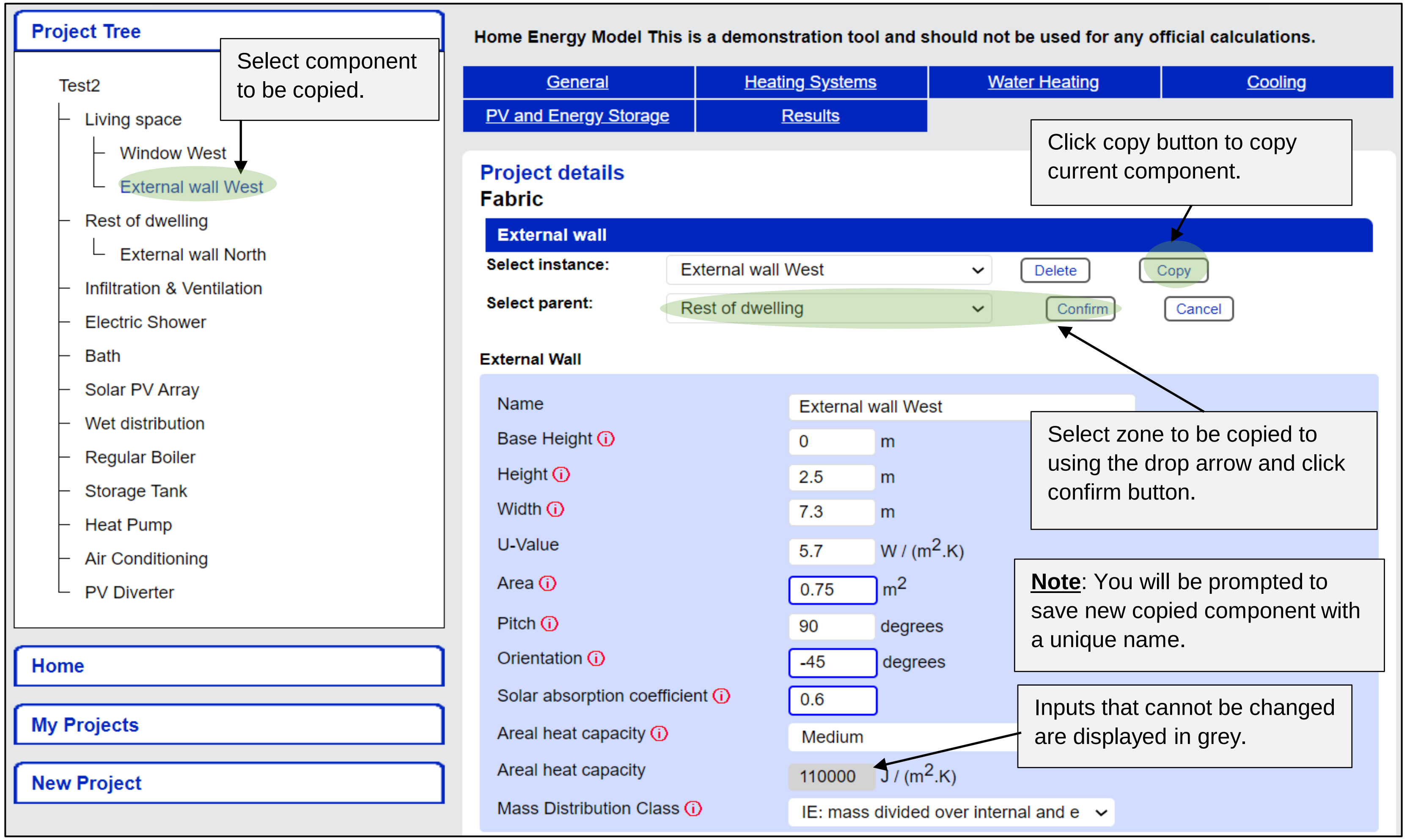
ii. Delete and Copy Component

- Example using PV and Energy Storage.



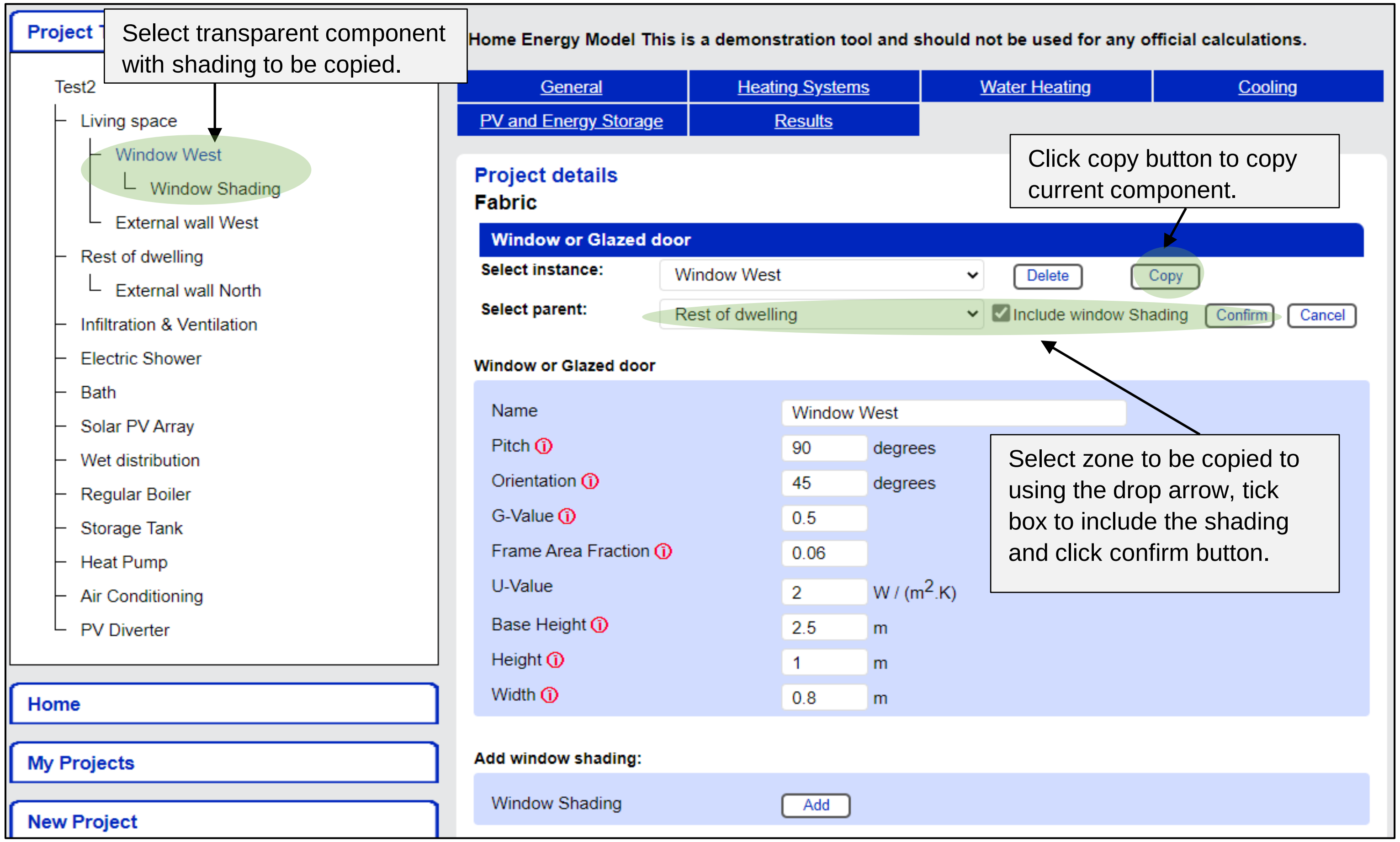
iii. Copy Components into Another Zone

- Example using Living space zone.



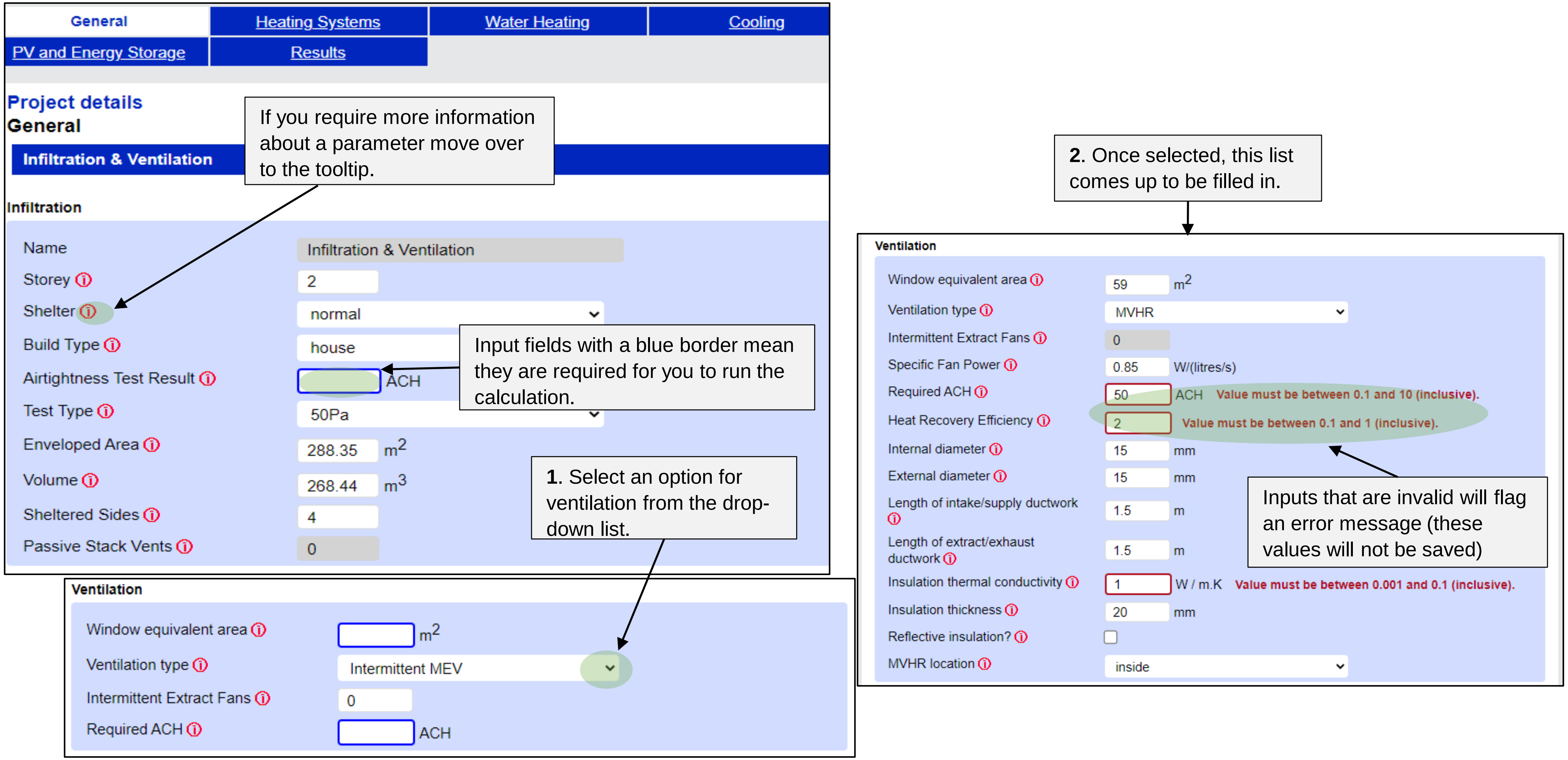
iv. Copy Transparent Component Shading into Another Zone

- Example using Living space zone. This shows how to copy transparent component shading.



