

RENEWABLE ENERGIES & SUSTAINABILITY

STATEMENT

FOR

AN OFF-GRID HYBRID PASSIV HAUS DESIGNED

NEW DWELLING HOUSE

ON LAND ADJACENT HILL TOP FARM

BOSWORTH ROAD – WELLSBOROUGH – NUNEATON – CV13 6PA

FOR

Mr & Mrs D & C Cordy

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INTRODUCTION

This document has been produced by acbuckley architectural in support of a large modern country dwelling house to be built on 2.18 hectares of land adjacent Hill Top Farm, Bosworth Road, Wellsborough, Nuneaton, CV13 6PA. This statement outlines the clients original brief to design a completely 'off-grid' energy efficient home to the highest possible standards, using innovative and proven techniques to meet their requirements. The brief was to make use of the site and to locate a Code 6 Zero Carbon or Passiv Haus low energy, zero carbon/carbon neutral home being itself energy efficient and sustainable, built to the highest standards using quality products that have the least impact on the environment at source and during the lifetime of the products' known life cycles. The new house was to be sited in the most advantageous position on the land, maximising the panoramic vista beyond the enclosed field, whilst screening it from inclement weather conditions and atmospheric adverse conditions which may or will affect the external fabric of the building and at the same time making it invisible in profile within the rural landscape and from the highway and in an aerial observed position.

In December 2006 the Government published details specifically laying out the future targets for new homes in England and Wales called, Code for Sustainable Homes – A step-change in sustainable home building practice. The document stated.

As the Stern Review highlighted, there is now an overwhelming body of scientific evidence showing that climate change is a serious and urgent issue. In 2004, more than a quarter of the UK's carbon dioxide emissions – a major cause of climate change – came from the energy we use to heat, light and run our homes. So, it's vital to ensure that homes are built in a way that minimises the use of energy and reduces these harmful emissions.

Construction and use of our homes have a range of other environmental impacts, created for example through water use, waste generation and use of polluting materials, which can be significantly reduced through the integration of higher sustainability performance standards within the design of a home. More sustainable homes can also provide us with improved overall wellbeing and quality of life.

The Code for Sustainable Homes has been introduced to drive a step-change in sustainable home building practice. It is a standard for key elements of design and construction which affect the sustainability of a new home. It will become the single national standard for sustainable homes, used by home designers and builders as a guide to development, and by home-buyers to assist in their choice of home.

It will form the basis for future developments of the Building Regulations in relation to carbon emissions from, and energy use in homes, therefore offering greater regulatory certainty to developers. And in this era of environmental awareness amongst consumers and increasing demand for a more sustainable product, it will offer a tool for developers to differentiate themselves.

If we build the homes we need, then by 2050, as much as one-third of the total housing stock will have been built between now and then. Current house building plans therefore offer an important opportunity to build high standards of sustainability into the homes we will use in the future. The Code for Sustainable Homes will play a key role in enabling us to seize this opportunity, and to build a future housing stock which both meets our needs and protects the environment.

Unfortunately, this step-change was not widely adopted and development of new homes by major developers fails to meet the high levels as proposed, choosing to put profit before the benefits of the home buyer/occupier. It is therefore left to self-builders to do what they can to address the need to build homes large and small which aspire to meet the highest energy efficient/zero carbon homes. Many authorities are taking the initiatives at local levels to implement sustainability of newly built homes, commercial and industrial buildings through changes made in their local planning policies.

The principles of the Code for Sustainable Homes gave a list of objectives that should be met through the design process. These included;

- energy/CO2
- water
- materials
- surface water run-off
- waste
- pollution
- health and well-being
- management
- ecology

CODE STANDARDS

This section lists the issues under each of the sustainability categories included within the Code, the minimum standards where applicable, and the points available for each issue. The table below summarises all of the minimum standards which exist under the Code:

Table 1.1: Summary of Environmental Categories and Issues

Categories	Issues
Energy and CO2 Emissions	Dwelling emission rate (M)
	Fabric energy efficiency (M)
	Energy display devices
	Drying space
	Energy labelled white goods
	External lighting
	Low and zero carbon technologies
	Cycle storage
Water	Home office
	Indoor water use (M)
Materials	External water use
	Environmental impact of materials (M)
	Responsible sourcing of materials – basic building elements
	Responsible sourcing of materials – finishing elements
Surface Water Run-Off	Surface Water Run-off Management of surface water run-off from developments (M)
	Flood risk
Waste	Storage of non-recyclable waste and recyclable household waste (M)
	Construction site waste management
	Composting
Pollution	Global warming potential (GWP) of insulants
	NOX emissions
Health and Well-being	Daylighting
	Sound insulation
	Private space
	Lifetime Homes (M)
Management	Home user guide
	Considerate Constructors Scheme
	Construction site impacts
	Security
Ecology	Ecological value of site
	Ecological enhancement
	Protection of ecological features
	Change in ecological value of site
	Building footprint

(M) denotes issues with mandatory elements.

The Code assigns one or more performance requirements (assessment criteria) to all of the environmental issues. When each performance requirement is achieved, a credit is awarded (except the three mandatory requirements with no associated credits). The total number of credits available to a category is the sum of credits available for all the issues within it.

Mandatory minimum performance standards are set for some issues. For three of these, a single mandatory requirement is set which must be met, whatever Code level rating is sought. Credits are not awarded for these issues. Confirmation that the performance requirements are met for all three is a minimum entry requirement for achieving a Level 1 rating. The three uncredited issues are:

- Environmental impact of materials
- Management of surface water run-off from developments
- Storage of non-recyclable waste and recyclable household waste

If the mandatory minimum performance standard is met for the three un-credited issues, four further mandatory issues need to be considered. These are agreed to be such important issues that separate Government policies are being pursued to mitigate their effects. For two of these, credits are awarded for increasing levels of achievement recognised within the Code.

The two issues with increasing mandatory minimum standards are:

- Dwelling emission rate
- Indoor water use.

The final two issues with mandatory requirements are Fabric Energy Efficiency and Lifetime Homes. To achieve an overall Code rating of level 5 it is necessary to achieve at least 7 credits in Ene 2. To achieve an overall Code rating of level 6 it is necessary to achieve at least 7 credits in Ene 2 and 3 credits in Hea 4 – Lifetime Homes.

Tables 1.2 and 1.3 below illustrate how, for the creditable mandatory issues, the minimum mandatory standards increase with increasing rating levels. For CO2 emissions there are increased mandatory minimum standards for each increase in Code level.

Table 1.2: Code Levels for Mandatory Minimum Standards in CO2 Emissions (Ene 1)

Code Level	Minimum Percentage Improvement in Dwelling Emission Rate over Target Emission Rate
Level 1 (★)	0% (Compliance with Part L 2010 only is required)
Level 2 (★★)	0% (Compliance with Part L 2010 only is required)
Level 3 (★★★)	0% (Compliance with Part L 2010 only is required)
Level 4 (★★★★)	25%
Level 5 (★★★★★)	100%
Level 6 (★★★★★★)	Net Zero CO2 Emissions

For indoor water use there are increased mandatory standards at Code Levels 1, 3 and 5

Table 1.3: Code Levels for Mandatory Maximum Standards in Indoor Water Consumption

Code Level	Maximum Indoor Water Consumption in Litres per Person per Day
Level 1 (★)	120
Level 2 (★★)	120
Level 3 (★★★)	105
Level 4 (★★★★)	105
Level 5 (★★★★★)	80
Level 6 (★★★★★★)	80

Further credits are available on a free-choice or tradable basis from other issues so that the developer may choose how to add performance credits (converted through weighting to percentage points) to achieve the rating for which they are aiming.

The environmental impact categories within the Code are not of equal importance. Their relative value is conveyed by applying a consensus-based environmental weighting factor (see details below) to the sum of all the raw credit scores in a category, resulting in a score expressed as percentage points. The points for each category add up to 100, see table 1.4.

1.2 Weightings, credits and percentage points

Table 1.4 shows how weightings are applied across all Code categories of environmental impact to adjust the relative values of credits within different categories. Within each category, credits are awarded for achieving specified degrees of performance. The weighting factors show the contribution made by each category to the total performance recognised and rewarded by the Code. The total available contribution is expressed as 100 per cent. The weighting of each category is expressed as a fraction of this, such that the sum of all the category contributions equals 100 per cent.

As an example, the 31 credits available for energy and CO2 emissions contribute 36.4 per cent of the total available performance. Similarly, the four credits available for pollution contribute 2.8 per cent of the total available performance. By dividing the weighting factor by the number of credits for each category, we arrive at an approximate weighted value for each credit. For instance, within the energy and CO2 emissions category, 36.4 per cent contribution to the total, divided by the 31 credits available, means that each credit in this category is worth roughly 1.17 percentage points. Similarly, for the Pollution

category, 2.8 per cent contribution to the total, divided by the four credits available, means that each credit in this category is worth roughly 0.70 percentage points.

It is important to note that weightings apply at the category level and not to individual credits to avoid rounding errors. For instance, for the Energy and CO2 Emissions category, 36.4 per cent weighted contribution divided by 31 credits equals 1.1741935 expressed to seven decimal places, but 1.17 when expressed to two decimal places.

It is also important to note that achieving high performance in one category of environmental impact can sometimes result in a lower level of performance for another. For instance, if biomass is used to meet heating demand, credits will be available for performance in respect of energy supplied from a renewable source, but credits cannot be awarded for low NOX emissions. It is therefore impossible to achieve total percentage points score of 100.

Table 1.4: Total Credits Available, Weighting Factors and Points

Categories of Environmental Impact	Total Credits in each Category	Weighting Factor (% points contribution)	Approximate Weighted Value of each Credit
Category 1	31	36.4%	1.17
Energy and CO2 Emissions			
Category 2	5	9.0%	1.50
Water			
Category 3	24	7.2%	0.30
Materials			
Category 4	4	2.2%	0.55
Surface Water Run-off			
Category 5	8	6.4%	0.80
Waste			
Category 6	4	2.8%	0.70
Pollution			
Category 7	12	14.0%	1.17
Health and Well-being			
Category 8	9	10.0%	1.11
Management			
Category 9	9	12.0%	1.33
Ecology			
Total	-	100.0%	-

Table 1.5 summarises the environmental impact categories, issues, credits and weighting factors.

