Ditton Mill House
Cleobury Mortimer
Shropshire
DY14 0DH
01299 270011
www.energyzone.co.uk
sales@energyzone.co.uk

Project Reference:
Virginia Sweetingham C/O Seymour-Smith Architects
Proposed new paragraph 79 Dwelling
Oxpens
Wigginton

Concepts for Heating, Power and Ventilation from EnergyZone

Our design concept for this property is to start with a detailed calculation as to the total energy requirements of a building located here.

The energy demands will be for the following:

- Space Heating
- Heating of Domestic Hot Water (DHW)
- Electricity for Domestic usage
- Electricity for transport / electric cars (EVs)

There will also be Solar gain in the building which will be minimised by design but also can be recovered and put to good use. Finally, we will also look at the ventilation losses and design a solution to minimise these.

Once we have established the overall energy balance we will look at how we can best harness sustainable energy sources from the surrounding area so that the building has zero carbon energy demand with minimal impact on the local environment.

We will treat the buildings as one requiring an overall energy solution and produce a carbon balance calculation for the system designed for this property.

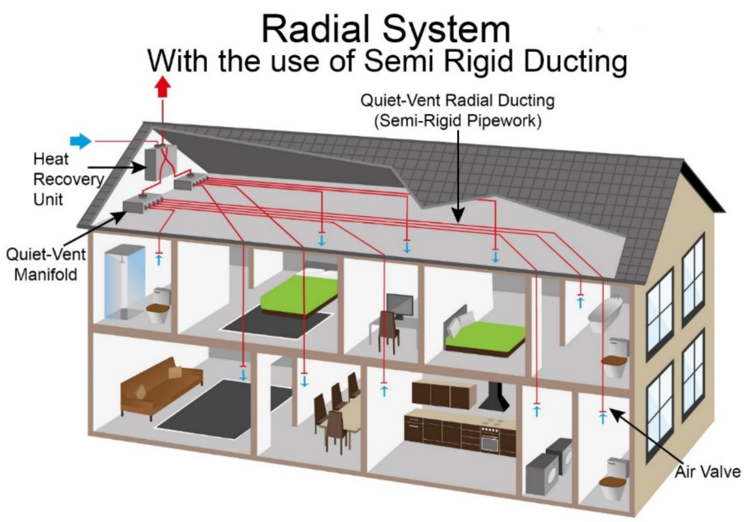
Ditton Mill House
Cleobury Mortimer
Shropshire
DY14 0DH
01299 270011
www.energyzone.co.uk
sales@energyzone.co.uk

Energy Demands

Heat & Ventilation

The Architectural design of the building will minimise both the heat losses and unwanted heat gains through detailing, choice of materials and aspect. We have designed an integrated Mechanical Ventilation system with Heat Recovery (MVHR) with both Passive Cooling and Boost Heat Capacity. There will be 3-separate MVHR units which will minimise the duct lengths and sizes, minimise the noise and power required overall for the ventilation. For each area that has the potential to over-heat we will include a cooler battery.

These batteries effectively take heat from the air as it passes through the duct reducing the temperature by around 5 - 7°c, they are not the same as air conditioning as they take very little energy to run (<30W) and the resultant heat they collect will be stored in the Source Energy Store (SES, see Thermal Battery below). Each MVHR unit will work from a humidistat so that it will only increase the ventilation rate when the humidity in the building starts to rise. This automatic control eliminates the need for booster switches and manual overrides and ensures that the MVHR unit runs at the minimum level and always must. In addition to the humidistat, when the system senses the need for additional cooling then it will increase the fan speed accordingly to capture the available heat. Combining the MVHR solution with a cooler battery connected to a Source Energy Store (SES) provides another level of heat recovery beyond that of normal ventilation systems.