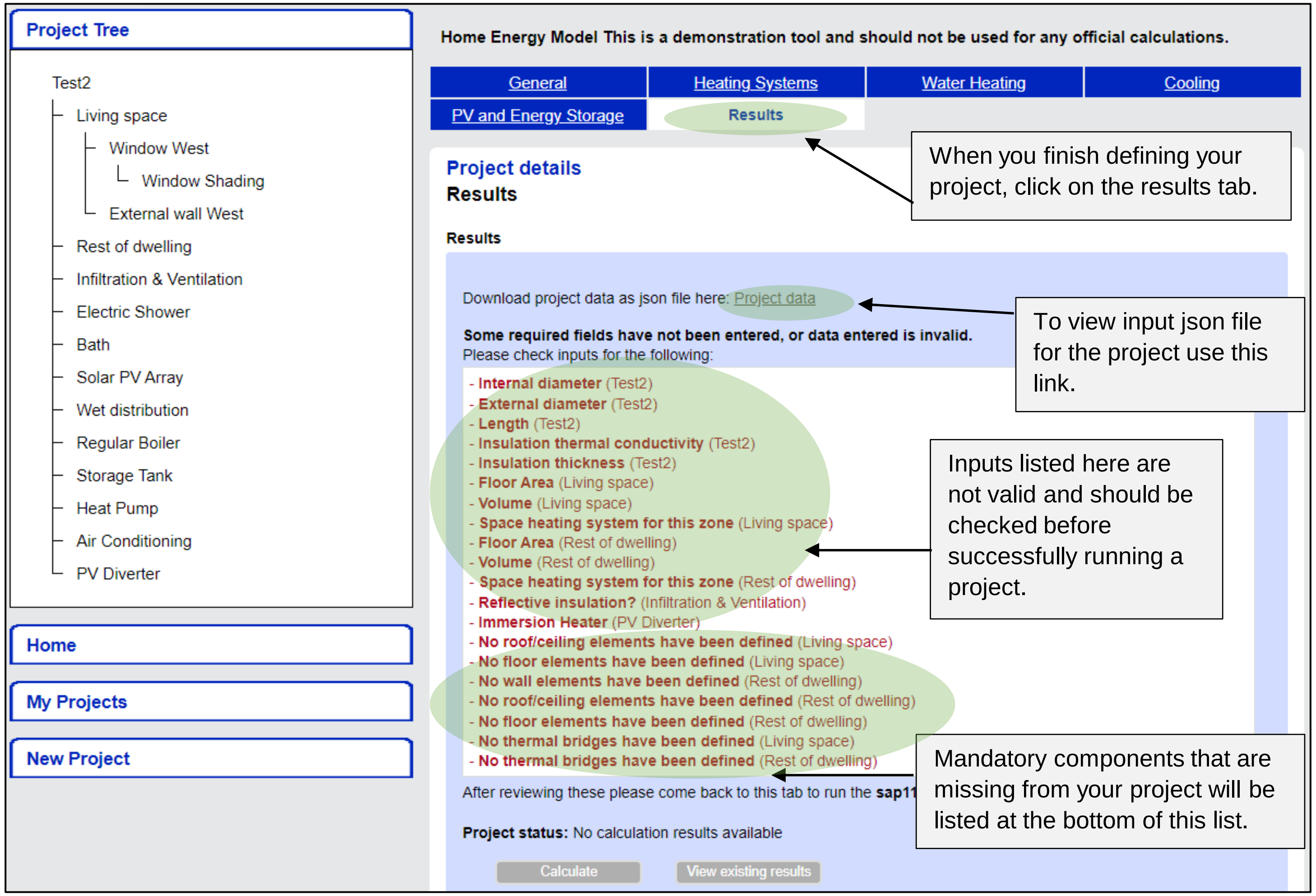
5. How to enter data

- An example of each type of data entry type (manual input, drop down list, checkbox) using infiltration and ventilation.



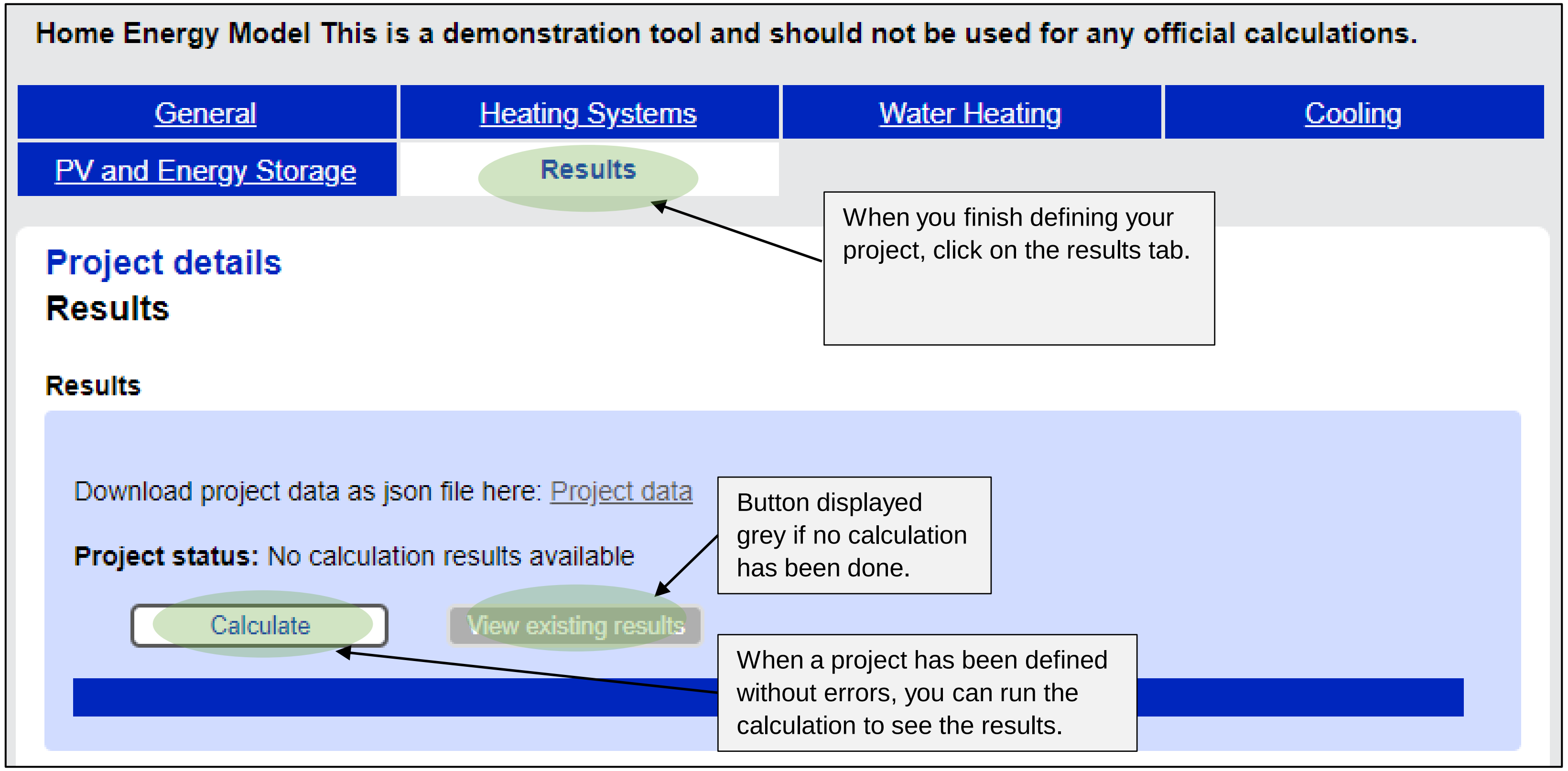
6. How to ensure your project is valid

- Error messages are displayed, this helps in final project validation.



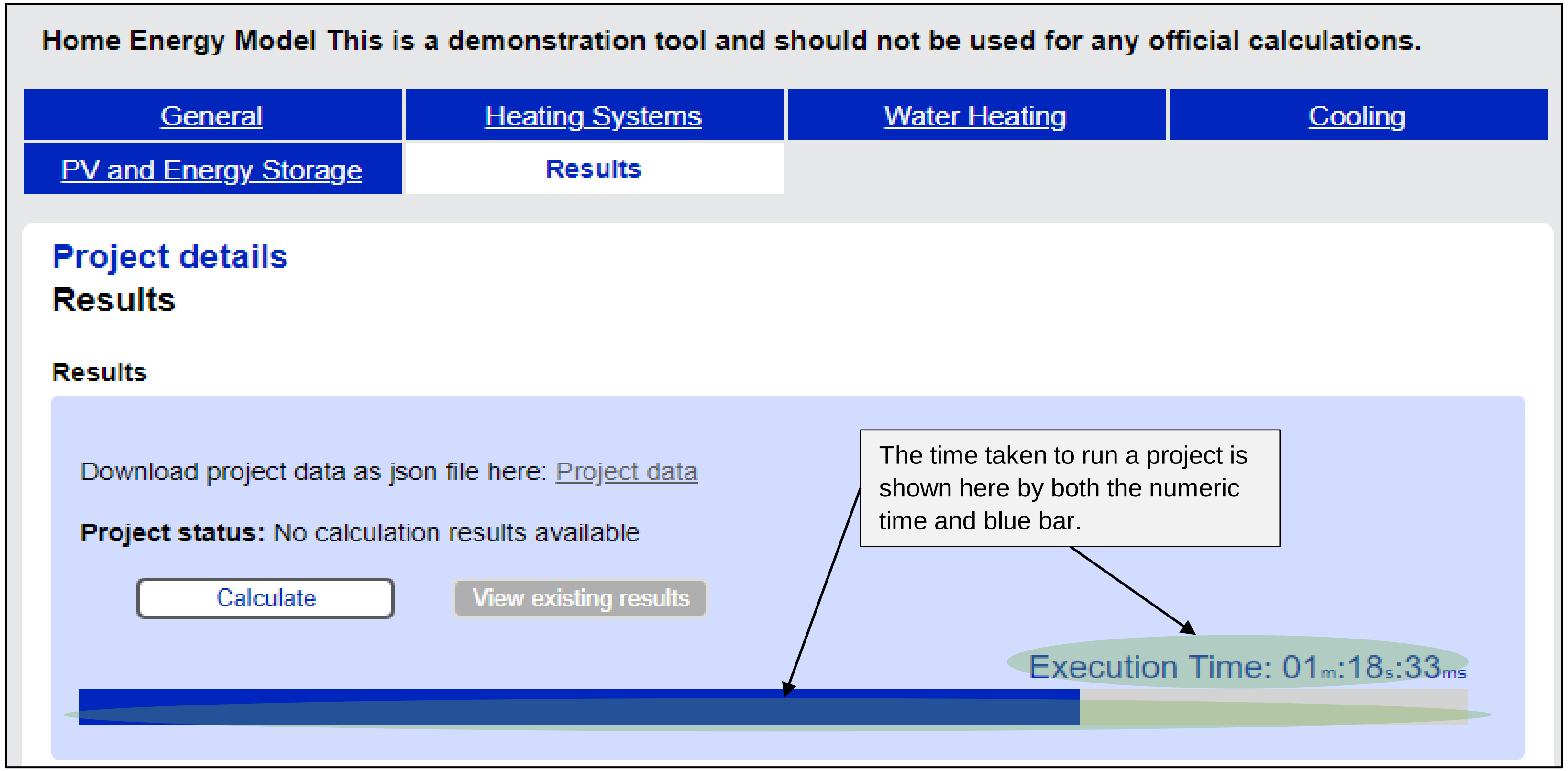
7. Understanding the calculation & results

- When you finish defining your project, click on the results tab.



i. Execution Time

- Results will take a bit longer to run and therefore display outputs will take some time to show, so make sure to come and check back on them.



ii. Project Results

- Results Summary of project will be displayed in this window.

My Projects

New Project

Summary | Downloads

Project Results

Back to Project details

Status: Calculations still in progress, more results expected.