Table 1.5: Summary of Environmental Impact Categories, Issues, Credits and Weighting

Code Categories	Available Credits	Category Weighting Factor
Energy and CO2 Emissions		
Dwelling emission rate	10	
Fabric energy efficiency	9	
Energy display devices	2	
Drying space	1	
Energy labelled white goods	2	
External lighting	2	
Low and zero carbon technologies	2	
Cycle storage	2	
Home office	1	
Category Total	31	36.40

Code Categories	Available Credits	Category Weighting Factor
Water		
Indoor water use	5	
External water use	1	
Category Total	6	9.00
Materials		
Environmental Impact of \Materials	15	
Responsible sourcing of materials – basic building elements	6	
Responsible sourcing of materials – finishing elements	3	
Category Total	24	7.20
Surface Water Run-off		
Management of surface water run-off from developments	2	
Flood risk	2	
Category Total	4	2.20
Waste		
Storage of non-recyclable waste and recyclable household waste	4	
Construction waste management	3	
Composting	1	
Category Total	8	6.40
Pollution		
Global warming potential (GWP) of insulants	1	
NOx emissions	3	
Category Total	4	2.80
Health & Well-being		
Daylighting	3	
Sound insulation	4	
Private space	1	
Lifetime homes	4	
Category Total	12	14.00
Management		
Home user guide	3	
Considerate Construction Scheme	2	
Construction site impacts	2	
Security	2	
Category Total	9	10.00
Ecology		
Ecological value of site	1	
Ecological enhancement	1	
Protection of ecological feature	1	
Change in ecological value of site	4	
Building footprint	2	
Category Total	9	12.00
Total	107	100.00

1.3 Calculating an assessment score

The assessment process should proceed in a logical order through the environmental impact categories and issues, summarised in figure 1.3 below:

- It should begin with a check that the three mandatory issues for which no credits are awarded have been achieved.
- The mandatory requirements for CO2 emissions, fabric energy efficiency, internal water use and Lifetime homes should be checked and confirmed at the minimum values required to meet the Code level sought.
- The remaining tradable credits should be checked and confirmed so that they also, contribute to the required Code level.

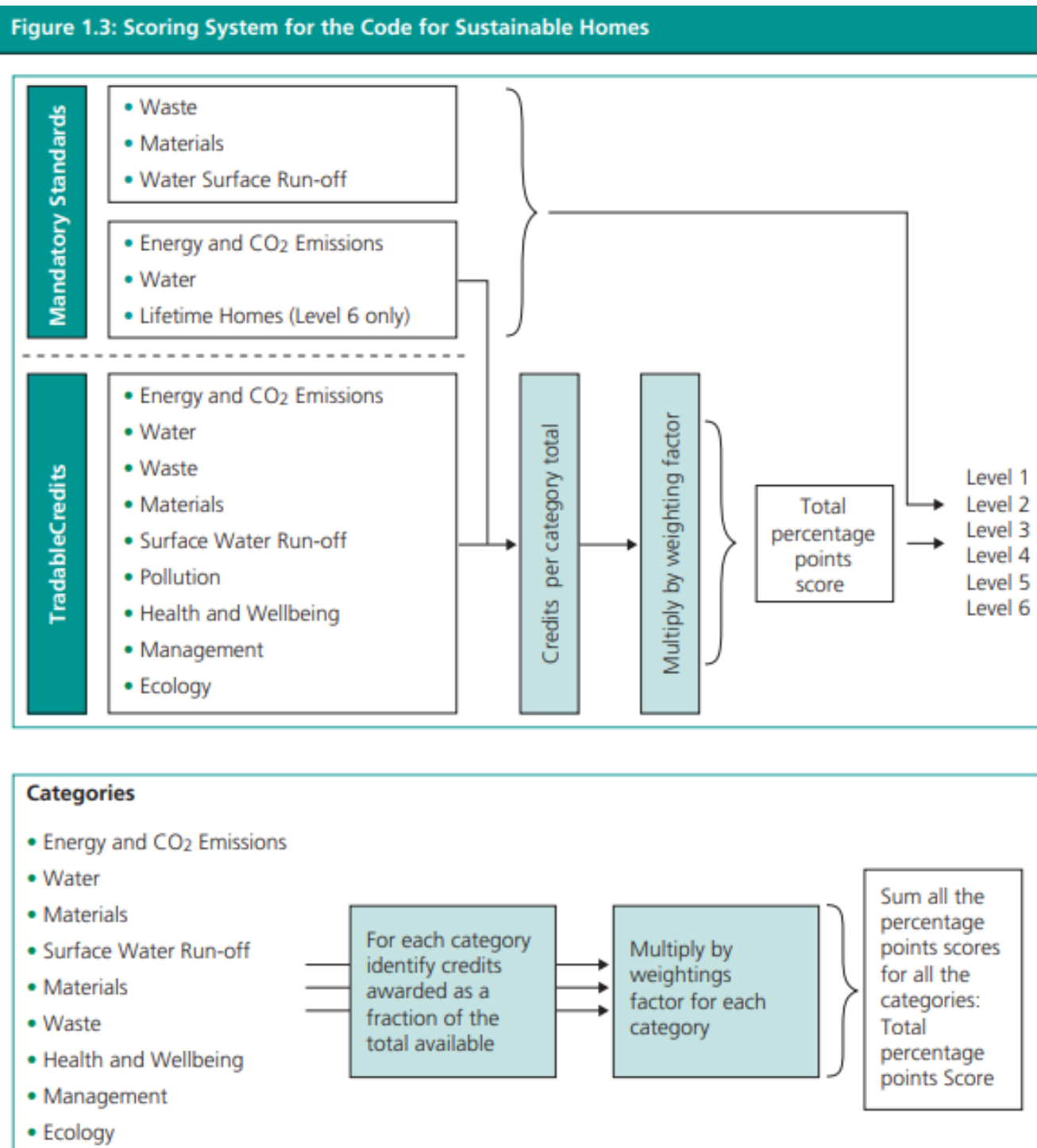
If any of the standards for the three non-creditable issues are not met, then a zero rating will result, regardless of the other credits achieved, including the creditable mandatory issues.

If all the non-creditable mandatory standards are met, but one or other of the creditable mandatory issues fails to reach the minimum required to achieve a higher level, the rating will be determined by the lowest mandatory level met.

1.4 Total percentage points score and resulting Code level

Figure 1.3 illustrates the calculation method to obtain the total percentage points score. For each category, the number of credits achieved is divided by the total available and multiplied by the category weighting factor to derive the percentage points score. This number should be rounded down to two decimal places before the next step.

The rounded percentage points scores for each category are then summed to arrive at the total percentage points score for the dwelling. The total percentage points score must be rounded down to the nearest whole number.



The Code level is then derived from the total percentage points according to table 1.6. Each Code level is represented on the certificate by an equivalent number of stars from 1 to 6.

Table 1.6: Relationship Between Total Percentage Points Score and Code Level

Total Percentage Points Score (equal to or greater than)	Code Level
36 Points	Level 1 (★)
48 Points	Level 2 (★★)
57 Points	Level 3 (★★★)
68 Points	Level 4 (★★★★)
84 Points	Level 5 (★★★★★)
90 Points	Level 6 (★★★★★★)

The report submission tool (available for assessors from the Code service provider) must be used to determine an accurate score for an assessment.

PASSIVE HAUS (HOUSE)

acbuckley architectural is a registered member of Passiv Haus ® and adheres to their code of practice in the design of low energy homes.

Passiv Haus (House) formulated 'Five Principles of Passiv House Design and Construction', which must be met in order to comply with their set criteria. These are;

1. *Super-insulated Envelopes.* The building envelope is what separates the interior of the building from the exterior; it consists of outside walls, roofs, and floors.
2. *Airtight Construction.* Heat can also be lost through the envelope via air leakage. ...
3. *High-Performance Glazing.* ...
4. *Thermal-Bridge-Free Detailing.* ...
5. *Heat Recovery Ventilation*

Super-insulated Envelopes

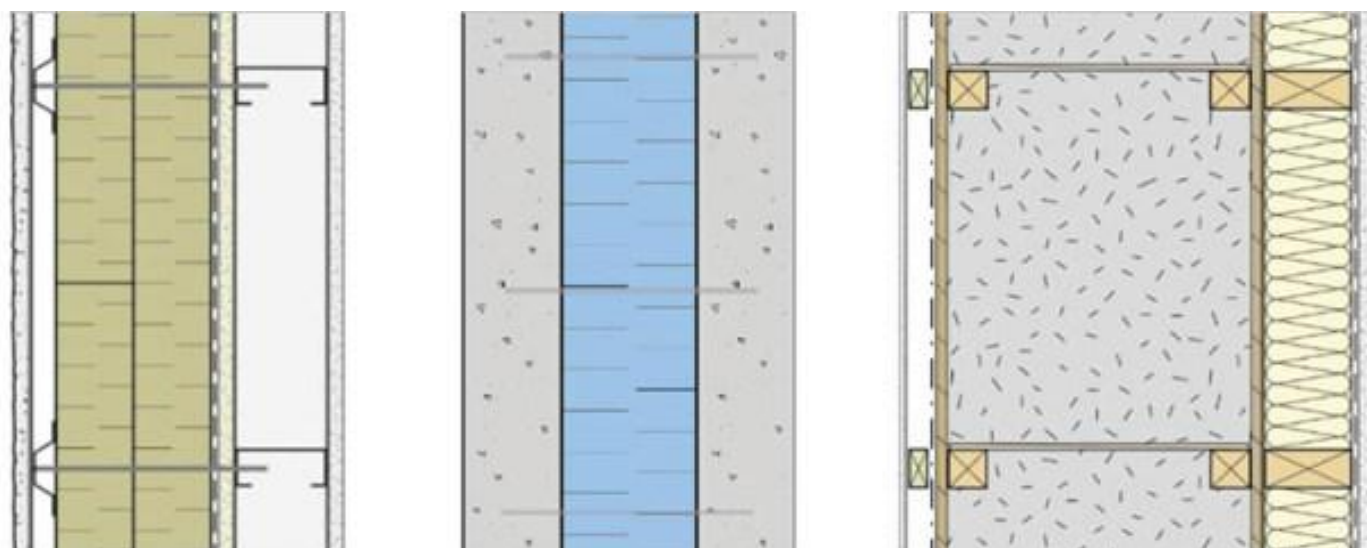
The building envelope is what separates the interior of the building from the exterior; it consists of outside walls, roofs, and floors. In cold climates like Canada, where inside air is heated to keep the building comfortable, some of that heat will be lost as it moves through the envelope (via the process of conduction). In order to reduce this heat loss, insulation made of low-conductivity materials is installed within the wall and roof assemblies.