With the Heat Recovery Ventilation system described:

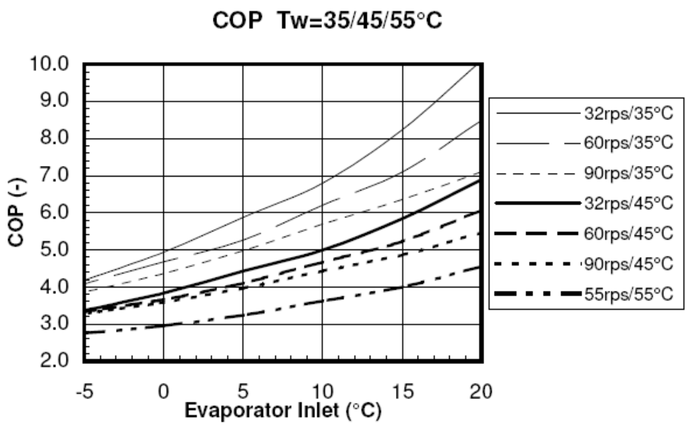
- The peak heat demand for these buildings is 22 Kw
- Total energy demand for the year of 42,000 kWh
- DHW demand is estimated to be 5kW with an annual energy demand of 5000 kWh

Ditton Mill House
Cleobury Mortimer
Shropshire
DY14 0DH
01299 270011
www.energyzone.co.uk
sales@energyzone.co.uk

Heating System

Innovative Multisource Heat Pump

A heat pump is a machine that can 'pump' heat from the source to supply a heat distribution system. They all use some amount of electricity to run the compressors and pumps to achieve the increase in temperature from source to supply. The bigger the temperature difference required from source to supply, the more electricity is required, so the higher the source temperature, and the lower the supply temperature the less electricity the heat pump will consume, equating to a better the efficiency. Efficiency is measured as Coefficient of Performance or 'COP'. The graph below shows the relationship between the source temperature (Evaporator) and different supply temperatures of 35^0, 45^0 and 55^0c. For example, an Air Source Heat Pump with an outside temperature of 0^0c heating to a source temperature of 45^0 c would have a COP of 3.8. A Ground Source Heat Pump at the same outside temperature may have a ground temperature of 5^0c and it's COP would therefore be 4.4.



All heat pumps currently available are either Ground Source, Air Source or Water Source but in normal UK weather conditions the best source of heat can change, sometimes the air temperature is greater than the ground or water temperature. There are also other sources of waste heat that could be utilised to create a higher source temperature for the heat pump to operate.

We have designed a 'Multisource' Heat Pump - a true innovation, and the first of its kind. This is a heat pump that can select where to get the best source of heat from (i.e. the highest temperature) and can continually switch between different sources of the to get the best mix to maximise the COP.

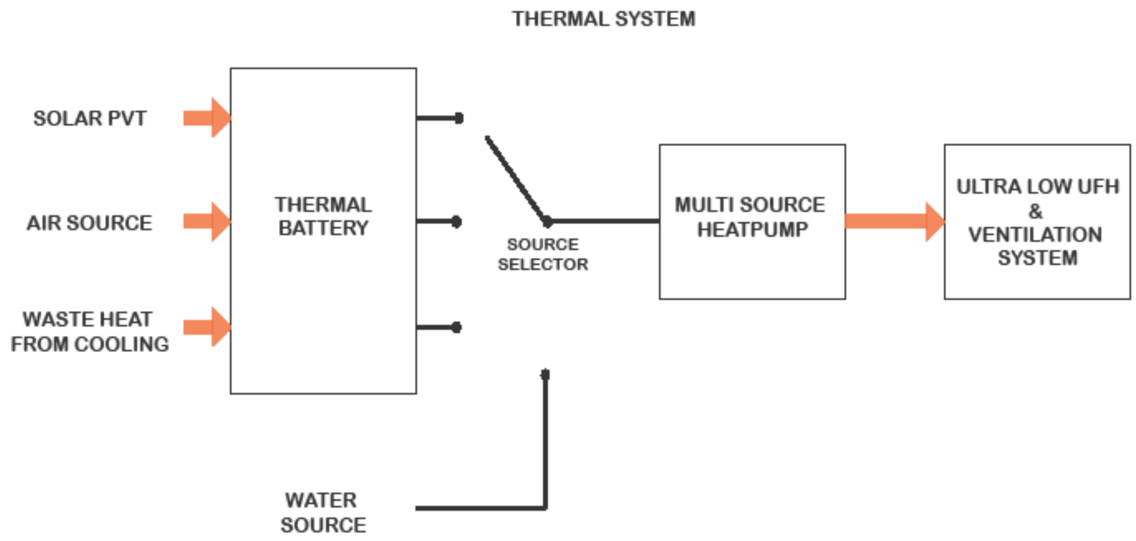
The Sources of heat we have available are:

