Case Study Farm 2 - Mixed Beef, Sheep and Fell Ponies

Summary Table

Location	[redacted]
Load size and variability	Farmhouse, lighting for cows through the winter. Rolling mill for crushing barley and mixer for mixing food stock daily. Ventilation fans in winter.
Suitable roof areas	There are a number of buildings with south facing roofs. Three options are considered below: A – corrugated roof over feed store/crusher room: • Slope: 30°, Orientation 20° off south • Area around 14.4m by 5.5m • Space for 7.5 to 9 kWp (avoiding rooflights) B – tin roof over/next to hay store: • Slope: 30°, Orientation 30° off south

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	• Area around 13.6m by 3.7m • Space for 7.8 to 9 kWp C – shed in middle of yard: • Slope: 15°, Orientation 30° off south • Area around 12.8m by 6.6m (rooflights ignored) • Space for 11 to 12 kWp
Maximum feasible array size on roofs	There could be space for over 50 kWp if a number of roofs were used.
Array sizes considered	3.5 kWp minimum used for calculations as fits within export limit with existing transformer. 10 kWp maximum used for calculations.
Current electricity supply	Single phase (1-ph) 100kVA supply from a pole mounted transformer (PMT) approx. 150m away.
Network limitations on generation capacity	Due to the impedance/length of the existing supply line and the 1-ph supply, anything above the Small-Scale Embedded Generation (SSEG) limit of 16A (3.68kW) would require reinforcement and new connections work. It may be possible to increase the generation capacity but, in this case, a detailed study would be required. The costs involved would differ dependant on the generator size.
Potential annual energy output	• 3.5 kWp system - Annual total 2896 kWh (29% of annual electricity use) • 10 kWp system - Annual total 8274 kWh (82% of annual electricity use)
Preliminary cost estimates	3.5kWp PV system without a battery approx. £5500 3.5 kWp PV system with a battery approx. £7000 10 kWp PV system without a battery approx. £12500 10 kWp PV system with a battery appro. £ 15000

Cost savings and export income. Lower end of range is with an electricity cost of 35p/kWh. Higher end is at 55p/kWh.	Without a battery • 3.5 kWp system - Annual total £886 - £1378 • 10 kWp system - Annual total £1680 - £2507 With a battery • 3.5 kWp system - Annual total £971 - £1521 • 10 kWp system - Annual total £2409 - £3733
EV charging potential	It may be possible to provide 1 or 2 7kW EV chargers from the current supply however the charge point installer would need to check the existing supplies maximum demand and calculate if there is spare capacity.

Network Upgrading Possibilities

The existing transformer is already the maximum size for a pole mounted transformer at 100kVA. However, it may be possible to increase the generation capacity, for example, by upgrading the supply line from the transformer, but a detailed study would be required. The costs involved would differ dependant on the size of the proposed generator.

The above information is based on a preliminary discussion with ENW. The Customer Engagement team at ENW connections department offer surgery sessions in which they can look at the network to a site in a bit more detail and provide a steer of what is in the art of the possible. Once you are in a position to submit an application, they can guide you through the process and submit an offer to you in line with your needs.

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Potential Solar Generation

The results from the PVGIS tool are attached. This gives the monthly energy output from a:

- 3.5kWp system 375 kWh per month in summer dropping to around 70kWh in December. Annual total kWh 2896 kWh. (29% of your annual electricity use)

- 10kWp system 1070 kWh per month in summer dropping to around 200kWh in December. Annual total 8274 kWh (82% of your annual electricity use)

