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Proposed Development of : **The Equestrian Arena, North Rye House Estate, Donnington, Moreton-In-Marsh, Gloucestershire GL56 0XU**

Energy & Sustainability Statement :
Issued in support of the planning application for the above referenced equestrian arena

This document sets out an analysis of the energy profile for spatial heating, rug drying and wash-down hot water demand for the proposed equestrian arena as conceived by Yiangou Architects. This will demonstrate how the adoption of renewable technologies will render this building to be effectively carbon neutral when taking a year round perspective.

In addition, the scope of the energy analysis is widened to demonstrate the potential to very significantly decarbonise the whole North Rye House estate.

The site is not on the mains gas grid. Therefore, kerosene (heating oil) is considered the default primary fuel for spatial heating and potable domestic hot water production.

The site sits at an elevation of 133m above sea level and analysis of data from the closest weather station suggests a full load equivalent run hours figure of 2261.7.

Cotswold District Council has adopted a Net Zero Carbon Toolkit and this has been used in determining the energy strategy both for the equestrian arena, including the service accommodation therein, and for the wider estate. The Tool Kit confirms an "*ambition to deliver Net Zero as the standard of all new housing and in the retrofit of existing homes*." In addition, the proposed energy strategy adopts the stated Core Principles from the Tool Kit;
a) energy efficiency

b) low carbon heating (Heat pumps are considered the most efficient low carbon heat source keeping energy use to a minimum, while not using fossil fuels on site.)

c) renewable energy generation (In new buildings, renewable energy generation should be at least equal to the energy use of the building on an annual basis for it to qualify as Net Zero carbon in operation. This is straightforward to achieve on site for most new homes through the use of solar photovoltaic (PV) panels. The roofs of existing homes should also be utilised for PV panels, to support the increased demand for renewable energy.) This reduces the "building's impact on the wider energy supply network, which is also an important consideration" within the Core Principles.

The owners of North Rye House estate have fully embraced the net zero agenda and recognise that, being off the natural gas grid, the estate will need to be at the forefront of decarbonisation because of the high carbon factors of the alternative default fossil fuels, oil and LPG. The energy and sustainability strategy adopted for the whole estate reflects the aspiration to progressively migrate, as a minimum, to carbon neutrality for all mechanical services.

Proposed Equestrian Arena

If built out, the service accommodation components of the equestrian arena would have an estimated energy demand for heating and DHW of 14,020kWh/annum.

Applying a typical boiler manufacturer's efficiency claim of 97% (Viessmann Vitorondens 200-T), the primary energy demand for heating and DHW would be : 14,455kWh/annum.

Using DEFRA carbon factors, most recently updated in June 2022, this level of oil consumption would generate 3,875kg CO2/annum.

By contrast, and in line with the Net Zero Carbon Toolkit, the proposal is to deploy an air-source heat pump to deliver all mechanical services and this, operating at a conservative predicted seasonal performance factor (SPF) of 3.0, would generate just 902kg CO2/annum.