- Water Source
- Solar PV-T (Solar panels that generate heat and electricity simultaneously)
- Air Source
- Waste heat from Cooling via the Mechanical Ventilation and Heat Recovery (MVHR)

Ditton Mill House
Cleobury Mortimer
Shropshire
DY14 0DH
01299 270011
www.energyzone.co.uk
sales@energyzone.co.uk

As some of the sources of heat are not necessarily available at the same time as the heat pump requires them we have also included a 'Thermal Heat Battery' which will be able to store the heat when it is produced by some intermittent sources (Solar, Air or Waste Heat) until it is required by the heat pump system.

We have also minimised the supply temperature required by designing ultra-low temperature underfloor heating and ventilation solutions. As such sometimes it will be possible to take stored heat directly from the Thermal Battery to supply the heating system without any input from the heat pump (∞ COP) when the Thermal Battery has been discharged enough, not below the supply temperature, the heat pump will be able to extract all the usable heat left in the battery until a different source will supply a better option. The combined sources of heat will lift the heat pump average COP to approx. 6.4 a truly impressive 50% higher than any other ground or water source heat pump system.



Ditton Mill House
Cleobury Mortimer
Shropshire
DY14 0DH
01299 270011
www.energyzone.co.uk
sales@energyzone.co.uk

Domestic Hot Water System

In the same manner as the heating solution we have also selected several sources of heat to provide the Domestic Hot Water (DHW). The hot water will be stored in conventional local cylinders but will be heated from the following:

- Waste heat from the heat pump, using a 'Desuperheater' (Waste Recovery Heat Exchanger)
- Spare electricity from the Solar PV system; this is any electricity generated and not used by either the house heating or car charging systems
- The Multisource Heat Pump

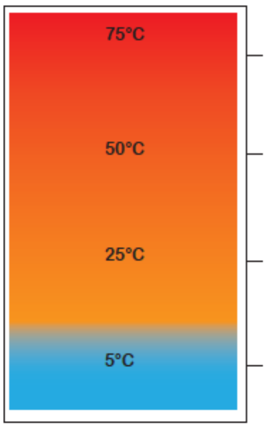
Energy Sources

1) Water source: As this site is on a suitable watercourse this is an obvious source for heat. Water has the highest specific heat capacity and as such the greatest potential stable source of heat throughout the year. The water temperature will typically start at around 10^0c and drop off to around 5^0c at the end of the Winter. Using this source will increase the potential SCOP to around 5.5 (a massive improvement on the standard Ground Source Heat Pump)
2) Source Energy Store (SES) Thermal Battery: Heat captured by the MVHR duct coolers, from the PV-T panels can be diverted along with heat from the Air Source can stored in here. This will have a design temperature of between 5^0c and 75^0c and will be capable of storing around 150 kWh of energy. If this store is fully discharged from hot to cold then the heat pump will be capable of reaching SCOP of around 7 for the energy extracted from here.