Response from calculation engine | **Time elapsed: 2.30 Minutes**

Engine messages:
Running 1 cases in series

Calculation engine version: SAP11v0.23beta2 + FHSv0.17beta

Results Summary

Output	Units	Actual Dwelling		Notional option A		Notional option B	
Emission rate	kgCO2/m2	3.574	(DER)		(TER)		(TER)
Primary energy rate	kWh/m2	81.651	(DPER)		(TPER)		(TPER)
Fabric energy efficiency			(FEE)		(TFEE)		(TFEE)
Energy demand :							
Space heating	kWh/m2	39.656					
Space cooling	kWh/m2	0.0					
Delivered energy use :							
Ventilation system	kWh/m2	1.336					
lighting	kWh/m2	2.421					
cooking electricity	kWh/m2	4.769					
appliances	kWh/m2	22.269					
HeatPump_auxiliary: Heat Pump	kWh/m2	1.750					
Heat Pump_water_heating	kWh/m2	12.318					
Heat Pump_space_heating: living area heating	kWh/m2	8.766					
Heat Pump_space_heating: rest of dwelling heating	kWh/m2	13.346					
Total	kWh/m2	66.974					
Delivered energy use by fuel :							
mains elec	kWh/m2	66.974					
Heat transfer coefficient	W / K	96.944					
Heat loss parameter normalised for floor area	W / m2.K	1.182					
Heat loss form factor	-	2.117					
On-site generation :							
Exported	kWh	0.0					
Used on-site	kWh	0.0					
Total	kWh	0					
Peak half hour electricity :							
Consumption	kWh	3.035					
Date occured	d M	8 MAR					
Time occured	h	7.5					

3. Conventions and FAQ

Introduction

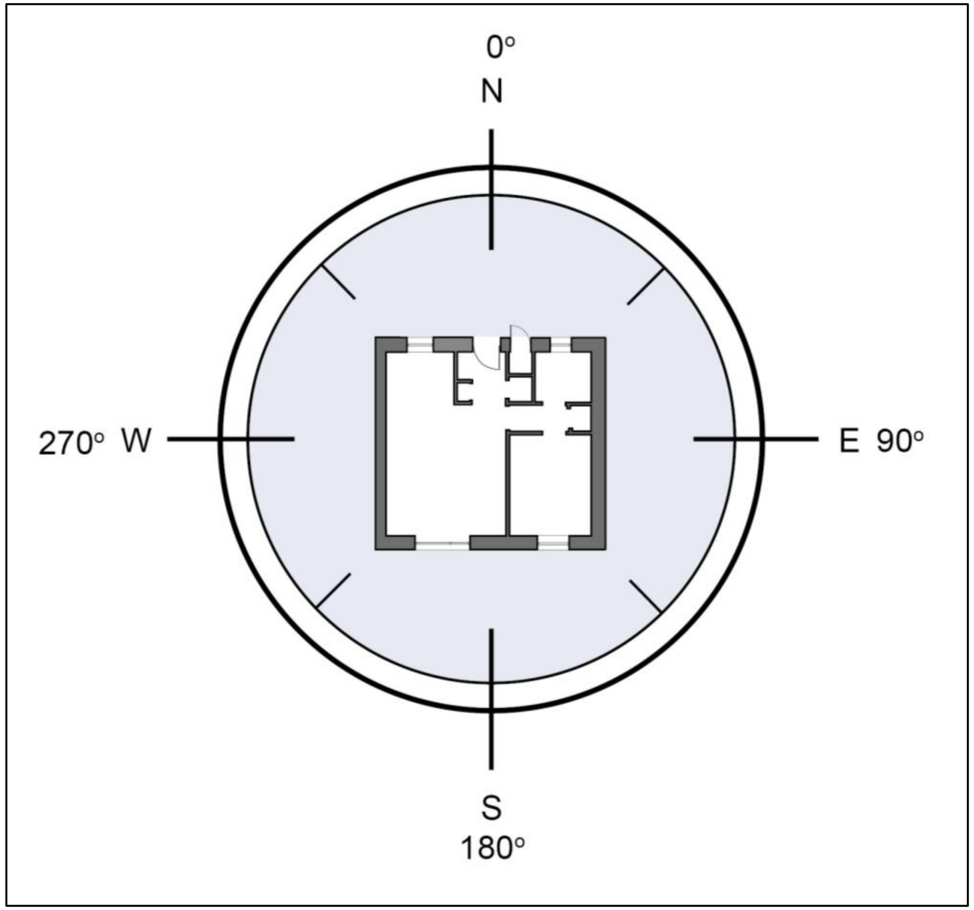
The Home Energy Model is still in development and does not yet have a comprehensive set of input conventions set out in a document, as SAP 10.2 does. To facilitate use of the new model, we highlight here some key conventions used for inputs and how they should be interpreted.

This section covers:

- Orientations
- Measuring zones (entering walls and thermal bridges between zones or fully within zones etc.)
- Perimeter and Pitch
- Distant shading
- Base heights
- Window shading
- Duct lengths
- Primary and secondary pipework
- Wet distribution
  - Eco design control class

Orientations

The orientation of the outside face of an object (such as a wall) should be measured clockwise from North to the nearest degree.



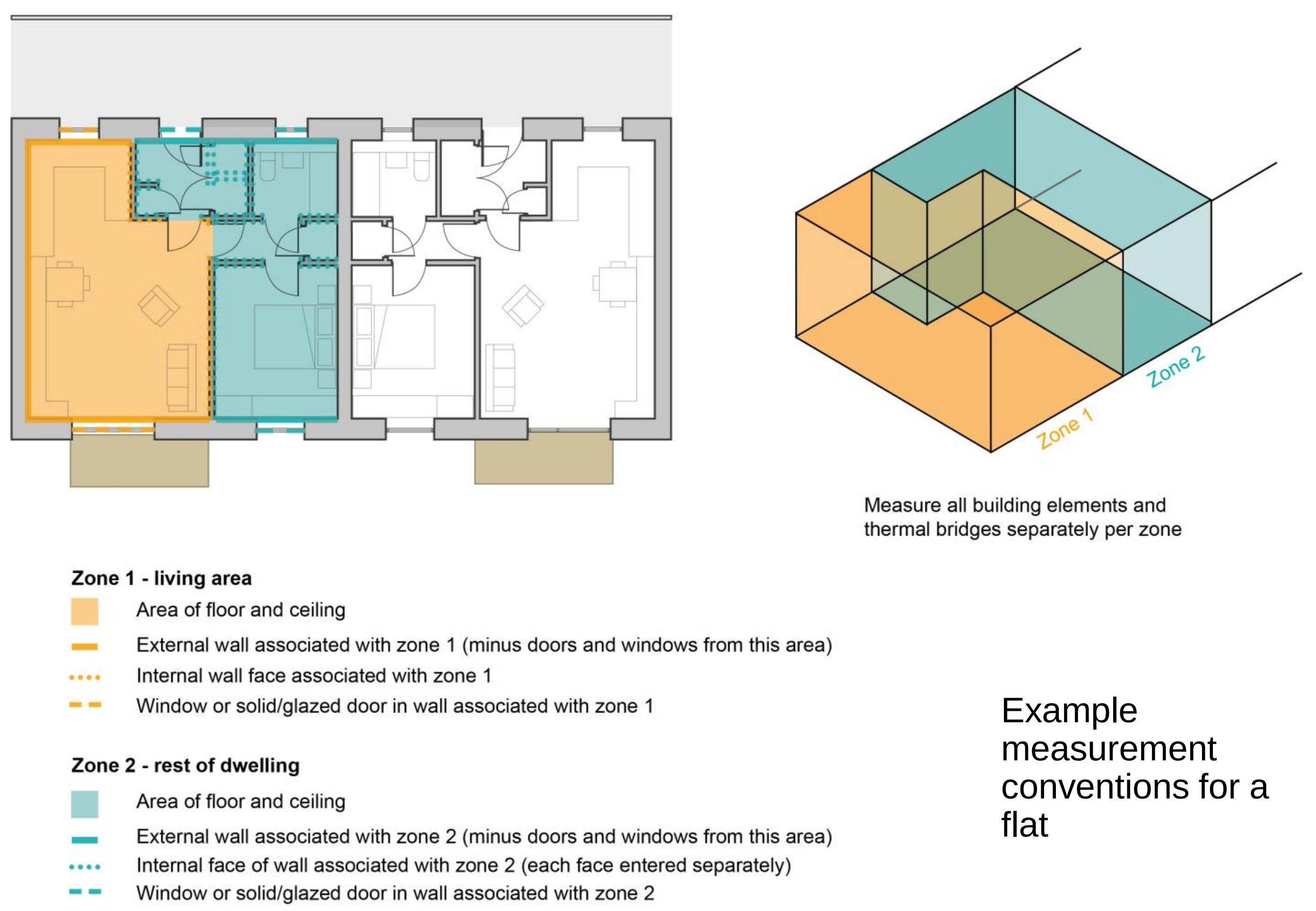
Measurement conventions - zones

There are two zones (living and rest of dwelling). The zones are measured independently.

External building elements such as walls, roof, floor, window are each individually defined and assigned to a zone. Window and door areas are not included in the wall areas (i.e. the user enters the net wall area, with aperture area subtracted).

Thermal bridges are also assigned to the zone they occur in, with their length and linear thermal transmittance.

The internal building elements are only included to account for thermal mass, and can therefore be grouped together if they have the same areal heat capacity, so internal floors, internal walls and internal ceilings only need to be defined once. For internal walls with two sides in the zone, both sides are counted as wall area. Where an internal wall is between two zones, only the area facing the zone is included.



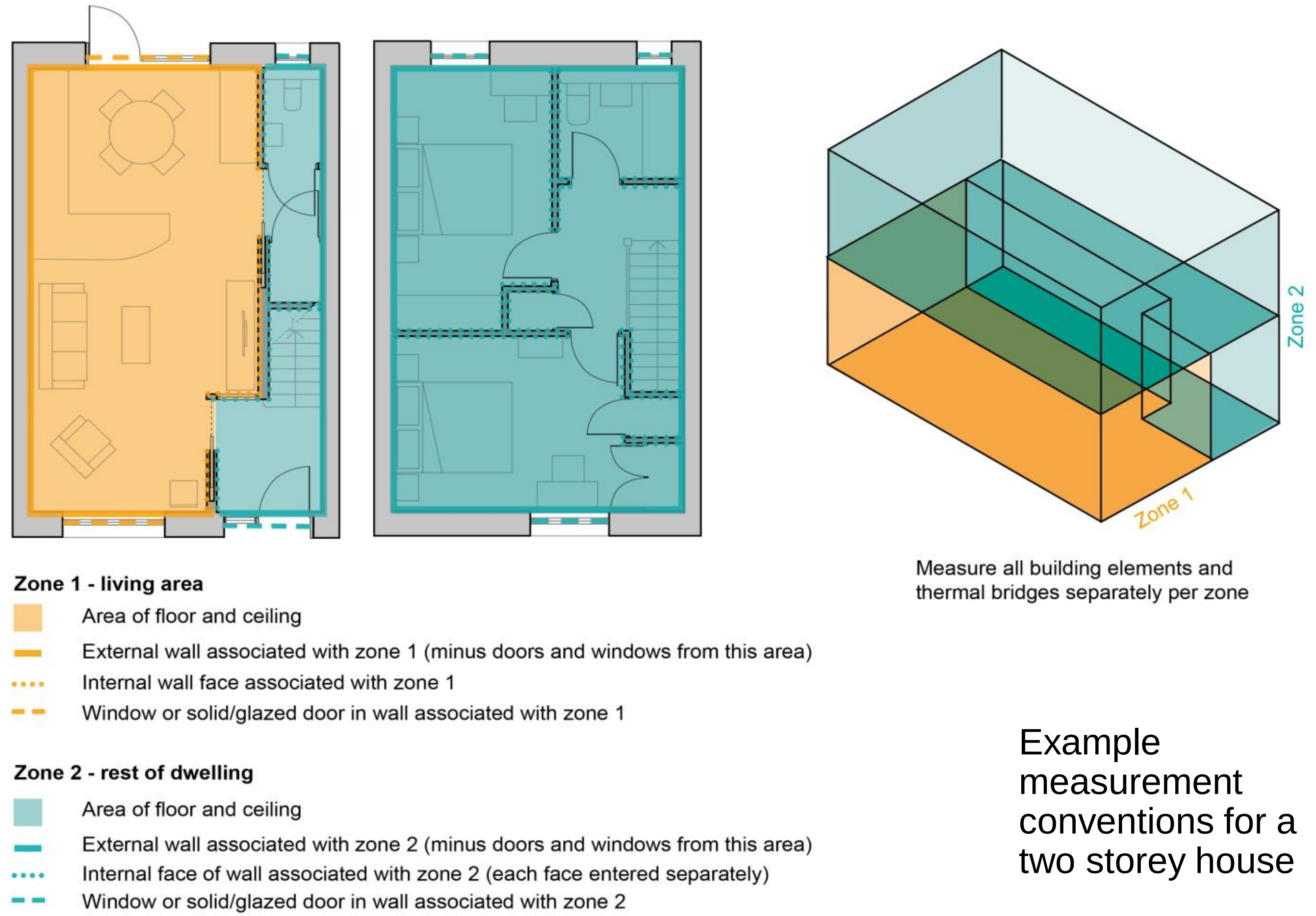
Example measurement conventions for a flat

Measurement conventions - zones

In the context of the housing energy model (HEM):
A "house" refers to a standalone residential building surrounded by open space or terraced or semi-terraced, ground floor walls are measured floor-to-ceiling, mid-floor walls are measured ceiling to ceiling

While a "flat" denotes a self-contained unit within a multi-unit structure, sharing common walls and areas. In a single-storey flat, wall height is measured floor to ceiling. In a two-storey flat, wall height is measured lowest floor to ceiling, upper-floor walls are measured ceiling to ceiling.