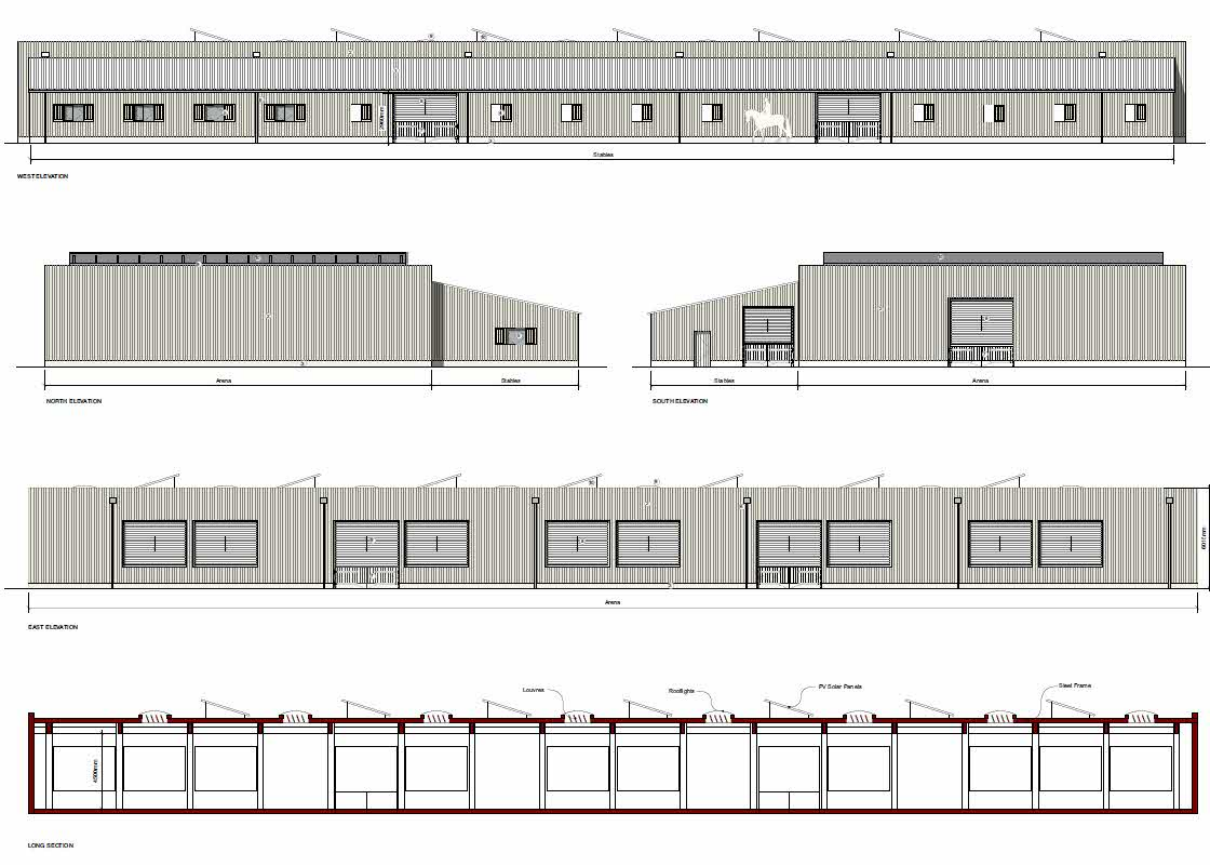
This represents a reduction of 77%, the equivalent of removing 1.7 average family cars from the roads, permanently. As the national grid continues to decarbonise, the heat pump deployment would be increasingly carbon efficient.

Solar Photovoltaic Generation Contribution

Again in line with the Net Zero Carbon Toolkit, the client proposes to invest in local electricity generation by deploying solar PV panels on the roof of the equestrian arena.