Mill Crusher

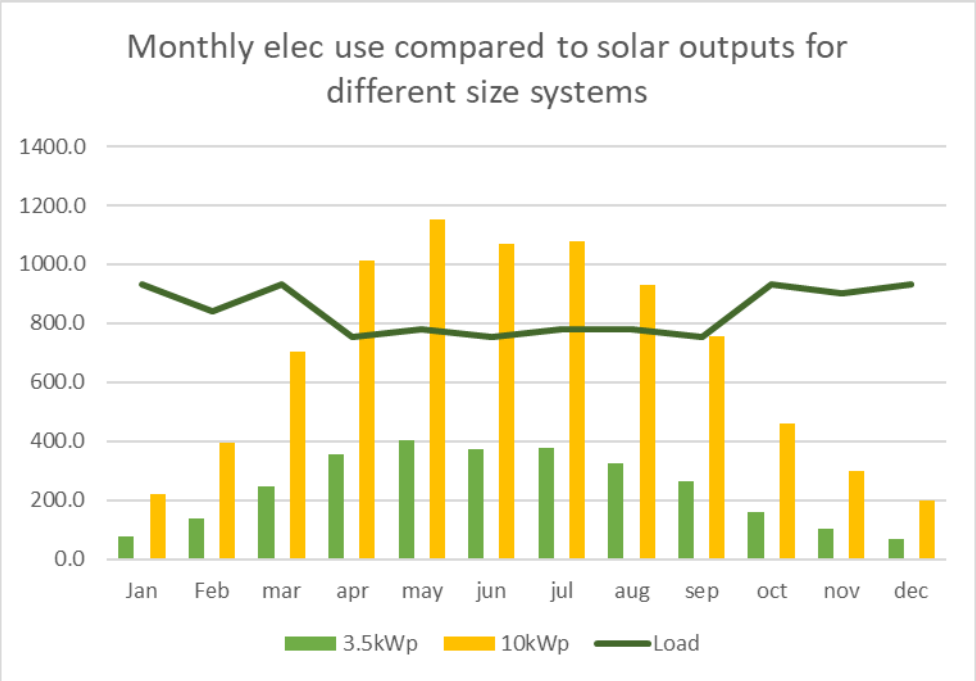
Potential barn roofs for solar modules

Comparison of loads and Generation

A review of recent electricity bills showed that the average daily energy use on the farm supply is around 29 kWh/day, so the monthly energy use is around 900kWh, and the annual consumption was 10050. Note however, that this data is mainly based on estimated meter readings which could be inaccurate.

The major loads identified included the mill crusher, (runs for 4 hours a day), compressor, ventilation fans and lights in winter for indoor cattle. If a solar system was installed it would be beneficial to run the crusher in the middle part of the day when solar power was most likely to be available.

The graph below compares monthly energy use with potential PV energy generation for 2 different size PV systems for each month of the year.



Options and Benefits

The smallest system (3.5kWp) is the green bars. Generation is consistently well below consumption so nearly all of the solar energy could probably be used on the farm in the daytime displacing electricity. However, that does depend on how even the load is and how well the time of day of loads matches the solar generation times. It may be useful to read the meters every couple of hours (in the daytime only) for a few days to check how much electricity consumption occurs over the middle of the day and how much late or early in the day or overnight. If a significant proportion of electricity consumption is early or late in the day adding a battery to the solar system may be worthwhile but does add significantly to the cost.

The large-size system (10 kWp) is the yellow bars. Generation is over the level of consumption from April to August which suggests the system is probably somewhat oversized. If the largest loads in summer occur during daytime the farm would probably still use the majority of the solar energy displacing buying electricity. Again, that does depend on how even the load is and how well the time of day of loads matches the solar generation times. If we estimate that 60% displaces electricity and 40% spills out the grid at 5.6p/kWh that should save between £1923 and £2916 per year depending on the cost of electricity. I've used a range of 35p/kWh to 55p/kWh which reflects the range of costs being paid by the farms we have spoken to recently. If the larger system was installed installing a battery is more likely to be worthwhile as it would allow solar energy to be stored for use at night or when the daytime load exceeds the generation at the time. This could increase the savings by £500 to £800 per year, which would need to be balanced out against the additional cost of the battery system.

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