The model distinguishes between these two types based on architectural and structural differences, considering factors like insulation and heating to accurately assess their distinct energy efficiency.

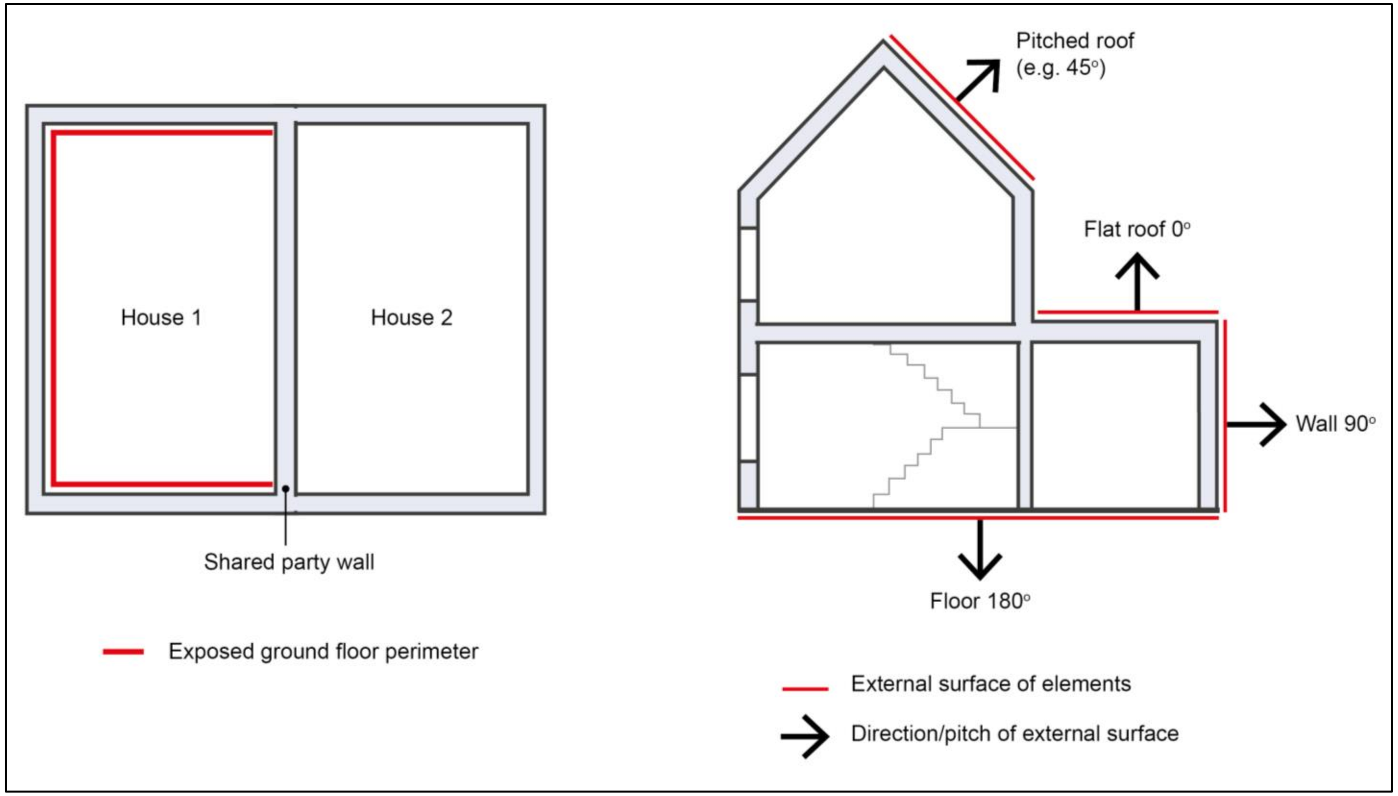


Example measurement conventions for a two storey house

Perimeter and Pitch

The perimeter of a dwelling should be entered as the exposed ground floor perimeter, excluding any shared party walls.

Where the pitch of a building element is entered, it should refer to the relevant angle of the element surface between 0-180°. Pitches should be interpreted as a rotation where a flat element facing upwards is 0° and a flat element facing downwards is 180°.



Distant shading - segments

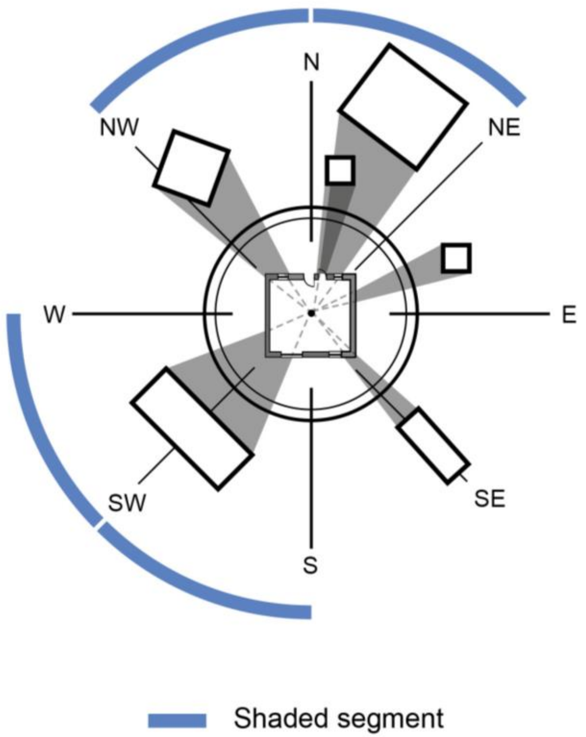
Distant shading has been simplified for the consultation and is considered in eight 45° segments taken from the centre of the dwelling.

A segment should be considered shaded if an object covers over 22.5° of the segment (i.e. half a segment). If an object straddles two segments and covers over 22.5° of either or both segments, then one or both should be considered shaded.

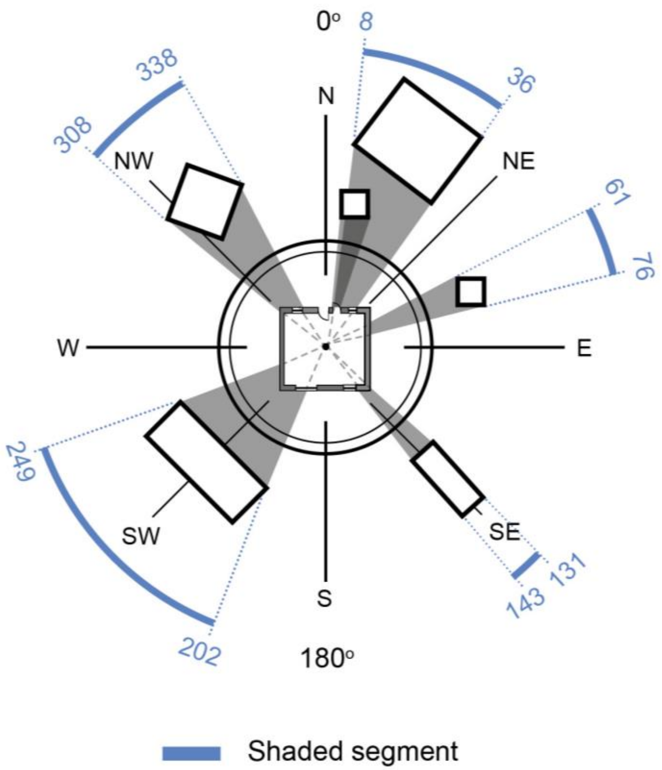
Where there are multiple shading objects in a segment only the most significant object should be entered.

If other parts of a connected building (such as courtyard block of flats) shade the dwelling these should be accounted for using the above conventions. However, in the unusual case where a dwelling shades itself (such as L-shaped dwelling) this should not be included.

The proposed Home Energy Model will later allow shaded segments to be entered in more accurate ranges, to the degree. Up to a maximum of 36 segments will be permitted (18 shaded and 18 unshaded).



Consultation simplified version



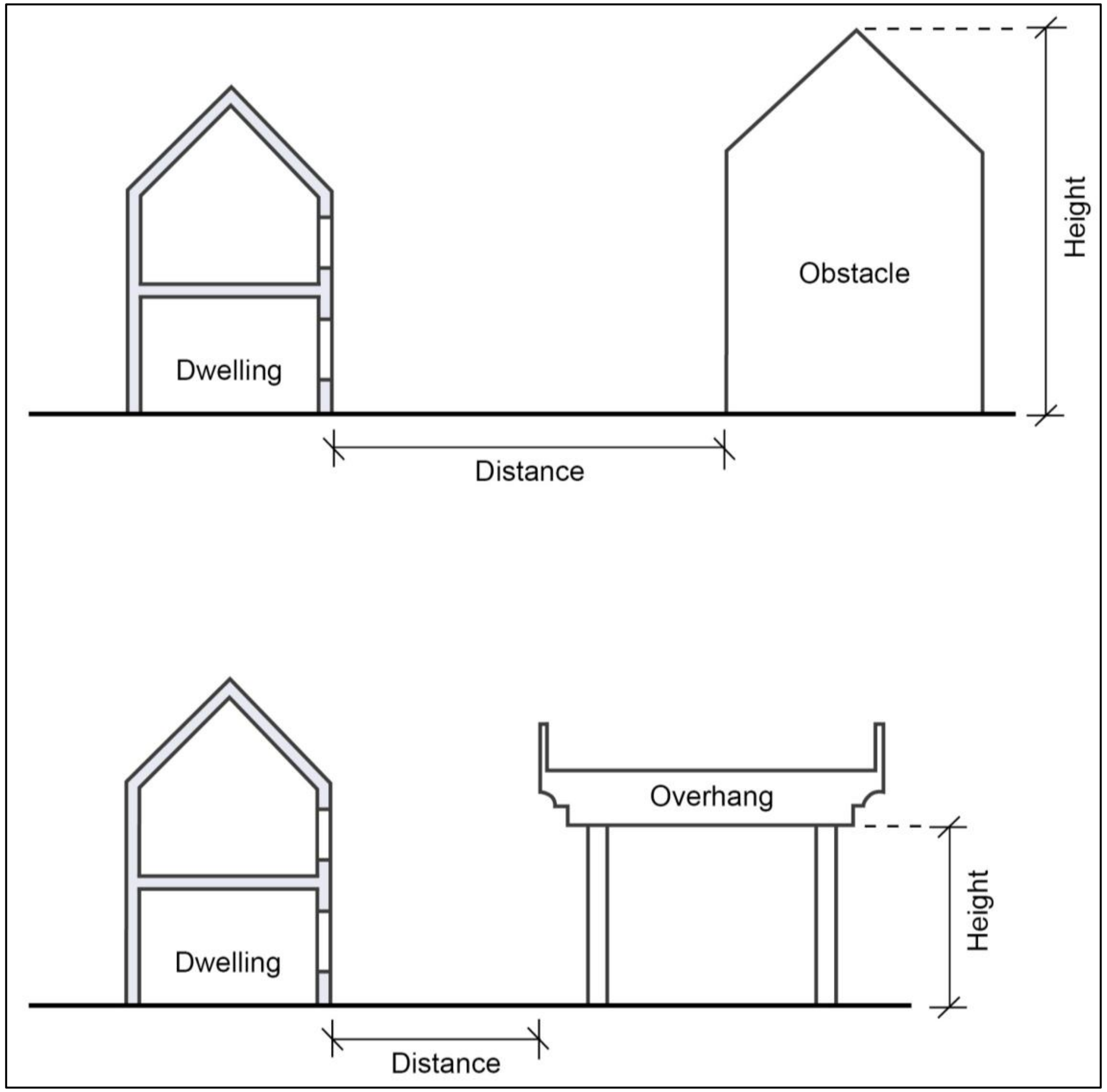
Proposed Home Energy Model

Distant shading - objects

Where a shading segment is determined, details of the most significant shading object (obstacle or overhang) in that segment should be entered. This includes the height from the established ground and the distance between the centre of the closest external wall of the dwelling to the centre of the closest face of the shading object.