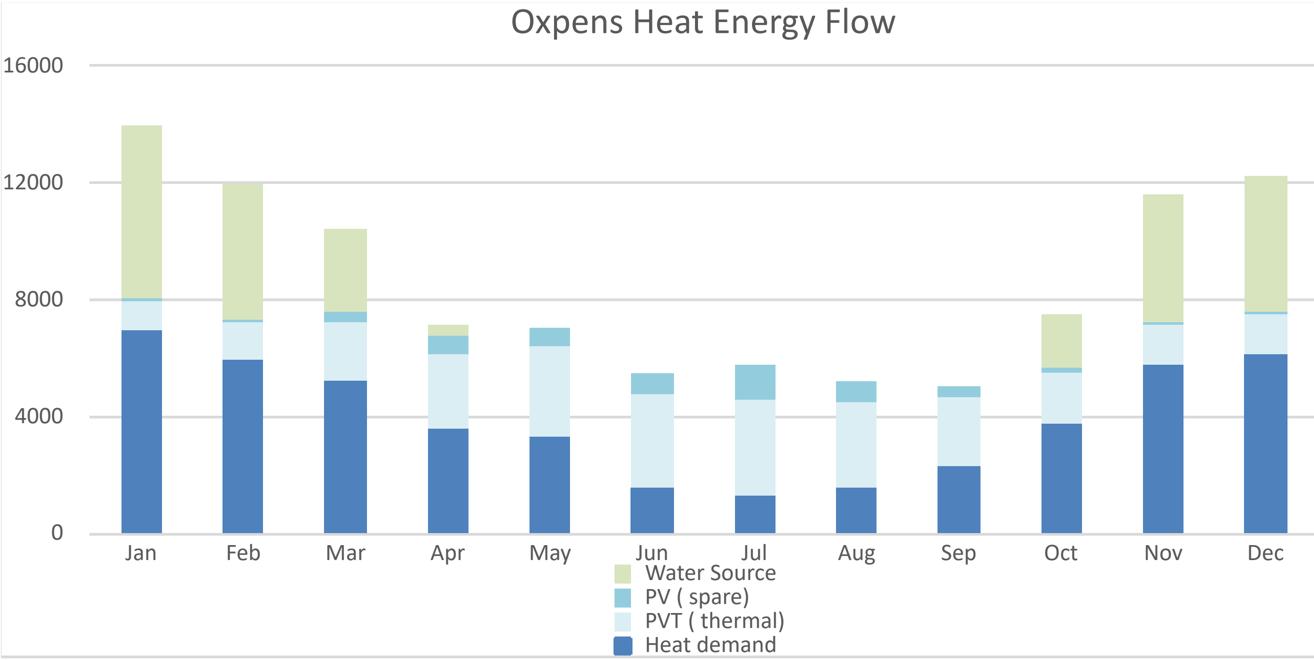
Taking all the likely proportions of the energy sources into account, the potential average SCOP would be 6.4

Source Energy Thermal Battery

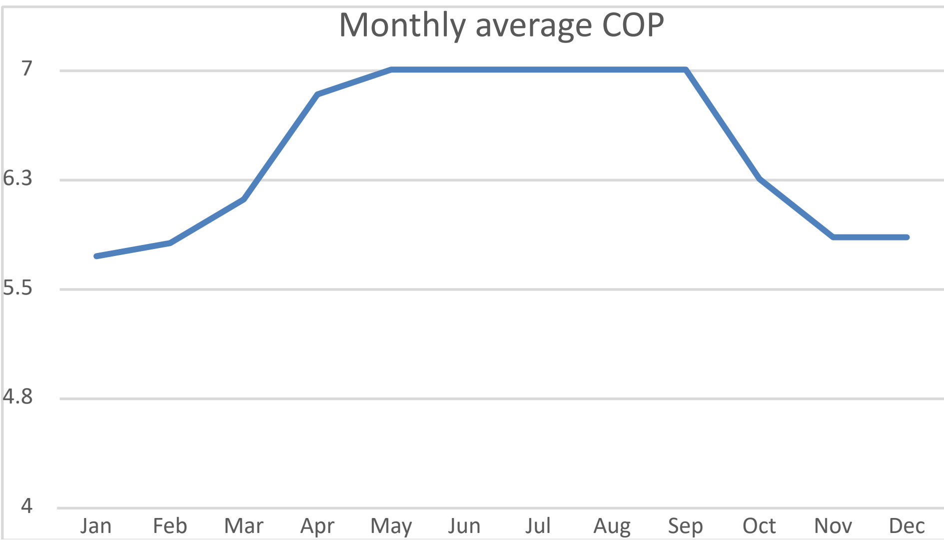
There are lots of examples of 'Thermal Stores' which are used to collate heat from different heat sources before distributing them to different locations. Our design differs significantly in that we are creating a vessel to store a much greater range of temperatures from 5^0c to 75^0c and the ability to fully 'discharge' the battery to achieve twice the normal storage capacity for the same size as a conventional Thermal Store.



