With tight weather windows in which to operate, one Berwickshire farm has recently invested heavily in grain drying and storage, with a renewable energy twist. **Alex Heath** finds out more.

Grain drying with a renewable difference

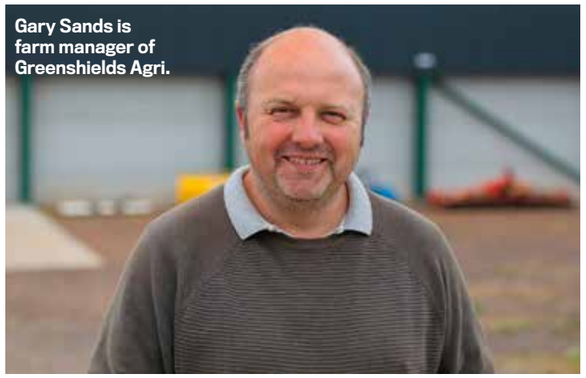
The Lemington farm site has invested heavily in a state-of-the-art drying and storage facility.

Grain is put into the shed via overhead conveyors. Underground ducting cools the grain, while Barn Owl sensors monitor the temperature.

Farming 3,240 hectares on the east coast of Scotland, between Berwick and Edinburgh, Greenshields Agri does not have the luxury of harvesting when both the weather and crop are perfect.

Gary Sands, farm manager of the group, says the window of opportunity to get the crop off the fields and into store is a narrow one and coupled with a busy drilling regime means time is of the essence.

He says: "Harvest is always a stressful time on-farm. I manage three hubs spread across 8,000 acres made up of owned, tenanted and contract farmed land. We have historically had a problem with drying grain, a necessary task when farming in close proximity to the temperamental east coast."



Gary Sands is farm manager of Greenshields Agri.

Now coming into its third season, the farm invested heavily in a state-of-the-art drying and storage facility at its Lemington Farm. Having had previous experience in the use of renewable energy to dry wood chip for on-farm electricity production, the farm decided this was the way to go, streamlining operations and cutting costs in the process.

Construction started in January 2018.

"We already had the Combined Heat and Power [CHP] system installed, which proved the effectiveness of renewable heat for drying," says Mr Sands.

"Coupled with our need for extra drying capacity, we could also see the benefit of increasing our storage capacity, so opted to build a new facility on a greenfield site, close by to the CHP plant."

A 6,000-tonne store was erected, coupled to the new drying facility, designed, installed and built by local firm John Thorburn. Mr Sands most of which consists of potato boxes and pallets. The farm has a license to take in the wood, still classed as virgin as it has not been treated with any preservatives.

The boiler itself will take a whole potato box, brimmed with other wood, heating up 40,000 litres of water which cycles round the skin of the boiler and is stored in a pair of 15,000-litre tanks. This provides a thermal mass which takes a long time to cool, if the boiler runs out of material.

Heat

was pivotal in its design, adding features he had seen on other farms to several ideas he thought in theory should work.

At the heart of the system, a Dragon biomass boiler is used to increase the ambient air temperature taken into the Opico Magna 4810QF batch dryer.

The Dragon boiler is housed in a separate shed to the main store, which also features a drying floor and reception pit. The predominant fuel source for the boiler is waste wood from surrounding farms and businesses, Depending on the material being burned and the time of year, which dictates the material being dried, the water can be heated between 30-70degC. Mr Sands says pallet- and box-type wood typically provides 1kW of energy, however, chaff and sawdust, which is denser, achieves double that. The denser material is usually used overnight when a slower burn is more appropriate.

Heated water is then directed to the open sided extension of the grain store, eliminating condensation in the store, says Mr Sands. This extension houses the heat exchanger and dryer. The Opico dryer sucks air in, the same as a standard version, however, its intake is ducted to the heat exchanger which sees the fresh air passing over a series of copper pipes, transferring the heat of the water to the air stream.

It is this process which provides the efficiency, says Mr Sands.

"Typically when we are drying grain, the temperature can range from the low-teens to the mid-twenties. The system automatically raises the intake temperature up to 70 degrees, meaning the flame in the dryer is barely lit, just topping the temperature up to where it needs to be for drying the grain, typically 120 degrees."

Mr Sands says the running costs of the system are 25 per cent of what it would be if it were just powered on diesel.

The reason for opting for a batch drier was twofold, says Mr Sands. Firstly, the system is constantly cleaning the grain every time it reaches the top of the drier, thus taking out chaff and straw as it dries, increasing the bushel weight. This chaff is then deposited in a bay near to the Dragon boiler and is burned. The second and most important consideration with this system is to ensure the heat produced by the boiler is always used.