If the vertical cross-section of the shaded object is not constant, the vertical cross-section shall be assessed in the middle of the object.

The difference between obstacles and overhangs is that an obstacle ends at a certain height above the ground level, while an overhang starts at a certain height above the ground level.



Base heights

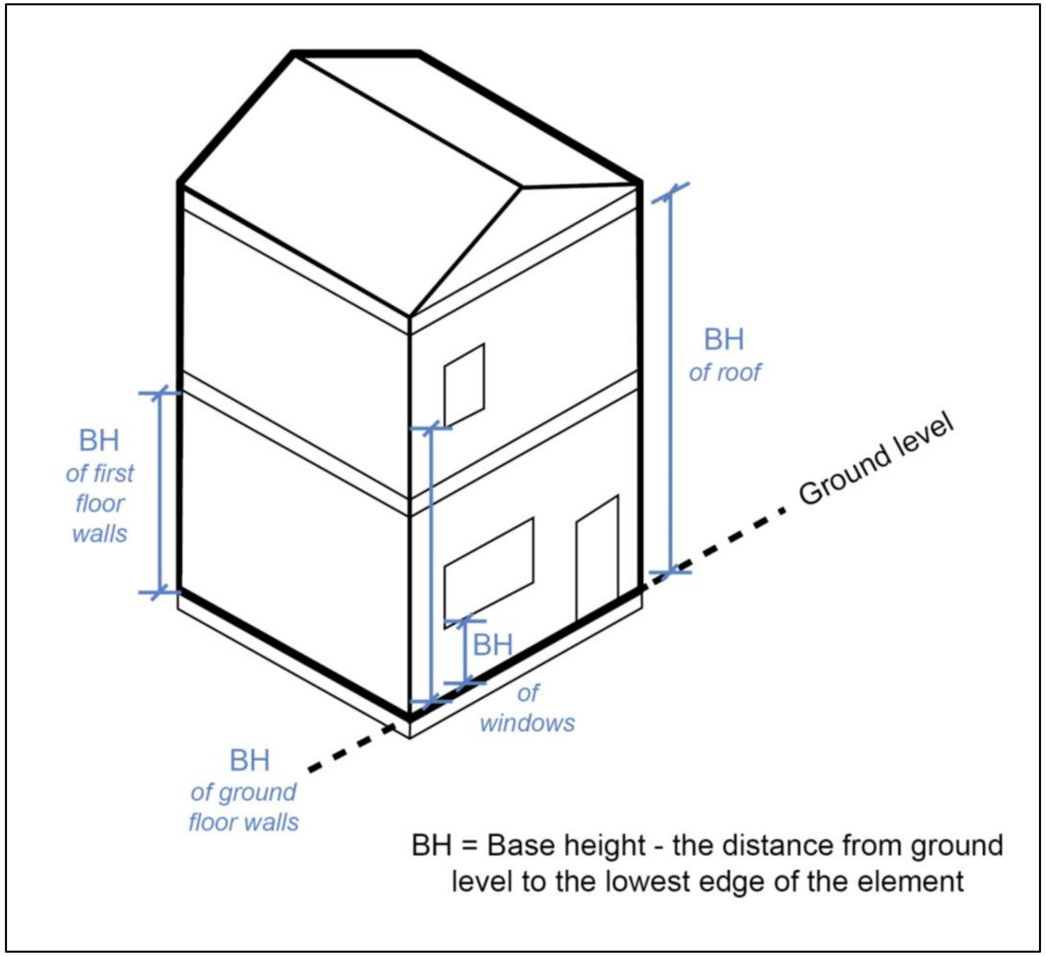
The base heights of building elements are required to inform the Home Energy Model where the element is, relative to the ground, to determine if the element is shaded by a distant shading object.

The base height of building elements should be measured from an established ground level. This is the level at which the lowest point of the building perimeter is in contact with the ground. Therefore, on a sloping site take the lowest level on the perimeter as the ground level. This same ground level should also be used when measuring the height of distant shading objects.

In a two storey house, the base height of the first floor is the height from ground level to the ceiling of the ground floor.

The base height of the roof is the height from ground level to the ceiling of the highest floor.

In a flat the base height is from the ground level to the floor level of the flat (as opposed to the ceiling level of the flat below).



Window shading

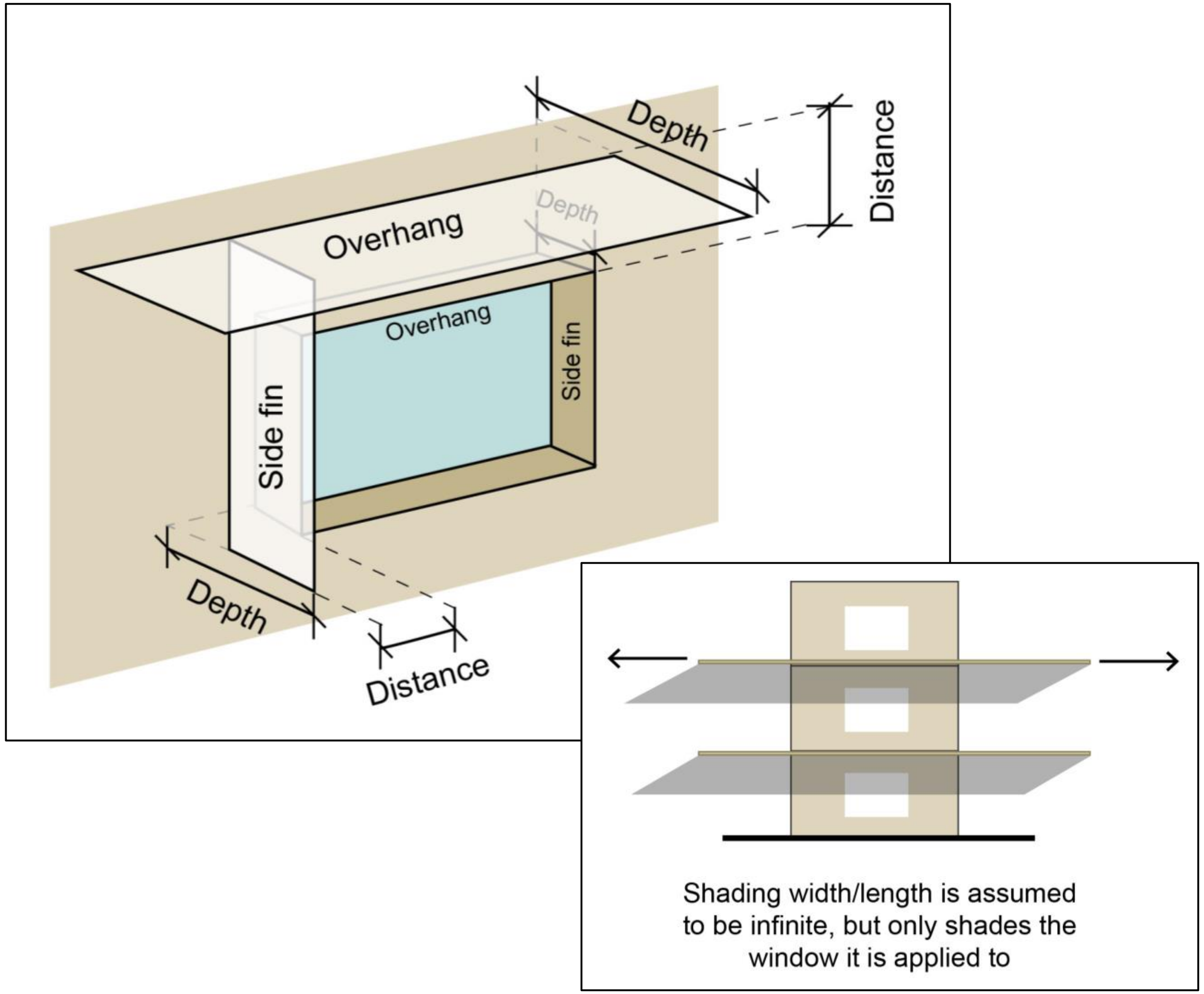
The shading effect of objects attached to the dwelling (including the dwelling itself) on transparent building elements (windows/glazed doors) is accounted for. To model this for each transparent building element any overhangs and side fins (including window reveals) should be added as window shading objects.

For each window shading object the shading type (overhang, left side fin, or right side fin) should be entered. The 'depth' should be measured from the face of the glass to the furthest edge of the shading object. The 'distance' should be measured from the side or top edge of the glass to the closest edge of the shading object. This includes the window frame width, note it is not the distance to the outside edge of the window frame (hole in wall).

Window reveals are considered as overhangs and side fins and should be entered accordingly. Where a shading device exceeds the depth of the reveal, only the shading device should be entered.

The width of overhangs and height of side fins is not considered, they are assumed to be infinite in relation to the associated building element.

Note: Left/right side fins should be specified from the perspective of looking out of the window.