Ditton Mill House
Cleobury Mortimer
Shropshire
DY14 0DH
01299 270011
www.energyzone.co.uk
sales@energyzone.co.uk

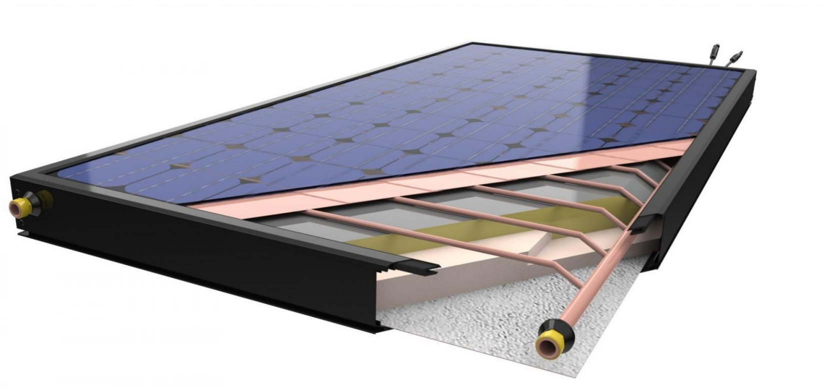


This graph shows the 'Total Heat Energy Balance' on this site. The Blue line is the 'Heat demand' each month which is met with heat sourced either from the Water Source, PVT (which includes passive gains collected by the duct coolers) and spare energy produced by the PV element. From May to September the site produces more energy than it needs. By averaging the COP of energy from each source on the Multisource Heat Pump we can produce the graph below showing the 'Monthly average COP' (detailed below). It is worth noting a typical heat pump is capable of an average COP around 4.0, this is a very significant improvement. The annual average SCOP should be around 6.4.



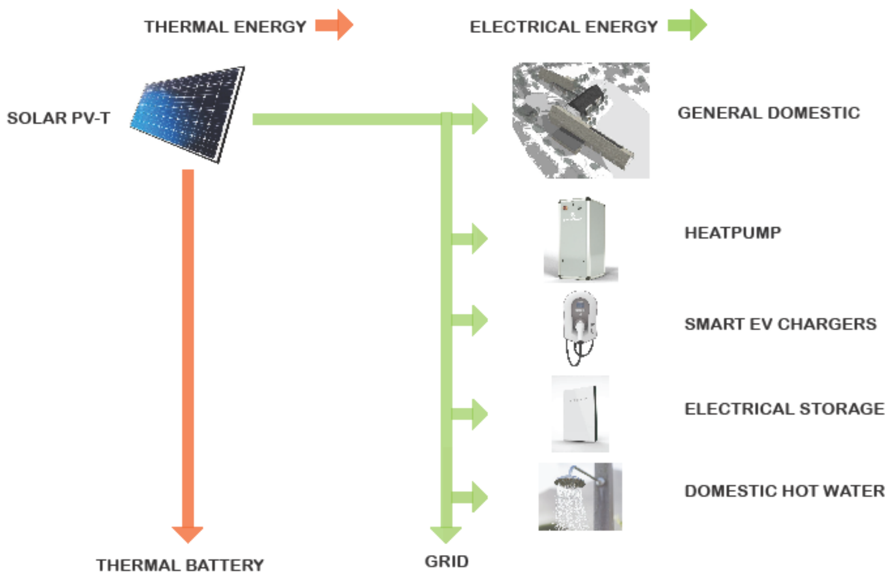
Ditton Mill House
Cleobury Mortimer
Shropshire
DY14 0DH
01299 270011
www.energyzone.co.uk
sales@energyzone.co.uk