Passive House makes the most of the envelope by super-insulating the building in order to minimize the heat loss. For a Passive House, the aim is to use assemblies with enough insulation to double or triple the heat resistance compared to what is required in current Canadian building codes. The result is a significant increase in the thermal performance expected from the building envelope. Insulating to Passive House levels has the added advantages of greater soundproofing, improved durability, and greater building resiliency—including the ability to maintain interior comfort for extended periods even if there is a power failure.

Achieving Passive House levels of heat resistance is not just about how much insulation you have, but whether that insulation is used effectively. Insulation is most effective when it wraps the building uninterrupted by other materials, but there will always be areas where this is not possible, such as around components used for structural reasons. When a material bypasses the insulation, it is known as a thermal bridge and can significantly reduce the effectiveness of insulation, especially if that material is very conductive, like metal.

Minimizing repeating thermal bridges and aiming for continuous insulation where possible, as in the assemblies shown in Figure 1, helps make the most of the insulation within the building envelope.

Figure 1. Example Building Assemblies



(left) Exterior insulated steel stud wall. (middle) Precast insulated sandwich panel. (right) Larsen truss wood-framed wall. (Courtesy of the Passive House Institute)

Airtight Construction

Heat can also be lost through the envelope via air leakage. A building's air barrier is a layer of material (membrane, tape, seals) around the envelope that restricts the movement of air in and out of the building. Gaps in the air barrier can allow air to move in and out of the building uncontrolled; they occur when there is insufficient detailing during construction, when there are numerous ducts or other penetrations in the air barrier, or when construction is of generally poor quality.

High volumes of uncontrolled air exchange with the exterior can lead to a whole host of problems, including increased energy use from having to repeatedly reheat the air, discomfort from cold air drafts near the walls, and localized moisture and condensation problems. While air exchange is necessary for ventilation and providing fresh air, it is far more effective to control air exchange by tightening the envelope and using mechanical ventilation.

There are strict design and construction requirements for a Passive House project to be certified airtight. Quantitatively, this means that when tested the building needs to have less than 0.6 air changes per hour (ACH50) to achieve Passive House certification. This stringent value can be compared to other high-performance building standards, such as the R2000 program, which allows up to 1.5 ACH50 from air leakage. As additional quality assurance for a Passive House project during construction, at least one on-site air leakage test must be completed to demonstrate that the building meets the airtightness requirements.

Achieving this degree of airtightness requires careful planning in the design stage, including making sure that the air barrier is continuous and evident on drawings, that effective air barrier materials are used, and that clear detailing for penetrations and terminations is provided. Construction quality with thorough quality control, from the contractor down to the trades, in the installation of the air barrier is critical. The entire construction team should be aware of the important role that airtightness plays in a Passive House project.

Airtight construction on a Passive House project will further reduce space-heating costs and localized condensation problems and will provide better comfort inside the building. In a Passive House building these advantages cannot be achieved by tightening the building envelope alone but must be coupled with a suitable ventilation strategy to deal with excess humidity in the building.

High-Performance Glazing

While the walls typically make up the largest area of a building's façade, the glazing systems (windows and glazed doors) can play an even bigger role when it comes to contributing to space-heating energy. Due to their function (providing light and visibility), glazing systems cannot be insulated to the same degree as a wall, resulting in the windows being the weakest areas of the envelope in terms of heat-flow resistance. Therefore, it is very important that high-performance glazing systems, such as Passive House-certified windows, are used to reduce that heat flow as much as possible.

Some key characteristics of a high-performance Passive House glazing system, as shown in Figure 2, include nonconductive framing or large thermal breaks; insulated framing; double- or more likely triple-glazed units; argon or krypton gas fill; multiple low-e coatings; and warm-edge or nonconductive spacers.

Figure 2. Example Features of a Passive House Window



Courtesy of Zola Thermo Plus Clad Window Profile

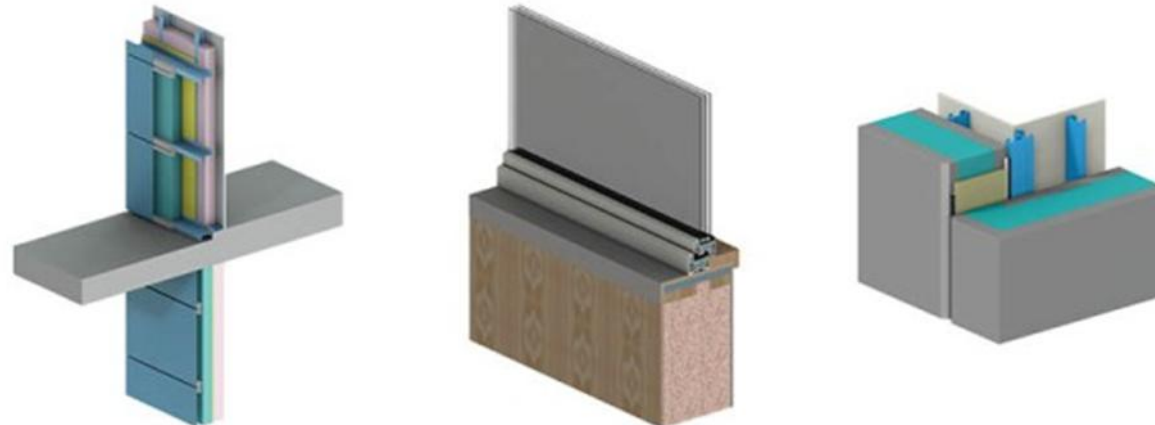
It is important not only to make sure to specify high-performance windows, but also to carefully consider how they are incorporated into the building design. Passive House designs take advantage of free passive heating from the sun. Solar heat gain through appropriately placed windows can help offset the amount of heat a building's needs during colder months. During the summer months, this needs to be counteracted with shading to prevent too much heat from the sun from getting into the building, causing overheating. For each Passive House project, there will be an ideal number of windows that can balance the advantage of free heat from the sun with minimizing the heat loss from having too many windows.

The final consideration for glazing systems is surface temperatures. When outside temperatures are low in winter months, the inside surface temperatures on low-performing windows can also be quite cold. Low temperatures around the window can result in a higher risk of condensation (and potential mould growth) and feeling colder when you are close to the window because of radiant heat loss or from temperature-induced drafts. To reduce these risks, certified windows must be assessed according to hygiene and comfort criteria that set minimum allowable surface temperatures around the window.

Thermal-Bridge-Free Detailing

The last envelope consideration is the minimization of thermal bridging. This was discussed earlier for repeating thermal bridges in the general wall and roof assemblies, but Passive House designs also aim to be thermal-bridge-free when it comes to architectural interface details. These are parts of the building where different architectural features meet that require additional attention in construction. Examples include how a window is attached to the walls, how a wall meets a balcony, and how walls meet at corners, as shown in Figure 3. The way these building features connect and are designed can also introduce thermal bridging that's not always easy to recognize.

Figure 3. Example building interface details



(left) Cantilevered balcony. (middle) Window sill transition. (right) Wall corner.
(Courtesy of Morrison Hershfield Ltd)

Thermal bridging from interface details can have numerous effects on building performance. For highly insulated envelopes like those in Passive House projects, thermal bridging can significantly reduce the benefits of super-insulating by allowing heat to flow around the insulation and out of the building, and can also create localized cold spots, increasing the risk of condensation and mould growth around these details.

The easiest way to avoid thermal bridging is by making architectural design changes (where possible), such as using self-supported decks and canopies for low-rise buildings or reducing the number of cantilevered balconies and articulating architecture (lots of corners) on larger buildings. This is not always realistic or achievable, and in these cases, special attention needs to be paid to these interfaces. Reducing direct conductive connections between the interior and exterior is important. Examples include installing intermittent connections for shelf angles, over-insulating in front of certain connections around the foundation, wrapping insulation around protruding details, or using special materials such as thermal breaks.

While it may not seem obvious, the thermal bridges caused by window-to-wall interfaces can have a very large impact. The total perimeter of all the window-to-wall connections can add up to several kilometres on some projects, so how a window is installed into an opening plays an important role in minimizing the heat flow. Reducing thermal bridging at this connection involves positioning the window to line up with the insulation layer, over-insulating in front of the frame, and minimizing how far closure flashings penetrate the rough opening while still maintaining adequate drainage paths. Eliminating or minimizing thermal bridging on Passive House projects helps ensure the effectiveness of the envelope performance in reducing space-heating energy use.

Heat Recovery Ventilation

Since Passive House projects are airtight, a ventilation system is needed to bring in fresh air and exhaust out built-up pollutants, odours, CO₂, and moisture. During winter, this means dumping out warm air and bringing in cooler air that needs to be heated up again, which increases the heating energy. A Passive House ventilation system uses a heat recovery ventilator (HRV) to continuously remove stale or moist air and deliver fresh air. During this process, it extracts heat from the exhaust air and puts it into the incoming air without directly mixing the airstreams together. This way, all the heat in the exhaust air is not completely lost to the outside. For a Passive House HRV, at least 75% of that heat needs to be recovered.

For warmer summer months, most Passive House-certified ventilation systems also feature a summer bypass damper that diverts air around the heat recovery core. That way the system can still bring in fresh air but doesn't recover heat when it's not needed.