Airflow

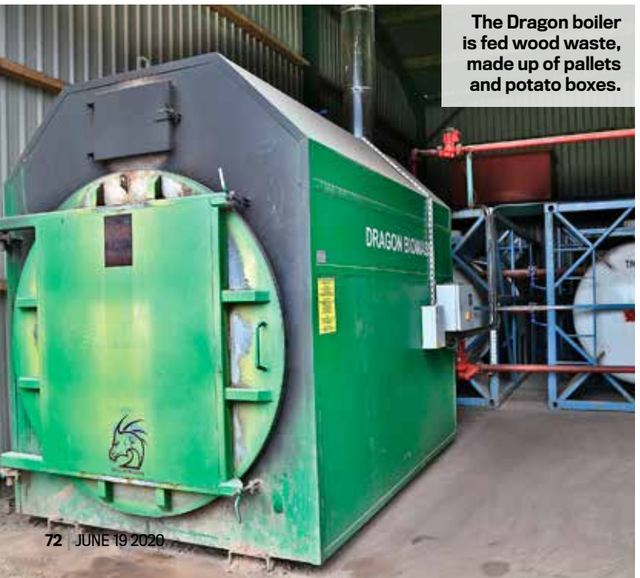
During emptying, filling and cooling the airflow is diverted from the drier to a drying floor adjacent to the boiler room. Two electric valves in the ducting automatically switch the flow of air from the dryer to a fan, which forces the warm air into the drying floor.

This floor can be used to reduce the moisture of the grain at harvest, while during the rest of the year, the material fed to the Dragon is dried and stockpiled. The Opico dryer then sucks in air through the bottom of its casing to cool the grain.

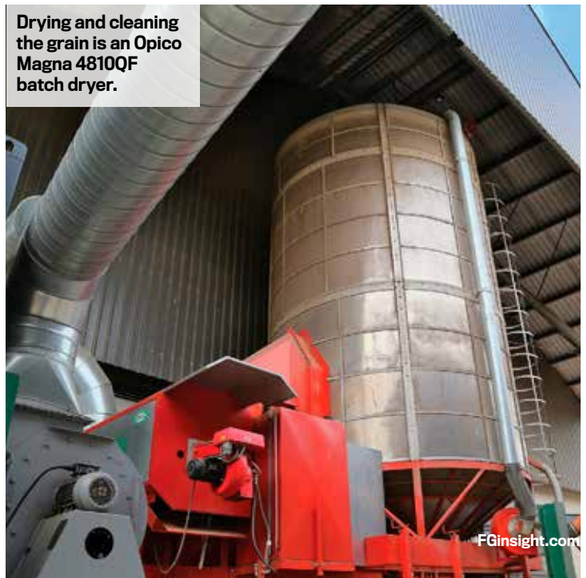
Come harvest, the bulk of which for the farm is mid-August through to the end of September, grain is carted using up to 12 trailers from the four combines run by the farm, over the weighbridge, where a full paper trail for that load is developed, before being deposited outside the reception pit. A computer system uses an algorithm

Greenshields Agri cropping

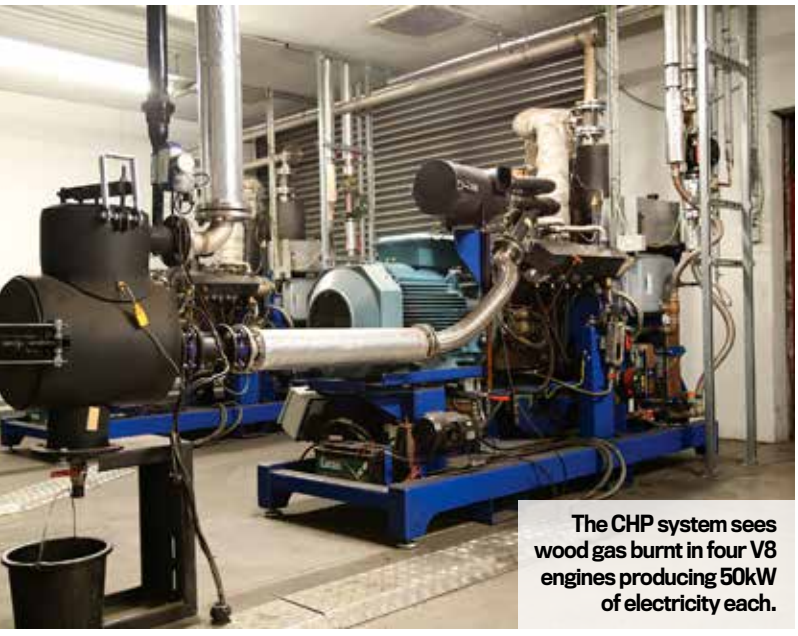
- **Wheat:** 1,416ha
- **Spring oats:** 404ha
- **Spring barley:** 404ha
- **Beans:** 200ha
- **Oilseed rape:** 200ha