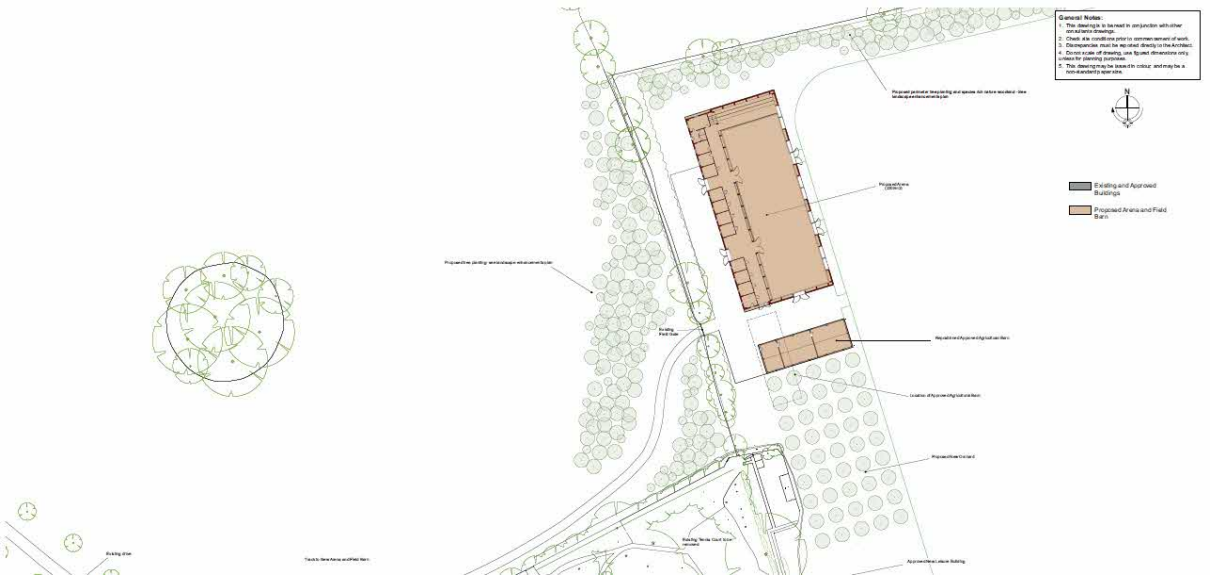
To meet the electricity demand for the proposed air-source heat pump will require just 4,675kWh/annum. Long term averaging of solar PV output at this location suggests a likely annual generation capacity in the range 900-1,000kWh/kWp deployed (see PV Power Potential mapping appended to this statement). Conservatively, therefore, a solar PV array of 5kWp would generate enough electricity for the service accommodation element to be considered carbon neutral across an annual cycle for both heating and potable hot water (for washrooms and wash-down bays).

Using the latest high power solar PV modules, this would require approximately 12 panels covering an area of approximately 30m². The total addressable area of roof allocated to potential solar generation, allowing for shading, is approximately 420m². This is clearly demonstrated in the elevations below.



Looking at the estate more widely, the proposed equestrian building has been specifically designed to balance the demands of the highest quality architectural design and functionality, and the desire to optimise the contribution to decarbonise the entire estate.

The building is aligned as close to a north/south axis as is practical. The proposed seven banks of solar PV panels have an angle of inclination that again balances function, form and the efficiency of output.



Estate-wide Heat Loads

There are conventional heating and potable hot water loads at four other buildings across the estate. Estimated thermal energy demands, oil consumption and carbon emissions, comparative heat pump electricity demands and resulting emissions reductions are shown in the table below.

Again, a typical boiler manufacturer's efficiency claim of 97% (Viessmann Vitorondens 200-T), DEFRA carbon factors from June 2022 and heat pump efficiencies of 3.0 (air-source) and 3.6 (ground-source) have been applied.

	Thermal energy demand kWh/annum	Oil consumption kWh/annum	Oil CO2 emissions kg/annum	Heat pump electricity consumption kWh/annum	Heat pump CO2 emissions kg/annum	CO2 emission reduction kg/annum
North Rye House	85,945	88,605	23,745	23,875	4,610	19,135
Pool Building	136,675	140,900	37,760	37,965	7,330	30,430
North Rye Bungalow	25,100	25,875	6,935	8,365	1,615	5,320
Lemell Hooks Barn	20,000	20,620	5,525	5,555	1,070	4,455
Totals	267,720	276000	73,965	75,760	14,625	59,340

The total carbon emissions saving achieved by adopting heat pump technology across the estate is 59,340kg/annum. This represents a reduction of 80%, the equivalent of removing 34 average family cars from the roads, permanently.

Estate-wide Solar Photovoltaic Generation Contribution

As established above, the total addressable area of equestrian arena roof allocated to potential solar generation, allowing for shading, is approximately 625m². This will accommodate approximately 168 panels. Deploying 415W high power modules, the total array power potential is 69.7kWp. Current negotiation with Western Power Distribution is likely to result in a limit being placed on the scale of solar PV generation that can be connected to the grid. It is anticipated that this will be in the region of 86kWp.