In dry locations, like the prairies, buildings without humidification in winter can leave the interior spaces at low interior humidity (under 30% RH), which leads to discomfort, potential health issues, and damage to interior materials. In these cases, an energy recovery ventilator (ERV) can be used. Unlike HRVs, which only transfer heat, ERVs can also transfer moisture from the outgoing exhaust to help maintain more-comfortable moisture levels in interior spaces. Occupants can also utilize natural ventilation (using cool summer breezes) from opening windows to exchange stale air by nonmechanical means and are encouraged to do so when it makes sense. Passive House designs utilize both methods to keep ventilation energy to a minimum. While Passive House projects can still be fitted with a heating system (such as air source heat pumps,

electric baseboards, or boilers) having heat recovery in ventilation can greatly reduce the size, capacity, and maintenance needs of this equipment, shifting project costs from the mechanical systems to a superior building envelope.

(Summary)

The incredible year-round fresh indoor air quality and stable temperature, the substantial reduction in energy use and operating costs, and the quiet atmosphere that the Passive House standard delivers are directly attributable to these five principles and the way they are integrated into a Passive House building. By following a holistic approach with these five principles through the design and construction on any project, owners, designers, and builders can be confident that they can achieve a truly high-performance building.

Neil Norris, senior industry consultant, Passive House Canada

DESIGN PROCESS & CLIENTS' BRIEF

The clients design brief had very specific targets to be achieved in response to their own considered views relating to the current awareness of issues regarding Global Warming and the impact of poor consideration of token sustainability in development. They have been very clear that the 'Sustainability' of their new home must be 'Unequivocally Sustainable' and not to be a byword to be 'current and fashionable'. The brief acbuckley architectural was asked to work with has evolved throughout the design process and will continue to change and improve through the manufacturing and the on-site construction process.

The clients' 'Brief' included following requirements that needed to be met through the design of the new house;

- Design a Code 6 Zero Carbon or Passiv Haus low energy, zero carbon/carbon neutral home which must be itself energy efficient and constructed from sustainable materials.
- The house shall be completely off-grid and not rely on connection to the National Grid for the supply of electricity or natural gas energies/fuels but shall use new and sustainable energy production methods to heat, light and power the home and the family's energy needs.
- New sustainable energy requirements shall include (and not limited to),
 1. solar voltaic array panels
 2. Wind turbines
 3. Air source heat pumps/geothermal borehole/ground source heat pump technology/ies.
 4. Rainwater harvesting and recycling – for use in toilet cisterns – laundry/washing of clothes – automatic garden irrigation systems
 5. Heating, ventilation, and air conditioning (HVAC)
 6. Internal waterfall technology
 7. Solar gain
- The house shall include all necessary/applicable renewable energies
- The new house shall be sited on or as close to the North-West corner of the site adjacent the old barn and the proposed new stables are to be built.
- An energy efficient/low energy house shall be highly insulated and air-tight to meet Code 6 or Passiv House standards.
- Large windows and rooflights or sun pipes shall be used to create as much natural daylight so as not to rely on electric lighting. All lighting shall be low-energy LED throughout including all external lighting needs.
- Materials used in the sub-structure shall be locally sourced wherever possible.
- All exterior materials shall be locally sourced wherever possible.
- The overall design should be spacious and open, at the same time as keeping room/space separation to maintain privacy.
- The home is a family home and as such must cater for all the family's current and changing needs.
- This is to be a 'forever' home and should include for eventualities due to physical ability of the occupants.
- A large entertaining/family kitchen/breakfast/family room with large windows shall open seamlessly onto a paved terrace with no threshold between the areas.
- Sliding/folding doors must be folded out of sight if possible.
- Children's playroom with cinema facilities – TBA further
- An indoor swimming pool, gym, far-infra red sauna and changing rooms are to be provided.
- All bedrooms shall have built-in wardrobes and where possible walk-in wardrobes
- All bedrooms will have en-suite shower rooms.
- There will be only one bathroom – no baths are to be provided anywhere else.
- Master bedroom shall have a balcony with access through large sliding/folding doors.
- Balconies shall have toughened/laminated glazed balustrading.
- Home office
- Utility room
- Pantry/larder/dry food store
- Ground floor WC and coat hanging facilities within the entrance or in close proximity.
- Three car garage for electric vehicles
- Gardener's external WC.
- Dog washing shower and space for feeding.

Consider all the aspect of the design and needs associated with our use of the spaces to be created. It is not only about materials use, but our own carbon footprint, both the immediate and long-term impacts we have on the planet.

The brief requires a minimalist material palette be used to achieve an attractive, but robust exterior that will sit well within the local landscape, whilst enveloping a spacious and ergonomic layout, within the traditional design principles of compartmentation and separation of defined spaces, allowing us as a family, privacy throughout the home in which we will live day to day and when entertaining our family members or guests.

We require you, the designer to meet the challenges and this will no doubt mean evolving the design right up to the construction of the house. Internally, it is especially important that the house is as light and airy as is possible and as a part of your brief is that at all times you are conscious of the running and maintenance costs of the house throughout our lifetime, so consideration is paramount that the use of the materials and systems incorporated are very low maintenance and have a long-expected performance/life duration/cycles.

We will need provision for hybrid vehicle charging and eventually whole electric vehicle charging. Provisions shall be required for battery storage to store electrical energy generated from solar and wind sources.

Energy generation is required for lighting, to power things like IT equipment; fridges and freezers, a washing machine and tumble drier, electric pumps for power showers, the internal wellness waterfall, ground and air-source heat pumps – kitchen cooker hobs and ovens, the HVAC system, security equipment and smart-house technologies.

In order to achieve solar gains through thermal mass, the use of dark materials will be used to absorb the sun's energy for additional heating of the house during the cooler/colder months.

The house must sit low in relationship to the roadway and the grounds are to be heavily landscaped to provide hedgerow, trees, shrubs, and pools to promote wildlife biodiversity as we are opposed to the use of insecticides and prefer nature's own method of insect pest control through the natural food-chain of species.

In addition to this, the house itself must be future proof as is possible. This will mean demountable floor and ceiling panels will cover cable and pipeworks within zones that maybe concealing air ventilation and heating systems or ambient hidden lighting.

This house be an 'off-grid home' in relation to heating and energy supply, relying on technologies such as deep bore geothermal ground source heat pumps; solar array and vertical axis wind generators with power-wall storage technology; rainwater harvesting for greywater use within toilets and garden irrigation; sewage treatment plant and reed bed technologies; bore hole fresh water supply. The building must use high quality materials which reduce overall maintenance and are sustainably resourced, with long-life expectancy.

The layout must flow well and be open and spacious to ensure good mental and physical wellbeing of the occupants and their visitors.

To this end, acbuckley architectural hopes to demonstrate in this Design & Access Planning Statement that the Clients' Brief has been met and that mitigation for a sustainable building complies with planning policies, locally and nationally.

ENERGY & CO₂ EMISSIONS

Achieving 'Off-Grid' & Sustainable Energy Needs

To achieve the sustainable power and heating needs for the house and the occupants several technologies have been suggested in the Clients' Design Brief. Currently there are new products coming to the energy generation market every day. Technologies are moving at a pace as the Governments of the World determine new Zero Carbon initiatives and ever Greener Energy Generation targets. Sustainability of material resourced for use in the manufacture of equipment and products are equally important as all manufacturing contributes to climate change.

Off-shore and on-shore wind and tidal generation – solar and nuclear energy generation are systems gaining innovative momentum. The world knows how to make use of Mother Nature's freely available resources, but still, harnessing those resources come at a price to the environment. Billions of Pounds – Dollars and Euros are being invested into new research and development (R&D) of geothermal energy generation from heat being generated by the Earth's core. Countries like Iceland have been using the immense thermal heat resource to drive steam turbines to produce electricity, whilst using the geothermal availability of that same heat is used to warm and cool Icelandic homes, schools, hospital, commerce and industry.

Other countries are making the most of their available natural energy assets; sunny climates turn solar energy into electricity; mountainous regions which have heavy rainfalls are able to use gravity and direct captured water to produce hydro-electrical power and costal locations make good use of the winds coming off the seas - wind especially has seen many more impressive inventions being developed, from the Spanish Oscillating poles to the bladeless Halcium Power Pods being developed in Utah in the USA.

Solar technologies are improving power generation, producing evermore effective ways of producing power. With closed loop geothermal vertical deep bore technologies being combined with wind and solar it is possible now possible to meet the power needs required to go 'off-grid'

Battery storage will be crucial to store and release power during the night and dark-cloudy/rainy days when solar cannot deliver enough energy to meet demand. Incorporating wind turbines will produce energy on windy days, but again they cannot produce sufficient energy on still windless days and nights. However, with the low energy demands of the building itself, harnessing all these technologies, the designers of the house together with the other experts in each of these fields will achieve a landmark house by which will pave the way for others to follow in their path. It is possibly an experiment, but the technologies available have given the applicants the confidence to invest in them.

GEOTHERMAL & HEAT PUMP

Ambitious targets

The UK's Net Zero Strategy has set ambitious targets to chieve net-zero carbon emissions by 2050. In 2018, only 10.2% of its energy total energy came from renewable resources and for heat only 7.27% (REA, 2020).

Strong potential

Heat makes up 52% of the UK's energy consumption. With almost 80% of people in the UK living in an urban area, it is an ideal location for geothermal heat generation and supply.

The UK Department of Energy and the European Commission funded a two-phase programme between 1977 and 1984 to estimate the potential of the UK for geothermal energy. These studies were used by Downing et al to estimate the total amount of accessible geothermal energy stored in individual Permo-Triassic aquifer formations.

The analysis showed that the stored geothermal energy would provide sufficient energy to supply all of the UK's heating needs many times over.

Even though the total energy stored in the potential geothermal reservoir formation indicated cannot be entirely economically exploited, it represents a quantitative measure of the potential of geothermal reservoir formations in the UK.

In 2011, a report identified a number of locations throughout Britain that have both potential and existing geothermal resources. It found:

The UK has a potential heat output of 100GW of geothermal energy, up to 2.2GW of which could be developed by 2030. This represents about 15% of the UK's 2020 renewable heat target.