Solar PV and PV-T

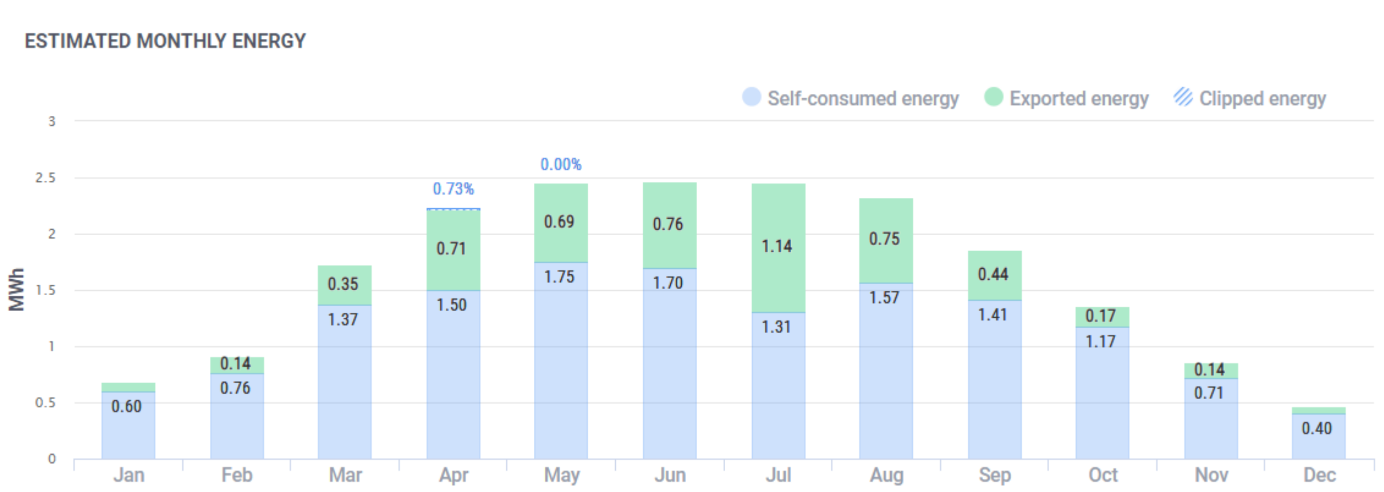


The site has excellent potential to collect solar energy to not only provide for normal domestic demands but also charging capability for an EV and to power the heat pump and ventilations systems. We propose to split the solar panel between standard high efficiency Solar PV panels and Solar PV-T panels. The PV-T panels generate both heat and electricity, because standard PV panels produce less electricity the hotter, they get. By taking heat away from the panel we will generate more electricity from the same panel and get useful heat. This heat will be pumped into the Thermal Battery and any spare electricity from both the PV-T and PV panels will be used to heat the DHW cylinders directly.

We will also include electrical storage of at least 20 kWh in a LiFePo4 battery. The storage of both electrical and thermal energy will ensure the project not only requires very little additional energy from the grid and it can choose when to take grid electricity. This reduces the running costs to the bare minimum but also removes and peak stress this site may otherwise add to the grid load. The ability to load shift energy from when it is needed to when it is easier for the grid to provide it is essential in the large-scale rollout of heat pumps and EVs across the country. It also makes it not only easy but optimal to choose a 100% green energy provider for the remaining power required for the property ensuring all energy consumed on site is zero carbon.