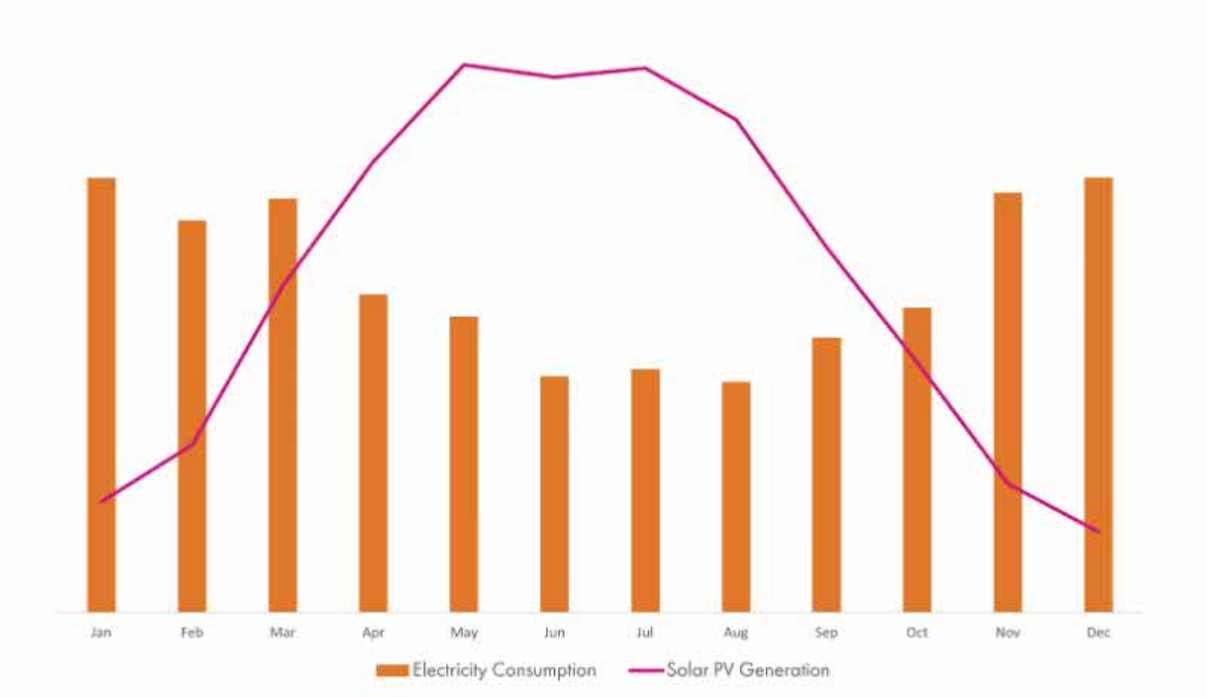
Using the likely generation capacity range of 900-1,000kWh/kWp deployed, a solar PV array of 69.7kWp would generate a conservative 66,215kWh of zero carbon electricity per annum. This represents 82% of the total electricity consumption, 80,435kWh, estate-wide for heat and potable domestic hot water, with the various heat pump systems deployed.

As a result, if the equestrian arena is built out as proposed, and if the solar PV generation capacity deployed as set out above, 82% the heated elements across the estate could be considered net zero carbon across an annual cycle for both space heating and potable domestic hot water.

This could be increased to 100% if it was considered appropriate to mount additional solar PV capacity on the west-facing shallow pitched roof of the stable block. Efficiency of an array on this roof space would be slightly compromised, but delivering a 100% carbon emissions displacement outcome could make this attractive.

Annual Cycles & Excess Generation

The electrical generation output for solar PV on the UK peaks when thermal loads are at their lowest as set out in the indicative graph below. If the total local zero carbon electrical generation exceeds the total thermal electrical load, then the site is considered to be carbon neutral across an annual cycle because excess electricity is "banked" with the grid in summer and "withdrawn" from the grid in winter.