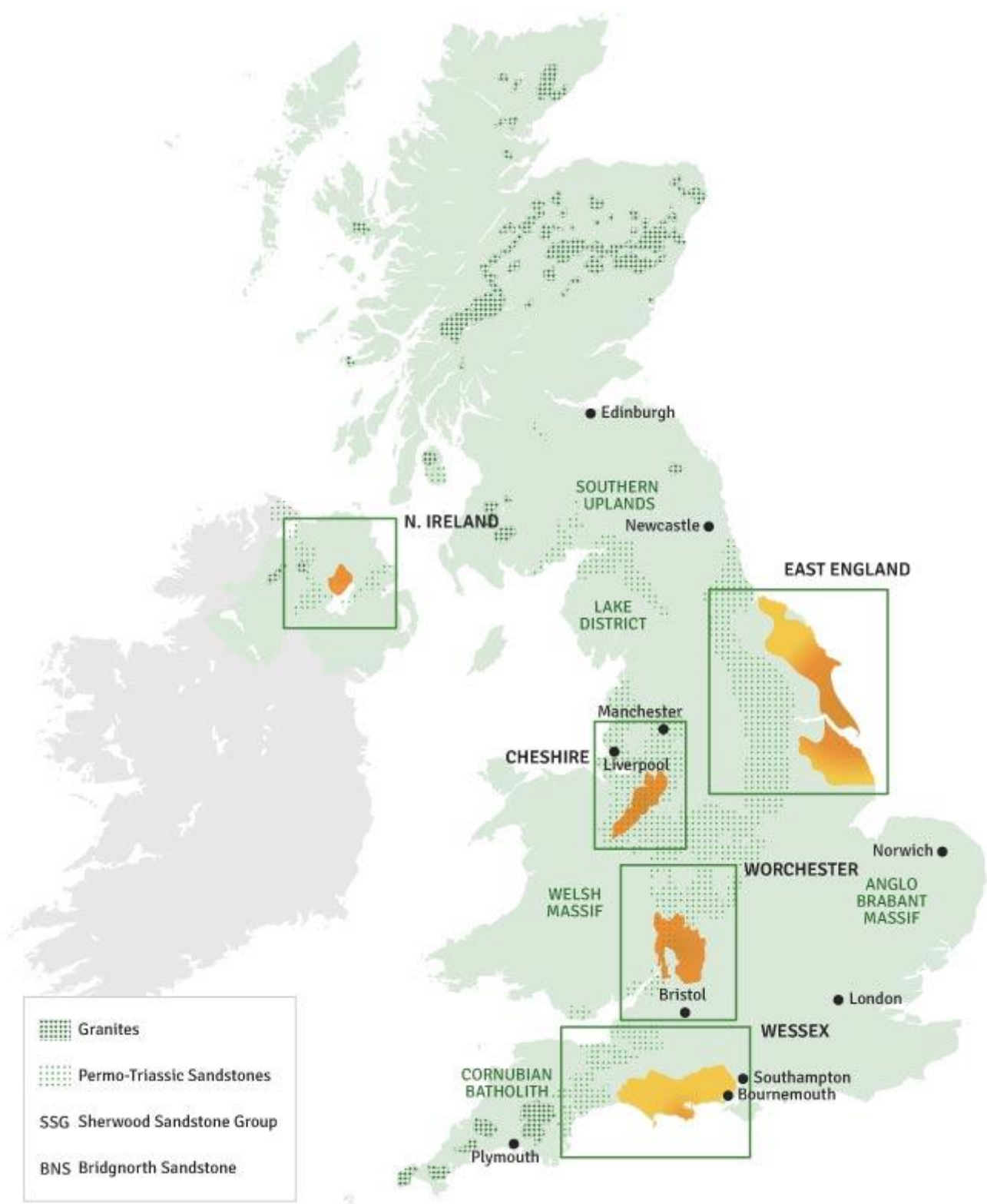
Renewable Heat Incentive

In 2011, the UK government introduced the Renewable Heat Initiative, the world’s first incentive for renewable heat. Anyone who installs a qualifying renewable heat system will be eligible for the initiative. A dedicated tariff for deep geothermal project was first established as part on the non-domestic RHI in 2011. The upcoming 3rd round of the RHI offers continued support for deep geothermal heat projects.

Job creation

The development of geothermal energy towards 2030 would require an investment of more than UK£3 billion. It would create thousands of jobs in construction, civil engineering, drilling, operation and maintenance, making the UK the global leader in geothermal heat development.

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© GT Energy – Energy for the future

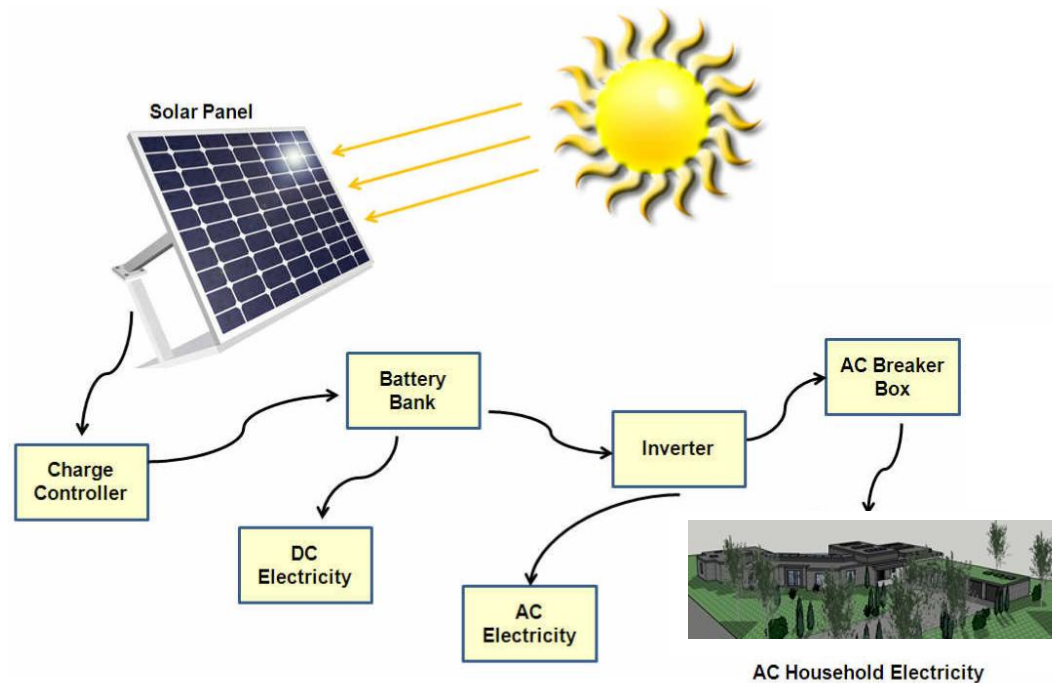
Deep-bore geothermal ground source closed loop systems offer the heating and cooling needs of the house and whilst the initial costs maybe high, the maintenance is low with typical heat pumps lasting more than 20 years. The infrastructure has a life span of up to 100 years.

The thermal ground source heat pump (GSHP) will provide sufficient hot water bathing/showering and the swimming pool. The space heating and cooling will also be provided from the GSHP through the HVAC system.

Geothermal heat generation has been used for over sixty years to heat and power homes throughout the world. There is research being done by a Canadian/European partnership which is proposing a mini-electricity generation system which is being trialled in a remote off-grid location in Indonesia which had been using diesel generators to provide power. The mini-geothermal generator is about the size of a shipping container and is producing electricity 24/7. Whilst ‘small scale’ geothermal electricity on a domestic scale is still in its early days, larger generators have been supplying multiple housing projects across the world for decades. There is little information available from the company at this stage in their development trials because of its commercial sensitivity, but they are confident that a small-scale domestic will be available within the next 2 to 5 years, this however does not provide a reliable energy source for this project, but will in due course.

PHOTO VOLTAIC SOLAR PANEL ELECTRICAL GENERATION

132 x 1.7m x 1.0m photo voltaic solar panels are required to meet the energy needs for the power and lighting of the proposed dwelling house. The energy produced will meet the expected needs, producing between 6.6kW & 33kW each throughout the year, allowing for all daylight and weather conditions during daytime hours. The proposal is to install the panels within the wildflower meadow with an inverter housing in close proximity to the panels.



Typical Solar Power System – Generation & Distribution Diagram

The power generated will be passed through to lithium-ion battery storage and drawn down by the house for its continuous power consumption. The siting of the battery storage shall be on the inner leaf of the Northern wall of the third garage of the utilities annex of the proposed dwelling house.



VERTICAL WIND TURBINE ELECTRICAL GENERATION

Savonius turbines have been gaining popularity. These wind turbines are simple drag-type devices that consist of two or three scoops. Due to their curvature, the scoops experience less drag when moving against the wind than moving with the wind, which makes it extract less wind power than other lift-type turbines of a similar size. However, they are cost-effective; will operate regardless of the wind’s direction; the blades within the turbine need no mechanisms to alter their angles, and they are more bird and bat friendly than the other conventional 3-bladed prop-type turbines.

Icewind CW100 & RW100

An Icelandic based company, Icewind produce two robust vertical axis wind turbines designed to withstand all weather conditions and to be installed in the most remote locations. The model most suitable for the house is the CW100 model which they claim requires little to no maintenance over its designed 25 year lifetime. It will start to produce energy at wind speeds as low as 2 m/s and tested to withstand

windspeeds of 60 m/s (130 mph) and generate up to 600 watts. It is omni-directional; reliable; self-sufficient and the makers claim that it is a “set and forget” installation. These units stand 1.5-meters and have a low visual impact. The RW100 is an industrial grade version and is designed to be attached to commercial towers.



The benefit of having the vertical wind turbines allows the application to harness wind that maybe available during the winter season when solar energy generation may be limited by the shorter days and lower levels of available sunshine and especially at night when the solar panels will not be operable.

Halcium PowerPod

The Utah based company Halcium has studied the vertical vortex principles of the wind turbines and those of the more common tri-blade prop horizontal wind turbine; whilst the latter tends to produce higher levels of electricity when they are acting at their optimum, the draw backs are numerous; tall structural pylons – distance between turbines – mechanisms to ensure that they are facing into prevailing winds – dangerous and harmful to bats and bird and very visible in the landscape are some of their perceived and real disadvantages. They are costly and require regular maintenance which don't help their credentials as being efficient or cost-effective in the long-term.