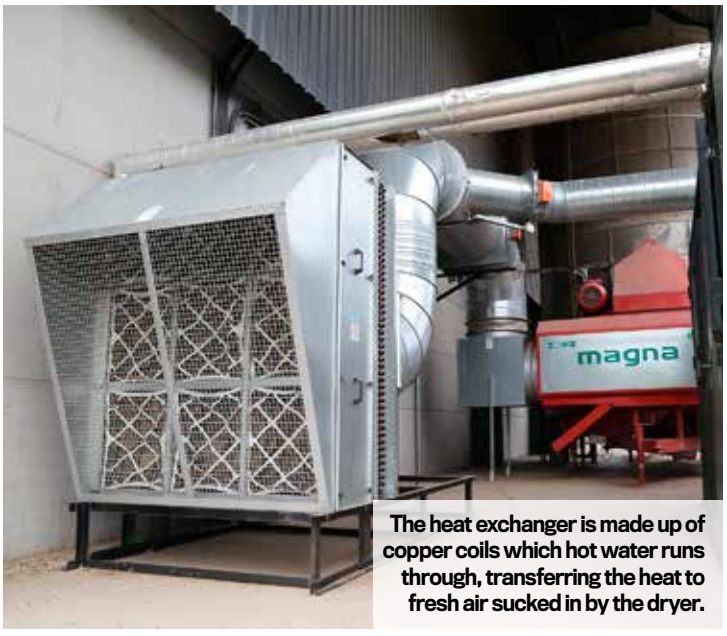
The Dragon boiler is fed wood waste, made up of pallets and potato boxes.



Drying and cleaning the grain is an Opico Magna 4810QF batch dryer.



The CHP system sees wood gas burnt in four V8 engines producing 50kW of electricity each.



The heat exchanger is made up of copper coils which hot water runs through, transferring the heat to fresh air sucked in by the dryer.

to calculate the ingoing fresh weight versus the dried weight to be stored, which Mr Sands says is very accurate.

In an ideal world all grain would be harvested at or under 19 per cent moisture, says Mr Sands, however, the farm harvests up to 30 per cent at times. Under the reception pit, 125t/hour elevators transport the grain to the dryer or to the store, if the grain is coming from another of the farm's stores.

The grain handling elevators and conveyors were purposely over-specced, with the idea of expanding the 30- by 54-metre store in the future. In the store, overhead conveyors deposit grain in the correct pile. Walls are 4m high on the long edges, rising to 6m under the apex of the shed.

Underfloor ducts

To negate the need for hauling heavy pedestals and fans up piles of grain, underfloor ducts were installed, with manholes strategically placed on the floor of the store. Fans are then situated on the outside of the store, pushing cool, fresh air through the grain. Mr Sands says this set up is safer and easier to install than traditional systems.

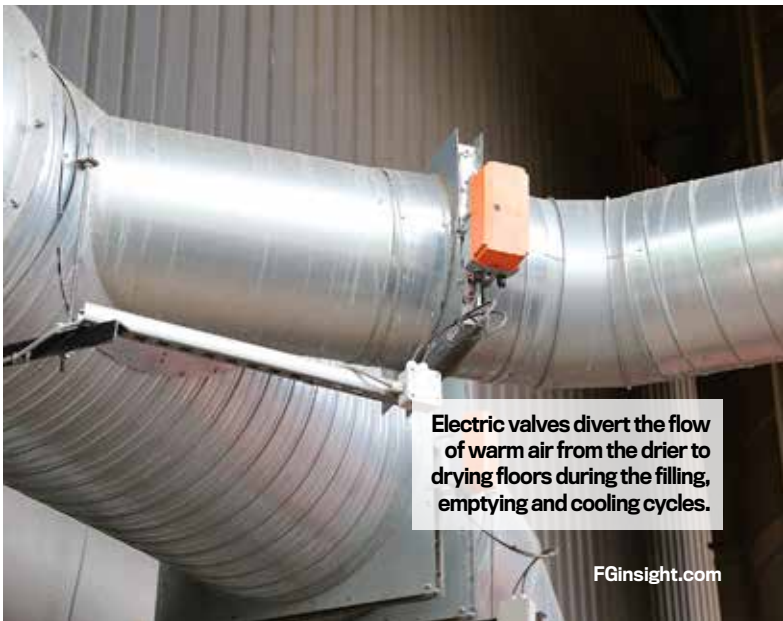
Barn Owl monitors are used to control the fans. They kick in when the ambient temperature outside the shed drops five degrees lower than the temperature of the grain pile. Small perforated turrets slot into the underfloor duct, with marker poles ensuring drivers are aware of their location.

The CHP system located nearby can also be employed during a wet season. The CHP installation uses four reformers, which 'melt' the woodchip, sourced from local forests, at 600 degrees, producing a gas which runs four engines. The engines of choice for the system are reconditioned V8 truck engines from the US, which are modified to run on gas rather than diesel. These in turn power 50kW generators, with electricity put straight into the grid. Before the gas is used by the engines, it is cooled to 80degC via water-based heat exchangers.

The resulting hot water is used to heat the system's drying floors, which typically dry the woodchip ready for the aforementioned process. However, the two floors each have the capacity to dry 100t of grain, taking out the first 10 per cent of moisture in 24 hours, when it comes off the field at 30 per cent, says Mr Sands.

"The drying and storage facility took a lot of planning and head scratching to get everything to work efficiently and in sync," adds Mr Sands.

"However, the planning and investment has paid off, giving us capacity even for the wettest years, with efficient, quick and ultimately an affordable way of drying the farm's crops."



Electric valves divert the flow of warm air from the drier to drying floors during the filling, emptying and cooling cycles.