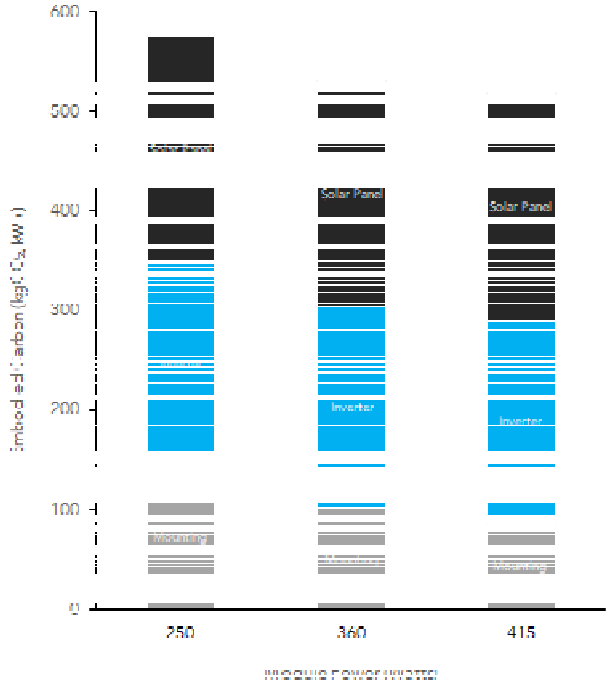
In the case of the North Rye House estate, summer loads for the pool building and future electric vehicle charging will result in more of the summer solar PV generation being used on site. If all purchased in electricity required to make up the shortfalls in the winter months is procured from a genuine zero carbon supplier, then the estate will potentially be carbon neutral for all energy demands, not just heat and potable hot water.

Solar PV Embodied Carbon

Etude, one of the co-authors of the Net Zero Carbon Toolkit, has been carrying out preliminary research into the relative embodied carbon associated with different variants of solar PV deployment. The research is not yet complete, but early findings suggest that :

i) Embodied carbon of bolted pitched roof-mounted systems is likely to be lower than of ballasted flat roof systems due to lack of need for ballast weights and supporting structure
ii) Embodied carbon for roof-mounted systems is likely to be lower than for ground-mounted systems
iii) Embodied carbon is lower for high efficiency and high power modules

Ground-mounted solar PV systems compete with agriculture and equestrian pasture for grazing and there is a clear political and policy preference for roof-mounted systems where appropriate roof spaces are available.



Summary

The proposed equestrian arena has been demonstrated to be carbon neutral, or better, (for spatial heating and DHW) across an annual cycle. The building would, therefore, be efficient and highly sustainable from the perspective of primary energy use.

In addition, it has been demonstrated that the equestrian arena provides a unique opportunity to drive the decarbonisation of the wider estate by enabling the powering of heat pump systems using predominantly local, zero carbon electricity, generated on the roof of the building. This will minimise the impact that the estate has on the local electricity networks.

If all of the envisaged renewable technology systems are deployed across the estate, a total of 77,840kg in equivalent CO2 emissions will be saved, compared to burning Kerosene as the primary fuel. This is the equivalent of removing 44 average family cars from the roads, permanently. In doing so, the estate will be transitioning away from fossil fuels well in advance of the potential legislation to do so as currently proposed under the consultation that government will be responding to in late autumn this year : https://www.gov.uk/government/consultations/phasing-out-fossil-fuel-heating-in-homes-off-the-gas-grid

The air quality impact will also be positive because the deployment of heat pump systems and solar PV generation will completely remove emissions of NOx, SOx and particulates across the estate.

The proposed equestrian arena development would therefore provide for very significant environmental advantage at a time when energy efficiency and carbon emissions reductions are key facets of Government Policy.

Ends

Report prepared by :

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Appendix