In areas where wind average speeds can be low, regular wind turbines get just enough wind to start moving, but generate hardly any electricity. What a PowerPod does is accelerates the wind speed itself, so that more power is created, more often. The pod takes air and funnels it into a smaller exit than in a normal turbine, which speeds it up before it hits the internal blade. Wind can enter from multiple directions at all once, something which can often cause regular turbines to shatter. Increasing wind speed also reduces the need to put PowerPods on tall poles, which are expensive to mount and take up a lot of space. “They are also ugly, in our opinion,” says Hodges.

Consumers can use a PowerPod by itself, hooking it up to a power system the same way as solar panels, with the same equipment. Or, if you already have a solar system, it can connect seamlessly and provide an additional, diversified source of power.

The blade is contained entirely within the shell, meaning it's **safe to have around children**, pets and wildlife.

Hodges has created a map showing the average daily power generated from a 1kW PowerPod, vs a 1kW solar system in different cities around the world. It shows that PowerPods have the potential to produce equal or greater power than their more expensive solar counterparts.

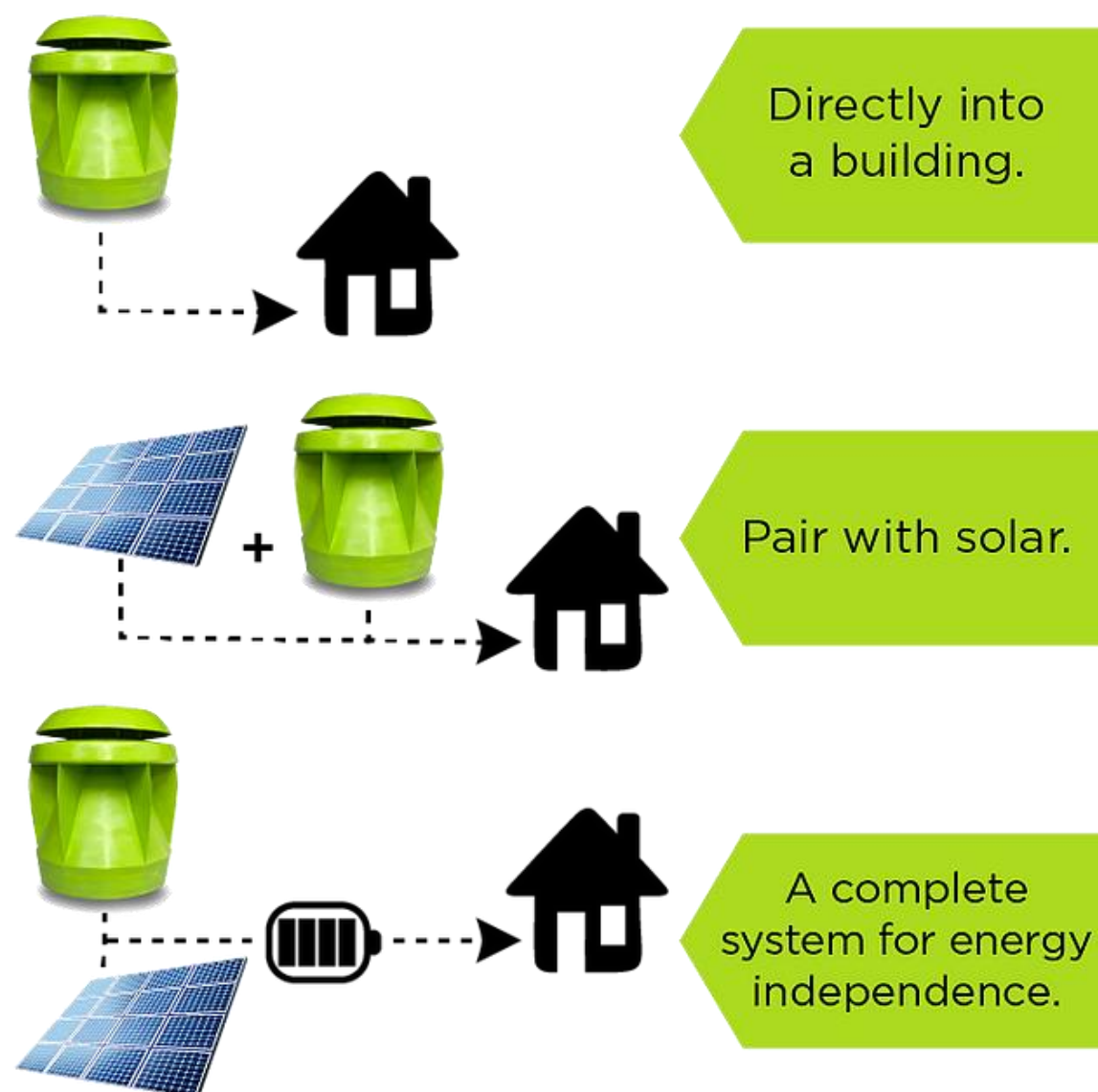
The PowerPod is a prototype small-scale wind turbine designed specifically to work in towns and cities. Its design is intended to collect incoming air from 360 degrees and focuses it into an internal blade. The effect is safe wind energy specifically for cities and towns. The PowerPod is still in its very early stages of development and is still yet to hit proof of concept. With no External Moving Parts the airflow is



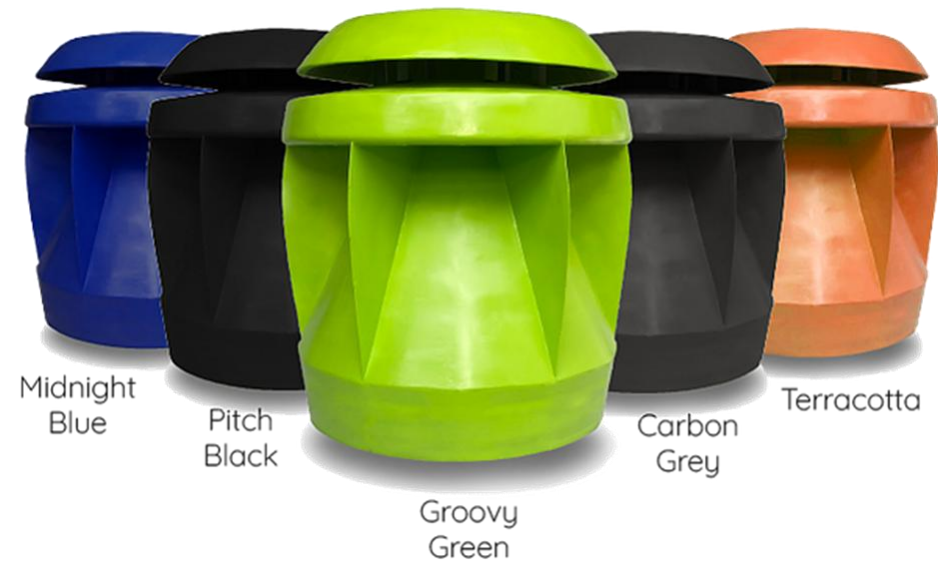
intended to be collected by the exterior of the pod and focused on a circular blade. The blade is contained entirely within the pod, making it safe for nearby people and wildlife. Showing internal blade spinning in red area from graphic above. The external shell does not move - it is fixed in place. Because of its shape, it can take wind from any direction, changing directions, or even multiple directions at once. When regular turbines are in such conditions they can shatter - throwing blades at high speeds.

Standalone or Part of a System

PowerPod's intent is to give a viable wind energy option to those looking for a complete renewable energy system in cities and towns, or those who are unsatisfied with open bladed designs. The alternator inside can hook into a building's power grid with the same equipment needed for any other wind turbine. It can also be added to a solar and/or energy storage system with the same equipment used to integrate other wind/solar/storage systems.



The PowerPod is a great addition to an off-grid, energy independent system to diversify away from reliance on sunny days.



A Global Solution

The PowerPod is not yet in manufacturing as it is still a concept and not a market-ready product. However, once in production our goal is to produce PowerPods locally, with local manufacturing and materials, wherever possible. European PowerPods will be made in the EU, American PowerPods will be made in the USA, Indian PowerPods in India, and so on. Our goal is to use the PowerPod to support the local markets and jobs of the people who are using them to help us make the world a better place.

Still In Development

The PowerPod is still in development, and we have not yet reached minimum viable product. Our team is raising funds to continue research into the PowerPod's viability as a small-scale wind turbine. Our plan is to start with a comprehensive analysis done by our technical adviser, Dr. Meredith Metzger of the University of Utah's engineering department.

© Halcium Energy Inc. · Salt Lake City, UT USA



Source Halcium Power Pod Global Map

WATER

Off-Grid Hybrid Passive Haus Designed Dwelling House for Mr & Mrs Cordy
Bosworth Road – Wellsborough – Nuneaton – CV13 6PA
RENEWABLE ENERGY & SUSTAINABILITY STATEMENT

Drinking Water

The basic need for water will be achieved from a bore hole which will be sunk in the north-western corner of the site and will be filtered through a water purification system for use as drinking water and made available for washing.

Grey Water

The water used in UK homes is clean drinking water (known as potable water), which generally comes in through the mains and exits through the sewer. Fifty to eighty per cent of a household's wastewater comes from baths, showers, washing machines, sinks and dishwashers. This is referred to as grey water.

Grey water is never safe to drink, even when treated. However, recycled water may be used to flush toilets, wash clothes and water your garden.

It's called grey water because usually, it has had no contact with human waste, unlike toilet water, which is known as black water. This makes greywater easier to treat and recycle. There is no faecal matter involved which contains harmful bacteria and disease-causing pathogens.

If greywater is recycled properly, it can save approximately 70 litres of water per person per day in domestic households. Therefore, greywater recycling systems are one of the best ways to decrease water usage.

It's important to reduce the amount of clean drinking water used typically for all the things that don't need fresh drinking water. Instead, we can use treated grey water, reducing the clean water for drinking, washing and cooking food and dishes.