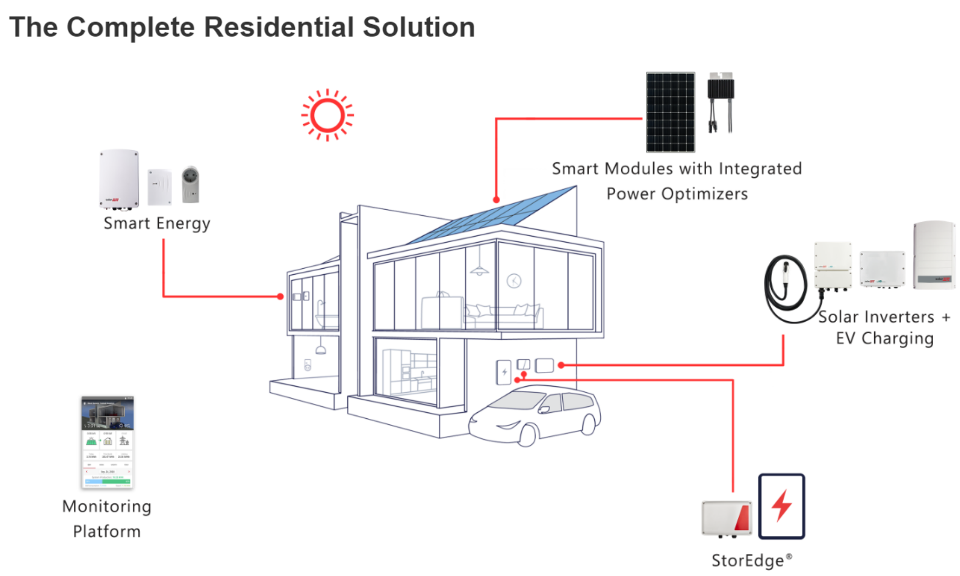


Ditton Mill House
Cleobury Mortimer
Shropshire
DY14 0DH
01299 270011
www.energyzone.co.uk
sales@energyzone.co.uk



To make the best use out of the electrical system it is important to be able to control the generation and consumption as much as possible. To do this we have chosen a single platform to provide a simple to use integrated approach. The solar edge system will:

- Maximise the potential generation from the site by fitting optimisers to each solar panel
- Provide a smart EV charger to allow a car to be charged from free/excess electricity
- Provide 4 immersion controllers to again divert any spare electricity generated into the DHW cylinders and HES
- Provide a control to charge up the LiFePO4 battery
- Provide the option of smart switches which can be turned on/off dependent upon generation profiles
- Provide an integrated app to see all the above and simply control it if required



Ditton Mill House
Cleobury Mortimer
Shropshire
DY14 0DH
01299 270011
www.energyzone.co.uk
sales@energyzone.co.uk

Carbon Balance Calculation

We have calculated the typical amount of carbon used by a standard new build property on gas with a petrol car and compared this to Oxpens with an electric car and a green tariff. The result is that by building Oxpens rather than a standard property we would produce a negative amount of carbon of just under 30 tons per year.

Comparing carbon emmissions and savings of Oxpens vs standard modern new build (values in Kg Co2)		
Carbon producing activity	Current standard new build property with gas central heating and low energy light bulbs etc with new petrol car	Oxpens with a new electric vehicle, green electic tariff.
Electrical use	2100	-19500
Heating	2500	0
Car use	2400	0
Indirect home and vehicle	2600	0
Miscellaneous (clothing, food etc)	8060	8060
	17660	**-11440**
Oxpen Carbon reduction per year compared to building a standard property		**29100**

Summary

The proposed Multisource Heat Pump is an innovative new solution, rethinking an existing technology to improve its efficiency by an impressive 50%. Combined with an integrated package of Renewable Heat powered by local solar and green grid electricity designed to optimise the resources available on site, this will provide a long term sustainable zero carbon heating and power system, fit for the future and proving the benefits of thermal and electrical storage which could be applied to any property. In fact this site will produce more clean carbon free energy per year that it will consume.

[redacted]

Andy Perkins
EnergyZone