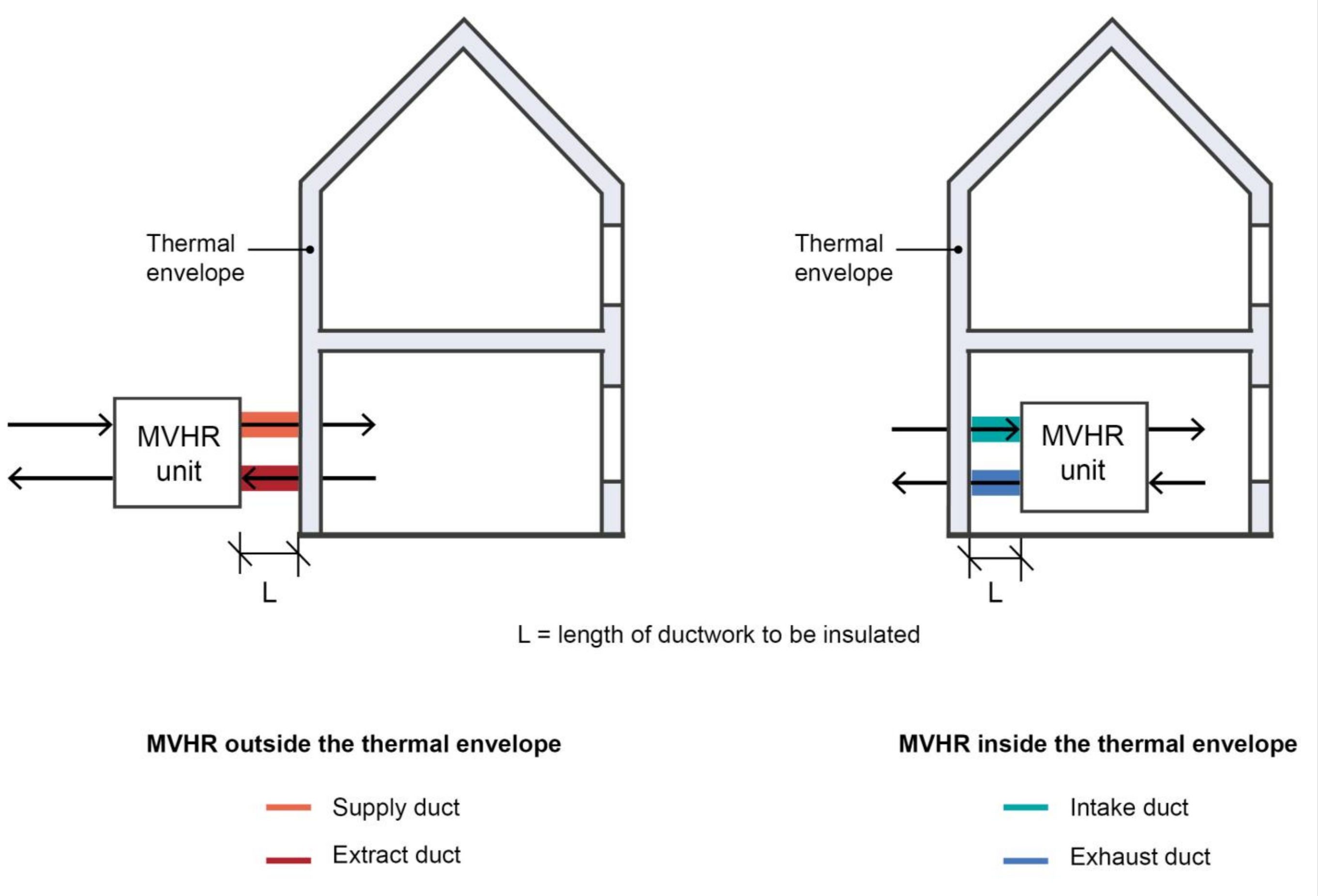


Duct lengths

Duct lengths should be entered when a MVHR (Mechanical Ventilation with Heat Recovery) unit is present.

If the MVHR unit sits outside the thermal envelope, supply and extract duct lengths should be entered measuring the distance between the unit and the exterior of the thermal envelope of the dwelling.

If the MVHR unit sits within the thermal envelope the intake and exhaust duct lengths should be entered measuring the distance between the unit and the interior of the thermal envelope of the dwelling. In both cases the full length of the ducts given are assumed to be insulated as specified.



Primary and Secondary pipework

The length of secondary distribution pipework is needed for modelling the hot water distribution system. (HEM does not handle secondary circulation pipework, which is secondary hot water pumped around in continuous circulation).

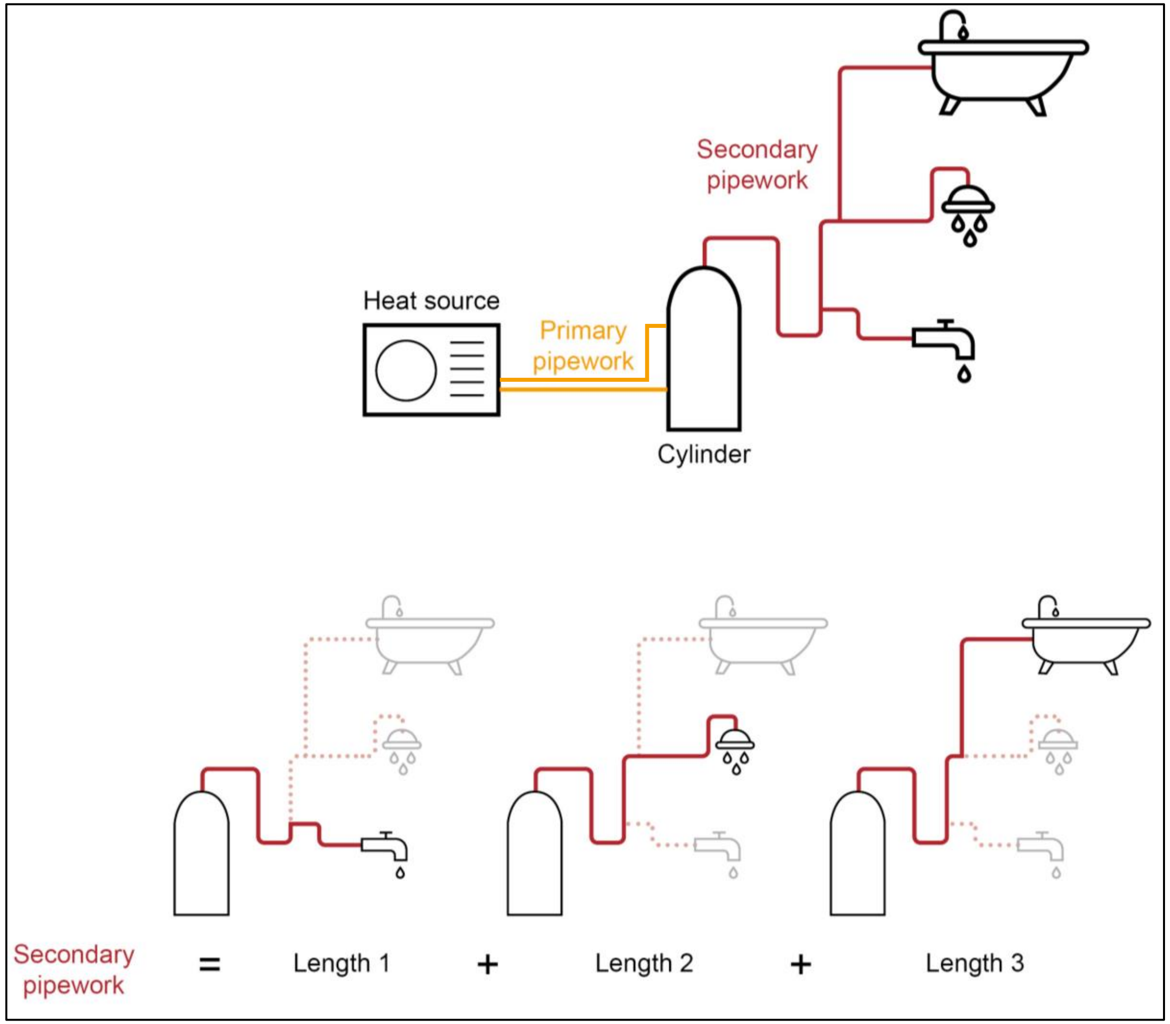
The total secondary hot water distribution pipework length should be calculated as the sum of all lengths of pipework from the hot water source to a tapping point (i.e. tap, bath or shower), hence if a pipe is shared for multiple tapping points the length of shared pipe should be duplicated and added for each tapping point.

If there is hot water distribution pipework outside the thermal envelope it should be entered in the separate pane marked ‘external’.

***NOTE**: Secondary distribution pipework is always needed if there are any hot water outlets in the property (hot water taps, showers).*

If required, the length of primary pipework should be measured from the heat source to the storage tank. Both the primary flow and return lengths should be included.

***NOTE**: Primary pipework is required whenever there is a hot water tank or a thermal storage tank in the heating system, and it has pipework connected to a separate heat source.*

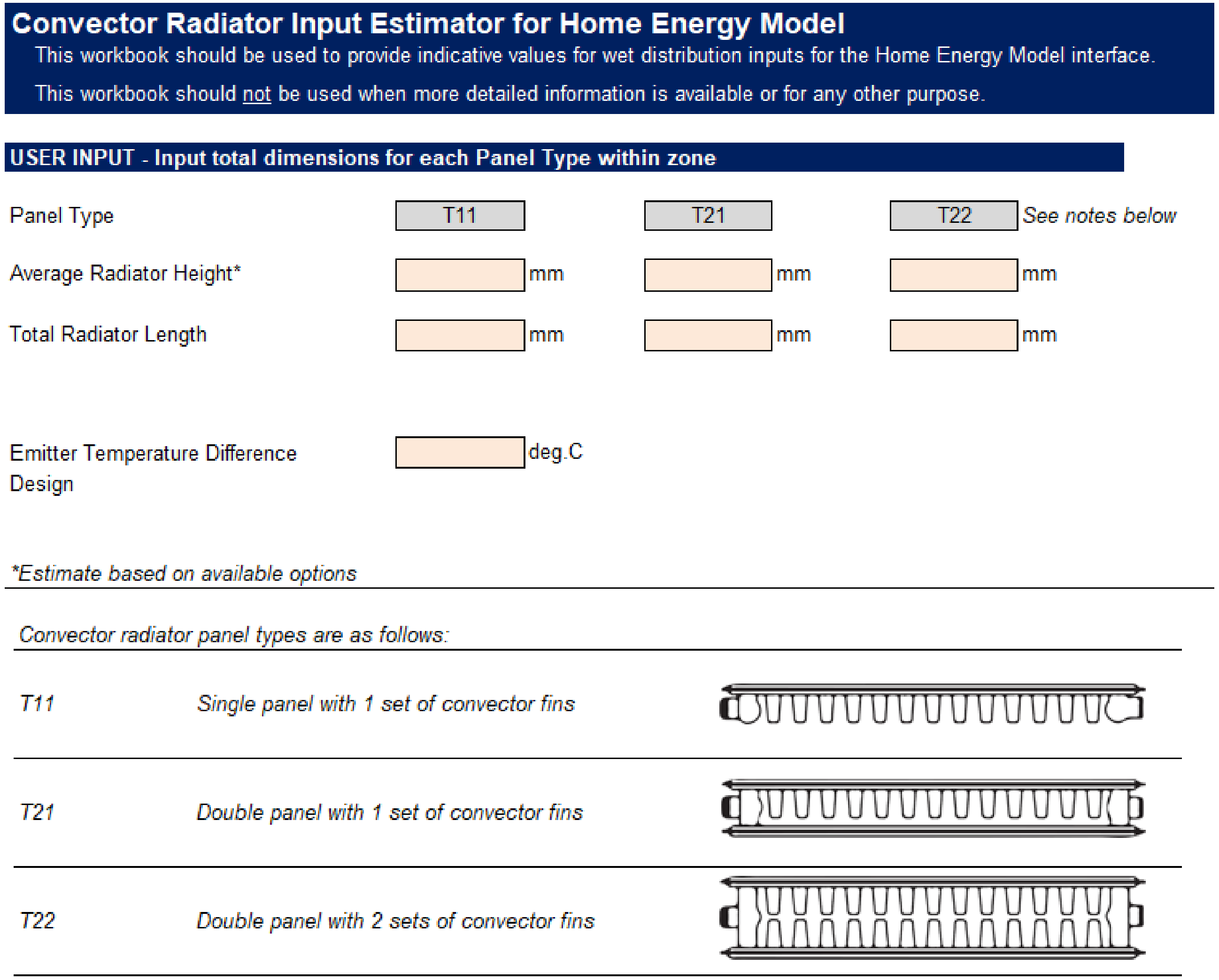


Wet Distribution

When a wet distribution space heating system is included in the dwelling there are several associated inputs (Heat Emitter Constant, Heat Emitter Exponent) that need to be supplied. To help estimate what these should be, an accompanying workbook has been produced. Note this is to calculate indicative values for a given system setup and should not be used outside this tool. The workbook can be found here.

Note the interface inputs should be for all the emitters in the given zone, hence when using the workbook, for each panel type the average radiator height should be input, along with the total radiator length and the system emitter temperature difference design. When these values are entered, a set of suggested emitter inputs for the tool will be generated.

(Note: pipework also has some thermal mass, the workbook currently does not calculate the pipework thermal mass.)



Convector Radiator Input Estimator for Home Energy Model

This workbook should be used to provide indicative values for wet distribution inputs for the Home Energy Model interface.

This workbook should not be used when more detailed information is available or for any other purpose.