Grey water systems filter water that has already passed through the sink, dishwasher, washing machine, hand basins, bath or showers, removing dangerous bacteria so it's safe to reuse. There are various different systems you can use to treat grey water, and they vary in complexity. Once treated, the water is linked back to the desired appliances for use, thus saving the drinking water.

© OMDI Gareth Wood 2018

Sewage Treatment

A sewage treatment plant processes your wastewater and sewage independently of the public water mains. Using an environmentally friendly process, it produces purified water that is clean enough to be discharged directly into a stream or ditch. It is deemed to be the solution for this new property which is located a long distance from the nearest sewer. Sewage treatment plants often require electricity to operate and will also need regular servicing and emptying.

A sewage treatment plant operates by circulating air to encourage the growth of naturally occurring bacteria that breaks down sewage. The goal is to deliver a cleaner effluent that is kinder to the environment. The process itself involves removing any harmful contaminants before discharging non-polluting wastewater into a nearby stream or river without posing a threat to fish or plant life living in the surrounding area.

Here are five key benefits from having a dedicated sewage treatment plant.

- Minimal odour – modern sewage treatment plants give off very little odour.
- No sewage bills – using the public sewers incurs regular bills. Having your own independent wastewater treatment plant will save you from having to pay to send your wastewater into already overstretched public sewers.
- Little maintenance required – once your sewage treatment plant has been installed it will need little looking after to keep it ticking over. Sludge may need to be removed roughly every two years, and it's advisable to have the system serviced often.
- Reuse and recycle – once the wastewater has been treated, the environmentally-safe product can be reused or released back into the environment. Many people are now also using sludge produced by sewage treatment plants as a source of green energy.
- Environmentally-friendly – sewage treatment plants use natural processes to filter contaminants and produce clean, non-polluting effluent that can then be released directly into a stream or ditch.

The choice of sewage treatment plants is wide, but to enable this new home to further enhance the sustainability, it is important that it should also be a treatment plant that has the largest capacity and uses no electricity and requires the lowest maintenance. The favoured system that fits the criteria for this application is specifically ClearFox Nature (non-electric).

The manufacturers claim that their product is **"The only non-electric treatment plant that will not require replacement parts or media throughout its lifetime.*"** and is available in 4; 8; 16; 24; & 32 person capacities with a gravity outlet.

**Certified by EN-12566-3, SR66, British Water, UK2020 Septic Tank Upgrade Regulations, CE marked*

The ClearFox Nature is the only non-electric domestic sewage treatment plant on the market that never requires any replacement parts or media throughout its lifetime. It is a sustainable and eco-friendly treatment plant, using only natural ventilation and naturally occurring bacteria to effectively process domestic wastewater. For homeowners, the yearly savings are significant with no electricity costs, no media or parts and no specialist maintenance requirements. This meets the requirements of the Clients' Design Brief.

The modular (expandable) design of the ClearFox Nature means that it is suitable for both domestic and commercial applications. It features a gravity outlet and is suitable for installation in most soil conditions. The installation process is quick and easy without the need to connect the tank to a power supply. The ClearFox Nature features a flat base, single piece watertight tank made with reinforced HDPE that does not require concrete backfill on most sites. Again, the less concrete used to deliver the finished house, further reduces the Carbon Footprint.

The ClearFox Nature holds a CE declaration independent test certificate, meets EN12566-3 and SR66 standards and is approved by British Water. They can therefore guarantee the quality of this non-electric domestic sewage treatment plant.

Benefits of Non-Electric Sewage Treatment Plant

- Uses natural ventilation and naturally occurring bacteria to process domestic wastewater to excellent standards.
- No daily operational costs, the ClearFox Nature does not require electricity to operate.
- No wearing parts or media inside for trouble free operation and maintenance.
- Significant yearly savings for end-users.
- Modular (expandable) design suitable for both domestic and commercial applications.
- Fast installation with no connection to power supply.
- Steel reinforced flat base tank does not require concrete backfill on most sites.
- No noise, no odour

Most domestic wastewater treatment plants use small air compressors to aerate the wastewater in order to provide the bacteria with sufficient oxygen. However, the ClearFox Nature uses natural ventilation through a 1m high vent stack to draw fresh air into the tank. This does not require electricity.

Raw domestic sewage enters the first tank or primary chamber through the inlet pipe. Large solids settle and compact at the bottom of the chamber. Any fat, oil or grease in the wastewater floats to the top of the water column to form a scum layer. All floating material and solids remain in the primary chamber, this allows for longer desludging intervals. This completes the primary treatment.

The primary cleaned wastewater flows by gravity into the second tank, the reactor chamber. The plastic media in the bioreactor has a very high surface area. A tipping plate spreads the effluent evenly over the entire media surface. Naturally occurring bacteria colonise the media and feed on the nutrients and organic material in the incoming wastewater. It is the action of the bacteria that cleans the domestic wastewater to a very high standard before it exits the treatment plant.

Sludge accumulates inside the primary chamber of the ClearFox Nature which has a total capacity of 3,500l. Like all treatment plants, the sludge shall be removed on a regular basis by a professional sewage disposal company who will pump it out and take it away for disposal. This is the most prudent way to tackle the sludge in this domestic wastewater treatment system.

A fully detailed grey water: sewage and run-off water solutions will be designed as part of the construction detailing of the house by the nominated designers

Run-off Water

Run-off water is not likely to be an issue in terms of its disbursement, however rainwater is a valuable resource and will be harvested. Rainwater harvesting has been integral to this scheme from the very start of the design process, to use this water, filtered and cleaned for the initial use of toilet cistern flushing and external washing/jet washing of vehicles, terraced areas and irrigation for the garden during seasonal dry spells.

MATERIALS

From the outset, the choice of materials was an important consideration to reflect the right aesthetics of the finished building. Their sustainability and local availability all played a part in the finished house design. The materials and finishes chosen are as follows.

- Rough cut grey random stonework – this is a sustainable resource available locally from quarries within Leicestershire
- RAL 7016 coloured powder-coated steel standing seam vertical cladding – an available material which will provide additional insulation and is easy to install, reducing other labour intense construction methods/materials with higher Carbon footprints
- Sto-Render R (Rilled textured finish) in white acrylic – this a colour impregnated textured application which is self-cleaning and is low maintenance and longevity.
- Ibstock Dark Atlas Grey facing brickwork – hardy facing bricks produced locally requiring no maintenance to the north-west and north-east elevations.
- Aluminium powder-coated high performance triple glazed windows and doors – excellent thermal credentials (see appendix F)
- Insulated closed panel timber frame constructed inner-leaf with insulated warm-deck timber roof with single ply membrane



Natural Rough Stone



Powder-Coated Steel Standing Seam Vertical Cladding



Sto-Render R



The Ibstock Atlas Dark Grey brick I one of three new products, manufactured at the Atlas factory in Walsall, designed to meet growing demand from homeowners and architects for dramatic and unique finishes. Offering a cooler pallet, and smooth, contemporary texture will add a distinct finish to the property. This brick will be used in the garage & utilities single storey annex and throughout as 4 no. layers for the damp proof external perimeter course work. It is classed as smooth facing brick and has stock availability

WASTE

Using a timber frame, insulated closed panel construction methods reduces site waste during construction to a minimum. Most manufacturers claim that they are able to recycle up to 99% of their factory generated waste. The use of prefabricated concrete formwork panels to the lower-ground floor abutment with the excavated groundworks, will ensure a continuous watertightness which will further reduce the site created waste from timber shuttering formwork and ready-mixed concrete deliveries – the need for disposal of such formwork is negated to the factory where recycling will be an integral part of the manufacturing process.

Provisions will be made for the separation of waste generated and where possible recycled. We aim to recycle up to 80% of site waste. This is to be monitored not so much for specific environmental issues, but to faithfully record actual real site waste which will become a part of the clients'-built record as well as budget spending, design changes/improvements and costs for the finished decorated habitable shell.

HEALTH & WELL-BEING

Insulation

Positive up-cycling of shredded cotton/denim clothing and sheep's wool are eco-friendly alternatives to formaldehyde laden insulants used throughout the construction industry to keep the cold out and the warmth in . When compacted into wall voids, they offer superb levels of insulation which do not off-gas and cause new-home syndrome which has been known to affect young children and those who are sensitive, often causing nausea, respiratory problems, headaches and vision disturbance.

- Sheep's Wool - is fire retardant. The material can keep a home warm the same way it helps sheep survive frigid temperatures. In recent years, scientists have learned how to apply the insulating properties of sheep's wool to home construction. The compressed wool fibres form millions of tiny air pockets; the outer layer is resistant to water while the inner layer absorbs moisture. This helps it generate heat while preventing condensation and it keeps homes warm in the winter and cool in the summer.
- Cotton/Denim - because cotton is a natural and renewable resource, it is one of the most eco-friendly insulation options on the market. Leftover blue jean scraps are shredded and recycled into thick batts that fit into walls just like fiberglass. To make it safe for humans as well as the environment, companies treat the cotton with a borate solution, so the insulation isn't flammable. Cotton is also a natural insect repellent, doesn't contain formaldehyde and doesn't cause respiratory problems. However, compared to fiberglass, it is incredibly expensive, costing nearly twice as much.
- Icynene – is one of the strongest home insulation alternatives. It is a spray foam made out of castor oil that expands about 100 times its volume when sprayed into a wall or ceiling void. Not only does it seal leaks and drafts, but it also cancels noise. During the foaming process, Icynene traps in tiny air bubbles, and when the foam cures, the air remains in place. That is why the insulation works so well. However, the sealing powers of Icynene are so strong, it is essential that a full-house HVAC system is installed to provide ventilation. sy Because of the additional requirements, upfront costs associated with installing Icynene can be expensive. However, it will reduce energy bill so drastically, in the long run, it will save money.
- Polystyrene – at first glance, it may not seem a green option, however polystyrene is considered to because it helps save an enormous amount of energy. Polystyrene is a plastic that comes in two forms: rigid foam boards that will add structural integrity to walls and a spray foam.
- Aerogel - is a man-made material containing 90 percent air, but it is difficult for heat to pass through it, making it excellent for insulation. The legend has it that Samuel Stephens Kistler invented aerogel in 1931 after making a bet with a friend. Kesler bet that he could replace the liquid in a jelly jar without causing the jelly to shrink, and he won by removing the liquid and replacing it with air. This led to aerogel, which is made by removing the liquid from silica under high pressure and temperature. Aerogel is ultra-lightweight and comes in sheets or stickers for easy installation. It is however the most expensive out of the products above.