USER INPUT - Input total dimensions for each Panel Type within zone

Panel Type	T11	T21	T22	*See notes below*
Average Radiator Height*	mm	mm	mm	
Total Radiator Length	mm	mm	mm	
Emitter Temperature Difference Design	deg.C			

**Estimate based on available options*

Convector radiator panel types are as follows:

T11	*Single panel with 1 set of convector fins*	
T21	*Double panel with 1 set of convector fins*	
T22	*Double panel with 2 sets of convector fins*	

Eco design control class

- **Class I** - On/off Room Thermostat: A room thermostat that controls the on/off operation of a heater. Performance parameters, including switching differential and room temperature control accuracy, are determined by the thermostat's mechanical construction.
- **Class II** - Weather compensator control, for use with modulating heaters: A heater flow temperature control that varies the set point of the flow temperature of water leaving the heater dependent upon prevailing outside temperature and selected weather compensation curve. Control is achieved by modulating the output of the heater.
- **Class III** - Weather compensator control, for use with on/off output heaters: A heater flow temperature control that varies the set point of the flow temperature of water leaving the heater dependent upon prevailing outside temperature and selected weather compensation curve. Heater flow temperature is varied by controlling the on/off operation of the heater.
- **Class IV** - TPI10 room thermostat, for use with on/off output heaters: An electronic room thermostat that controls both thermostat cycle rate and in-cycle on/off ratio of the heater proportional to room temperature. TPI control strategy reduces mean water temperature, improves room temperature control accuracy and enhances system efficiency.
- **Class V** - Modulating room thermostat, for use with modulating heaters: An electronic room thermostat that varies the flow temperature of the water leaving the heater dependent upon measured room temperature deviation from room thermostat set point. Control is achieved by modulating the output of the heater.
- **Class VI** - Weather compensator and room sensor, for use with modulating heaters: A heater flow temperature control that varies the flow temperature of water leaving the heater dependent upon prevailing outside temperature and selected weather compensation curve. A room temperature sensor monitors room temperature and adjusts the compensation curve parallel displacement to improve room comfort. Control is achieved by modulating the output of the heater.
- **Class VII** - Weather compensator and room sensor, for use with on/off output heaters: A heater flow temperature control that varies the flow temperature of water leaving the heater dependent upon prevailing outside temperature and selected weather compensation curve. A room temperature sensor monitors room temperature and adjusts the compensation curve parallel displacement to improve room comfort. Heater flow temperature is varied by controlling the on/off operation of the heater.
- **Class VIII** – Multi-sensor room temperature control, for use with modulating heaters: An electronic control, equipped with 3 or more room sensors that varies the flow temperature of the water leaving the heater dependent upon the aggregated measured room temperature deviation from room sensor set points. Control is achieved by modulating the output of the heater

4. Inputs Dictionary

General tab

Section	Input	Unit	Description
General	Project name	-	User assigned name for the project - this can be changed after the project is created.
	Weather Data Location	-	The location nearest to your planned site (options are not final).
	Number of Bedrooms	-	Rooms in the Rest of Dwelling zone, exclude bathrooms, kitchens, utility spaces, be counted as bedrooms.
	Number of ADF wet rooms	-	Rooms used for domestic activities, produce large amounts of airborne moisture. e.g. a kitchen, bathroom.
	Heating Control Type	-	SeparateTempControl – both living and rest of dwelling zones follow the same schedule but have different temperature set points. SeparateTimeAndTempControl – each zone has heating schedule and temperature set points.
	Water Heat Schedule	-	Default to all day
	Cold Water Source	-	Is cold water drawn from the mains water or a header tank. Currently a mixture of these for different outlets is not supported.
	Electricity Tariff	-	Type of electricity tariff (standard or a variable tariff)
	Cooking fuel	-	The primary fuel used for cooking. Can currently be either electricity or mains gas.
	Electricity grid connection	-	Whether the dwelling’s connection to the electricity grid is 1-phase (typical), 2 or 3 phase (to support higher electricity loads) or absent altogether (rare). This input is not currently used by the model and will not affect the results, future developments will make use of this data.
	Electric vehicle charge point	-	Whether present, charge only or bi-directional. This input is not currently used by the model and will not affect the results, but we anticipate future developments will make use of this data.
	Appliance energy rating	-	Fridge/freezer, Dishwasher, Oven/cooker, Tumble and Washing machine/washer-dryer, rate A - G
Secondary Hot Water Distribution (internal / external)	Length	m	Total length of secondary distribution pipework, multiple tapping points to be counted once for each point
	Internal and external diameter	mm	Internal / External diameter of the pipe. Variable pipe diameters are not handled in the Home Energy Model, the predominant diameter would have to entered instead.
	Insulation thermal conductivity	W / m.K	Thermal conductivity of the pipework insulation.
	Insulation thickness	mm	Thickness of the pipework insulation.
	Reflective insulation	-	Checkbox to indicate whether the internal surface of the pipework insulation is reflective.

General tab

Section	Input	Unit	Description
Distant Shading components	• It helps to use compass point directions and convert to degrees, measured clockwise as positive angle. There is no limit on the distance, but it has to be something in sight of the house. It could be a tree in the distance for example. • Self-shading or an attached building can be modelled with sidefins on a window. A sidefin is a vertical shading component to the window side, like a window reveal or a piece of wall jutting out. If there is a wall which is shading the window, treat the wall as a sidefin. The wall causing the shading can be the current building or an attached building. A distant component can also be used to model an attached building if it causes a lot of shading. • If a distant shading component covers more than half a segment, then include it in that segment. If the component straddles two segments and covers more than 22.5 degrees in total, enter the component in the segment that more than half of the component is in.		
	Direction	-	For simplicity, the consultation tool splits the ground plane into 8 segments of 45 degrees, labelled by compass points. Each segment can contain up to 1 distant shading component which will be assumed to occupy this angle. Checking the box will enable the subsequent fields to further specify the shading.
	Shading type	m	Shading type can be "obstacle" or "overhang". An obstacle extends upwards from the ground. An overhead component extends downwards from infinity. Overhead components may approximate certain real components. See section 2 of this guide for further information.
	Height	m	Height of the shading obstacle from the ground level. For an overhang component, the lowest extent from the ground level.
	Distance	m	The horizontal distance between the shaded surface and the shading component, as measured between their central points.
Move Dwelling	Rotate orientation	0-360 degrees from North	When the Confirm button is pressed, this will rotate all building components in the project by the amount specified. This is equivalent to rotating the dwelling, and enables compliance to be tested for a design regardless of its orientation. This may also be useful when copying a project. Generally this should only be done for a project where all components have already been entered.
	Shift dwelling up or down	m (up)	When the Confirm button is pressed, this will shift the base heights of all components up or down, while keeping distant shading components the same. This may be useful when copying a project, especially if considering a block of flats. Generally this should only be done for a project where all components have already been entered.

Inside each Thermal Zone

Section	Input	Unit	Description
Zone parameters	Floor Area	m^2	Floor area should be measured as the actual floor area, i.e. if the height of a room extends to two storeys or more only the actual accessible floor area should be used for the calculations. However, as an exception to this rule in the case of stairs, the floor area should be measured as if there were no stairs but a floor in their place at each level. In general, rooms and other spaces, such as built-in cupboards, should be included in the calculation of the floor area where these are directly accessible from the occupied area of the dwelling. However unheated spaces clearly divided from the dwelling should not be included.
	Volume	m^3	Internal volume of the dwelling. This includes internal partitions.
	Lighting Efficacy Class	lumen/W	Luminous efficacy of the lighting used in the dwelling. This is the average value for all fixed lighting in zone.
	Space Heat Control	-	Living room or rest of dwelling. Identifies whether the zone is part of the living room area or is part of the rest of the dwelling area. Open plan areas connected to the living room are included in the living room zone.
	Space heating system for this zone	-	The heating system has a set of parameters which define how it operates. Each zone is assigned to a heating system.
	Cooling system for this zone	-	Each zone is assigned to a cooling system.
Thermal bridges	**Linear Thermal Bridge**	-	
	Linear Thermal Transmittance	W/m.K	The heat loss from the thermal bridge in watts, per unit length and per unit temperature difference
	Length	m	Length of the thermal bridge
	Location of thermal bridge junction	-	
	Type of thermal bridge junction	-	

Inside each Thermal Zone

Section	Input	Unit	Description
Thermal bridges	**Point Thermal Bridge**	-	
	Heat Transfer Coefficient	W/K	Heat transfer coefficient of the thermal bridge at that point.
Add building components	**Common units to all components**	-	Walls, roofs, fully opaque doors (no glazing), floor, window/ glazed doors, ceiling **Walls** - A wall over multiple storeys should be split if across multiple zones. When in a single zone, it does not have to be split, but the user can choose to split the wall if that makes it easier to enter dimensions. If we take a house with zone 1 on the ground floor, and zone 2 on the first floor above it, then: • The ground floor wall height is measured floor to ceiling (zone 1). • The first floor wall height is measured ceiling to ceiling (zone 2). Also: • A ground floor wall height is always measured floor to ceiling. • A single storey flat is always measured floor to ceiling. This also means that the base height of a first floor wall in a house would be the ceiling level, not the floor level.

Inside each Thermal Zone

Section	Input	Unit	Description
Add building components	g-value	-	Solar energy transmittance, the fraction of solar energy that the glazing transmits into the dwelling
	Window Shading	-	
	Shading type	-	Overhang, Sidefinleft, Sidefinright. Left/Right side fins are taken when looking out of the window.
	Depth	m	Depth away from the transparent element.
	Distance from glazing	m	Distance of the closest edge of shading from the glass. Not distance to window frame.
	Ground/ Basement floor	-	
	u-value	W / (m^2.K)	Steady-state thermal transmittance of floor, including the effect of the ground. These are based on the calculation methods for ground floor heat flow as defined in in BS EN ISO 13370:2017, 6.6 Thermal transmittance and heat flow rate.
	Thermal resistance of floor construction	(m^2.K) / W	The total thermal resistance of all layers in the floor construction (excluding the effect of the ground).
	Internal periodic heat transfer coefficient	W / K	A variation in annual heat flow through the ground floor relative to internal temperature. The definition is in BS EN ISO 13370:2017 Annex H, H.4.1 Internal temperature variation. Default values are currently being provided for iHEM, and a calculation tool for this will be available at a later data.
	External periodic heat transfer coefficient	W / K	A variation in annual heat flow through the ground floor relative to external temperature. The definition is in BS EN ISO 13370:2017 Annex H, H.4.2 External temperature variation. Default values are currently being provided for iHEM, and a calculation tool for this will be available at a later data.
	Perimeter	m	The exposed external perimeter of the floor. Do not include any floor perimeter that is not exposed to the outside.
	Linear thermal transmittance	W / (m.K)	Linear thermal transmittance of the junctions between the floor and the walls
	Floor to Unheated Space	-	
	Areal heat capacity	J / (m^2.K)	This is the total heat capacity of all the construction layers, that is, the sum of the heat capacities of each individual layers.