Air-circulation – Heating & Cooling

Feeling comfortable throughout the year and inside the home, maintaining a constant temperature helps keep occupants healthy, both physically and mentally. Clean and fresh air circulation give real benefits and a 'whole house' Heating & Ventilation Air Conditioning/Circulation (HVAC) system fitted with heat exchangers and hep-filters ensures good air circulation removing air-borne contaminants, viruses and pollutants from the air within.

Internal Waterfall

Having waterfalls indoor sounds like an amazing idea. It's one of those things that can help you get past all the challenges in a day and just enjoy life for a day. More than 30 million homes in the US alone are dealing with some sort of health issues, stress and anxiety. Even simple things like lead or mould and mildew can end up bringing on respiratory problems. Which is why it makes a lot of sense to install a Water Wall or even an Indoor Waterfall if possible.

One of the major benefits provided by Indoor Waterfalls is the fact that they help one calm down and unwind. The fact that when a person is close to water, it helps them become a more tranquil person. Challenges and demanding situations just go away and people get to enjoy life for what it is. Which helps the body releases serotonin making people feel a lot happier.



One of the challenges in a home is keeping a proper airflow. If you have mould or any other similar compounds, the air quality will not be at its best. The Indoor Waterfall boosts the air quality naturally because it helps control the release of positive ions from electronics. Rushing water helps prevent that, meaning the promotion of negative ions caused by having humidity in the air, making it easier to unwind and feel better. It purifies the air, meaning that the occupants benefit from a sense of clarity and wellbeing that's really hard to receive from anywhere else.

Waterfalls also helps boost good sleep patterns making a positive impact on life. Staying healthy and improving wellbeing is much simpler with an indoor waterfall.

Physical Health & Fitness

The house has been designed to include an indoor swimming pool, gym, far-infra red sauna and games room for physical fitness and well being, enabling the occupiers to keep their health at its optimum.

Personal Space

To achieve Code 6, personal space is important. The house offers many 'personal space' areas – a children's playroom/cinema – library – snug – sitting room and bedrooms. The grounds extend to over 2 hectares and will be landscaped with semi-mature trees being brought in by specialist nurseries to quickly establish an advanced landscape. The grounds will be sub-divided into out-door areas for recreation – relaxation – sports and games and horse riding. It is hoped to encourage more wildlife into the development to enhance the feeling of being one with nature.

MANAGEMENT

Smart technology will enable the seamless control of power generation, storage and distribution from the renewable resources which are an integral part of the management and running of the house' heating and cooling; air-circulation; lighting and power. It will control the home security cameras and intruder alarms and access control, fire and smoke alarm detection.

The keeping of records from the 'spade in the ground' so to speak, will ensure that fully detailed management protocols are put in place to ensure routines are established at the outset. Cleaning of concealed rainwater gutters and internal storm pipes – water harvesting and levels – filtration and cleaning and changing of filtration systems. Cleaning of solar panels – emptying of sewage treatment plant (de-sludging).

Management of the whole house and the gardens and machinery/apparatus/tools/implements need to be maintained and timing will need to be appropriate and planned.

ECOLOGY

The new house is to be located in open countryside and as such it has extensive hedgerows with an array of diverse animal and insect species. It is the applicants' wish to sub-divide the site into smaller fields, using timber post and rail fencing and the planting of semi-mature trees brought in from specialist tree nurseries to give the site height and advance the appearance of an establish landscape.

Wildflower meadow will be in the southeast area of the site. This will have a pond created to encourage reptiles, insects and in particular birds. The installation of bat and bird boxes strategically positioned around the property will it is hoped to encourage other species to set up home and add to the diversity.

Landscaping will play a very important role in the success of the re-wilding of the environment. To this end, a fully detailed landscaping design and management plan will be implements throughout the development of the house so that the two elements are completed at the same time and compliment each other and begin to offer wildlife new opportunities to set up home as soon as is possible.

Summary

Wikipedia defines the word 'Sustainability' as;

Sustainability is the capacity to endure in a relatively ongoing way across various domains of life.[1] In the 21st century, it refers generally to the capacity for Earth's biosphere and human civilization to co-exist. For many in the field, sustainability is defined through the interconnected domains of environment, economy and society,[2] although efforts to extend its domains to other areas of human endeavours also exist.[3][4] Sustainable development, for example, is often discussed through the domains of culture, technology and politics.[5][6]

According to Our Common Future (Brundtland Report), sustainable development is defined as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs."[7][8]

Moving towards sustainability can involve social challenges that entail international and national law, urban planning and transport, supply-chain management, local and individual lifestyles and ethical consumerism. Ways of living more sustainably can take many forms, such as:

reorganizing living conditions (e.g., ecovillages, eco-municipalities, and sustainable cities) reappraising economic sectors (permaculture, green building, sustainable agriculture) or work practices (sustainable architecture) using science to develop new technologies (green technologies, appropriate technologies, renewable energy and sustainable fission and fusion power) designing systems in a flexible and reversible manner[9][10] adjusting individual lifestyles to conserve natural resources[11]

Despite the increased popularity of the use of the term "sustainability",[12] the possibility that human societies will achieve environmental sustainability has been, and continues to be, questioned—in light of environmental degradation, biodiversity loss, climate change, overconsumption, population growth and societies' pursuit of unlimited economic growth in a closed system.[13][14]

Definitions;

Originally, "sustainability" meant making only such use of natural, renewable resources that people could continue to rely on their yields in the long term.[15][16] The concept of sustainability, or Nachhaltigkeit in German, can be traced back to Hans Carl von Carlowitz (1645–1714), and was applied to forestry.[17] However, the idea itself goes back to times immemorial, as communities have always worried about the capacity of their environment to sustain them in the long term. Many ancient cultures had traditions restricting the use of natural resources.[18]

Modern use of the term "sustainability" really begins with the UN Commission on Environment and Development, also known as the Brundtland Commission, set up in 1983. According to Our Common Future (also known as the "Brundtland Report"), sustainable development is defined as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs."[7][8] Sustainable development may be the organizing principle of sustainability, yet others may view the two terms as paradoxical (seeing development as inherently unsustainable).[19][20][21]

Three dimensions of sustainability;

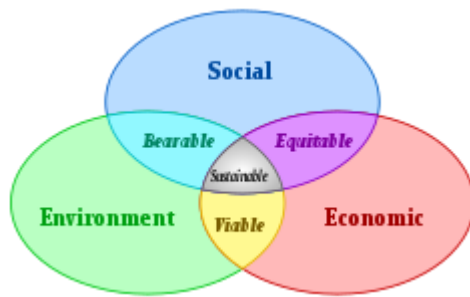
A diagram indicating the relationship between the "three pillars of sustainability", in which both economy and society are constrained by environmental limits[22]

A different view of sustainability emerged in the 1990s. Here, sustainability is not seen in terms of confronting human aspirations for increased wellbeing with the limitations imposed by the environment, but rather as a systems view of these aspirations, incorporating environmental concerns.[23] Under this conception, sustainability is defined through the following interconnected domains or pillars: environmental, economic and social.[2] In crude versions of this view (also termed the 'triple bottom line'), the three dimensions are equivalent, and the aim is to achieve a balance between them.[24] More sophisticated versions recognize that the economic dimension is subsumed under the social one (i.e., the economy is part of society), and that the environmental dimension constrains both the social and the economic one.[4] In fact, the three pillars are interdependent, and in the long run, none can exist without the others.[25]

The 2005 World Summit on Social Development identified sustainable development goals (SDGs), such as economic development, social development, and environmental protection.[26] This view can be expressed as a "wedding-cake" model, in which each of the 17 SDGs is assigned to one of the three dimensions.[27]

The three pillars have served as a common ground for numerous sustainability standards and certification systems, in particular in the food industry.[28][29] Standards which today explicitly refer to the triple bottom line include Rainforest Alliance, Fairtrade, UTZ Certified, and GLOBALG.A.P.[30][31] Sustainability standards are used in global supply chains in various sectors and industries such as agriculture, mining,

forestry, and fisheries. Based on the ITC Standards, the most frequently covered products are agricultural products, followed by processed food.[32][33]



Venn diagram of sustainable development:
at the confluence of three constituent parts[34]

A study from 2005 pointed out that environmental justice is as important as sustainable development.[35] Ecological economist Herman Daly asked, "what use is a sawmill without a forest?"[36] From this perspective, the economy is a subsystem of human society, which is itself a subsystem of the biosphere, and a gain in one sector is a loss in another.[37] This perspective led to the nested circles' figure (above) of 'economics' inside 'society' inside the 'environment'.

Thus, the simple definition of sustainability as something that may constrain development has been expanded to incorporate improving the quality of human life. This conveys the idea of sustainability having quantifiable limits. On the other hand, sustainability is also a call to action, a task in progress or "journey" and therefore a political process, so some definitions set out common goals and values.[38] The Earth Charter[39] speaks of "a sustainable global society founded on respect for nature, universal human rights, economic justice, and a culture of peace". This suggests a more complex image of sustainability, which includes the domain of politics.

More than that, sustainability implies responsible and proactive decision-making and innovation that minimizes negative impact and maintains a balance between ecological resilience, economic prosperity, political justice and cultural vibrancy to ensure a desirable planet for all species now and in the future.[6] Specific fields of sustainability include, sustainable agriculture, sustainable architecture or ecological economics.[40] Understanding sustainable development is important but without clear targets, it remains an unfocused term like "liberty" or "justice".[41] It has also been described as a "dialogue of values that challenge the sociology of development".[42]

We have demonstrated that by virtue of the design of the building and consideration of the proposed materials and building form within an enhanced bio-diverse landscape, that the new dwelling house will meet the requirement for sustainability and prove to be a house of exceptional architectural quality and design.

Appendix A
Appendix B
Appendix C
Appendix E
Appendix F

Bibliography

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