Inside each Thermal Zone

Section	Input	Unit	Description
Add building components	Name	-	User-assigned name of the component
	Base Height	m	Height of the base of the component above ground
	Height	m	Height of the component itself (starting from the base height)
	Width	m	Width of the component
	U-Value	W/ m^2.K	Thermal transmittance of the building element
	Area	m^2	Surface area of the component
	Pitch	degrees	Tilt angle of the surface from horizontal, in degrees between 0° and 180° (0° means external surface is facing up, 90° means external surface is vertical and 180° means external surface is facing down)
	Orientation	degrees	The compass orientation angle of the building component, from 0 - 360^0. N = 0/360°, W = 270°, S = 180°, E = 90°.
	Solar absorption coefficient	-	The fraction of solar radiation absorbed at the external surface. 0.3 = light colour, 0.6 = intermediate colour, 0.9= dark colour.
	Areal heat capacity	J / m^2.K	The heat capacity of the full thickness of the construction component (wall, roof, floor), per unit area.
	Mass Distribution Class	-	Distribution of thermal mass in building component, one of: - 'I': thermal mass concentrated on internal face - 'E': thermal mass concentrated on external face - 'IE': thermal mass divided over internal and external face, with less in the middle - 'D': thermal mass evenly distributed throughout the build-up - 'M': thermal mass concentrated in the middle of the build-up, away from the faces (Note that selecting the most relevant Mass Distribution Class is not always obvious, and a supplementary tool may be developed later to assist with the selection.) For further explanation, see BS EN ISO 52016-1:2017 6.5.7.2 Opaque components (walls, roofs, etc.) Table A.13 — Distribution of mass of opaque and ground floor components
	Window or Glazed door	-	
	Frame Area Fraction	-	Fraction of the window area that is the frame, that is, the fraction that is not glazing

Heating Systems tab inputs description

Section	Input	Units	Description
Add heat source	**Common units to all components**	-	Heat battery, Heat pump, Combi boiler, Regular boiler, heat network. **Systems that are not included** (on the way) – Hybrids heat pumps, Radiant heat panels, Gas powered heat pump, Solid fuel stoves
	Name	-	User defined name
	PCDB Number	-	Inputs expected to come from the PCDB
	Fuel type	-	Inputs should be retrieved from the PCDB
	Number of units	-	Number of units install in zone
	Location	-	Whether component is located "Inside" or "Outside"
	Rated Power	-	Nominal power of component
	Convective Fraction	kW	Convective fraction for heating
	Heat Source	-	component that describes the heat source (type, energy supply, control, flow temperature)
	Thermostat position	-	Position of the thermostat in the cylinder
	Heater position	-	Position of the heater in the cylinder
	Heat Battery	-	This category contains components that describe Heat Battery Systems
	Heat Pump	-	This category contains components that describe Heat Pump Systems
	Combi Boiler	-	This category contains components that describe Combi Boiler Systems
	Regular Boiler	-	This category contains components that describe Regular Boiler Systems
Add space heating system	**Instant electric heater**	-	This category contains components that describe Instant electric heater Systems
	Warm Air Heat Pump	-	This category contains components that Warm Air Heat Pump Systems

Heating Systems tab inputs description

Section	Input	Units	Description
Add space heating system	Design temperature difference	deg C	Design temperature difference across the emitters
	Electric Storage Heater	-	This category contains components that describe Electric Storage Heater Systems
	Wet Distribution	-	This category contains components that describe Wet Distribution Systems. This is not an individual radiator, it is the set of radiators and pipes for a whole zone.
	User Defined System	-	User-defined name of a Wet Distribution component
	Thermal Mass	J / deg C	Thermal mass of emitters
	Heat Emitter Constant	kW	Constant from characteristic equation of emitters (must be order of magnitude that the characteristic equation gives power output)
	Heat Emitter Exponent	-	Exponent from characteristic equation of emitters
	Design Temp Difference across Emitter	deg C or K	Design temperature difference across the emitters
	Convective Heating Fraction	-	Convective fraction for heating
	Eco-design Control Class	-	Various classes of heating system which may have features such as weather compensation. Refer to Eco-design Control Class section.
	Max Flow Temperature	deg C	Design flow temperature of heating fluid for the space heating system
	Temperature Setback	deg C	Minimum temp the heat pump is set during off hours.
	Advanced Start	hours	The number of hours the heat pump turns on before the time the heat is needed.
Add water heating system	**Point of use water heater**	-	This category contains components that describe Point of use water heater Systems
	Efficiency	-	The efficiency of the heater, between 0 and 1

Heating Systems tab inputs description

Section	Input	Units	Description
Add water heating system	Peak collector efficiency	-	Peak collector efficiency
	Hemispherical incidence angle modifier	-	Hemispherical incidence angle modifier – The variance in output performance of a solar collector as the angle of the sun changes in relation to the surface of the collector.
	First order HLC	$W / (m^2.K)$	First order heat loss coefficient
	Second order HLC	$W / (m^2.K^2)$	Second order heat loss coefficient
	Mass flow rate	$kg / (s.m^2)$	Mass flow rate solar loop
	Power of collector pump	W	Power of collector pump
	Power of collector pump controller	W	Power of collector pump controller
	Fuel type		Inputs should be retrieved from the PCDB
	Tilt	deg	The tilt angle (inclination) of the PV panel from horizontal, measured upwards facing, 0 to 90, in degrees. 0=horizontal surface, 90=vertical surface
	Orientation	deg	The orientation angle of the inclined surface, expressed as the geographical azimuth angle of the horizontal projection of the inclined surface normal, from 0 - 360^0. N = 0/360°, W = 270°, S = 180°, E = 90°.
	Heat Loss Coefficient (loop piping)	W / K	Heat loss coefficient of the collector loop piping
	Immersion Heater	-	This category contains components that describe Immersion Heater Systems
	Waste Water Heat Recovery System	-	This category contains components that describe Waste Water Heat Recovery Systems

Heating Systems tab inputs description

Section	Input	Units	Description
Add water heating system	**Storage Tank**	-	This category contains components that describe Storage Tank Systems
	Min temperature	deg C	Minimum temperature at which hot water is stored. The hot water system will start heating the water if it falls below this temperature.
	Temperature setpoint	deg C	Temperature at which the water is maintained at in the storage tank.
	Volume	litres	Volume of hot water in hot water source
	Daily losses	kWh / 24h	Measured standby losses due to cylinder insulation at standardised conditions.
	Primary Pipework	-	This category contains components that describe Storage Tank Pipework Systems
	Internal / External diameter	m	Internal / External diameter of the pipe. Variable pipe diameters are not handled in the Home Energy Model, the predominant diameter would have to entered instead.
	Length	m	Total length of primary pipework
	Insulation thermal conductivity	W / m.K	Thermal conductivity of the insulation
	Insulation thickness	-	Thickness of the pipe insulation
	Surface reflectivity	-	Whether the surface is reflective or not
	Solar Thermal	-	This category contains components that describe Solar Thermal Systems
	Location of the collector loop piping	-	Location of the main part of the collector loop piping (OUT: Outside; NHS: Non heated space; HS: Heated space)
	Area	m^2	Collector module reference area

Water heating demand tab inputs description

Section	Input	Units	Description
	Common units to all components	-	Mixer Shower, Electric Shower, Bath, Other hot water outlet. If you have a bath-shower combined outlet, these need to be entered as separate outlets.
	Name	-	User defined name
	PCDB Number	-	Inputs should be retrieved from the PCDB
	Flow Rate	litres/min	Water component flow rate (of mixed water) in litres/minute
	Rated Power	kW	component rated electrical power
	Volume	litres	component size

Infiltration and Ventilation tab inputs description

Section	Input	Units	Description
Infiltration	Name	-	Infiltration & Ventilation
	Storey	-	For flats, storey number within building / for non-flats, total number of storeys in building
	Shelter	-	Exposure level of the building
	Build Type	-	Very sheltered, Sheltered, Normal, Exposed
	Airtightness Test Result	ACH	Result of pressure test, in air changes per hour
	Test Type	Pa	Measurement used for pressure test i.e. based on air change rate value at 50 Pa (50Pa) or 4 Pa (4Pa)
	Enveloped Area	m^2	Total external envelope area of the building including party walls and floors. Includes any party walls and floors/ceilings between flats. Only for the 4Pa test type.
	Volume	m^3	Total volume of dwelling. Measured using internal dimensions. Does not subtract the volume of internal walls, furniture or any cavities inside the dwelling.
	Sheltered Sides	-	Number of sides of the building which are sheltered
	Passive Stack Vents	-	Number of passive vents
Chimneys/ Flues	Open Chimneys	-	Number of open chimneys
	Open Flues	-	Number of open flues
	Flues attached to Closed Fire	-	Number of chimneys / flues attached to closed fire
	Flues attached to boiler	-	Number of flues attached to solid fuel boiler
	Flues attached to other heater	-	Number of flues attached to other heater
	Blocked Chimneys	-	Number of blocked chimneys
	Flueless Gas Fires	-	Number of flueless gas fires

Infiltration and Ventilation tab inputs description

Section	Input	Units	Description
Ventilation	**Ventilation type**	-	Mechanical Ventilation with Heat Recovery (MVHR), Continuous Mechanical Extract Ventilation with background ventilators (Continuous MEV), Intermittent Mechanical Extract Ventilation with background ventilators (Intermittent MEV). **Note** Intermittent MEV is referred to as "natural ventilation with background ventilators and intermittent extract fans".
	Common inputs for multiple ventilation types	-	MVHR, Continuous MEV, Intermittent MEV
	Window equivalent area	m^2	The maximum equivalent area of all openings in the building (as calculated according to Approved Document O, Appendix D).
	Intermittent Extract Fans	-	Number of intermittent extract fans
	Required ACH	ACH	Result of pressure test, in air changes per hour
	Specific Fan Power	W/(litres/s)	Specific fan power
	Mechanical Ventilation with Heat Recovery (MVHR)	-	This category contains components that describe Mechanical Ventilation with Heat Recovery Systems
	MVHR location	-	Whether component is located "inside" or "outside". This is needed to determine which ducts are likely to have heat loss due to outside air. Warm ducts cause heat loss when the MVHR unit is outside, while cold ducts cause heat loss when the MVHR unit is inside.
	Heat Recovery Efficiency	-	The efficiency of MVHR (A number between 0 & 1)
	Internal/ External diameter	m	Diameter of the duct. Variable duct diameters are not handled in the Home Energy Model, the predominant diameter would be entered instead. Ducts are assumed to be cylindrical.
	Length of intake/supply ductwork	m	Total length of distribution ductwork.
	Length of extract/exhaust ductwork	m	Enter the length of the exhaust duct or for extract duct for internal MVHR
	Insulation thermal conductivity	W / m.K	Thermal conductivity of the insulation
	Insulation thickness	m	Thickness of the duct insulation
	Reflective insulation	-	Whether the surface is reflective or not

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Cooling tab inputs description

Section	Input	Units	Description
	Air Conditioning	-	This category contains components that describe Air Conditioning Systems
	Cooling Capacity	kW	The maximum cooling power available from the air-conditioning system
	Efficiency	-	The efficiency of air conditioning (A number between 0 & 1)
	Convective Fraction	-	Convective fraction for cooling.
	Fuel type	-	Inputs should be retrieved from the PCDB

PV and Energy Storage tab inputs description

Section	Input	Units	Description
	Common units to all components	-	Solar PV Array, Electric Battery, PV Diverter
	Name	-	User defined name
	Solar PV Array	-	This category contains components that describe Solar PV Array Systems
	Peak Power	kWp	Represents the peak electrical power of a photovoltaic system with a given area and for solar irradiance of 1 kW/m2 on this surface (at 25 deg). Units are kWp or kilowatt-peak.
	Ventilation Strategy	-	Used to determine the system performance factor based on a lookup table.
	Pitch	deg	The tilt angle (inclination) of the PV panel from horizontal measured upwards facing, 0 to 90, in degrees. 0 = horizontal surface, 90 = vertical surface.
	Orientation	deg	The orientation angle of the inclined surface, expressed as the geographical azimuth angle of the horizontal projection of the inclined surface normal, -180 to 180
	Fuel type	-	Inputs should be retrieved from the PCDB
	Electric Battery	-	This category contains components that describe Electric Battery Systems
	Capacity	kWh	The maximum capacity of the battery
	Charge/Discharge Efficiency	-	Charge/Discharge round trip efficiency of battery system (between 0 & 1)
	PV Diverter	-	This category contains components that describe PV Diverter Systems
	Immersion Heater	-	Immersion heater which is supplied water heating by the PV Diverter

Results tab

Section	Input	Units	Description
	Project data	-	Download project data as .json file using this button.
	Calculate	-	The first column on the results summary page (Output) will be filled quickly but the other (notional building) columns will take a bit longer to run and therefore display outputs will take some time to show, so make sure to come and check back on them.
	View existing results	-	
	Summary	-	Results summary page of your project run.
	Downloads	-	Project Downloads.
	Back to Project details	-	Re-visit your project components using this button.