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NET ZERO WILLOW

WILLOW CARVES NEW PATHS IN ROBOTIC TECHNOLOGY

Harvesting and processing willow for biomass plantations is highly labour intensive, so one project is seeking to automate the supply chain, to improve efficiencies and scale-up production.

Currently, harvesting willow for planting material (rods) requires a team of people between January and March to manually cut and prepare 2m long stems into bundles for cold storage. Enough has to be harvested to fulfil a biomass planting rate of 15,000 cuttings (each 20cm long) per hectare.

And there are gaps in efficiency, with harvestable wood often left on trees due to storage restrictions, as well as the labour needed in late spring to process the bundles into cuttings.

When it comes to planting – typically from late May to July – there is a mechanical element in the form of a step planter. However, these machines still require three to five people to operate, and only plant 3-5ha per day.

Given the UK's labour shortages, the current model is not fit for purpose, with new innovations required to achieve the UK's ambitions of planting more biomass crops.

Project

Jamie Rickerby, director at Willow Energy near Carlisle, Cumbria, has set out to deliver these innovations under the UK Government funded Biomass Feedstocks Innovation Programme.

The project's primary objective is to design and build equipment that:

- Is lightweight to address accessibility and footprint on marginal land
- Increases automation to address labour shortages
- Increases efficiency to address output and costs
- Increases quality of products to address upscaled market demands

Two other key objectives are to lower costs at every stage of production and reduce greenhouse gas emissions.

During harvest, farms currently use a tractor and trailer to collect the crop. However, given willow's late harvesting window it is not uncommon for tractors to get stuck and cause rutting, which in a perennial crop is difficult to rectify.

The project has therefore been working with an engineer in Switzerland to develop a specialised, low ground pressure, tracked willow harvester.

As of February 2024, the team has modified a commercial forage harvester; converting it from tyred to tracked, with a connected trailer that will have an unloading conveyor. This will enable the harvester to unload at the side of a field straight into haulage lorries, reducing vehicle access onto fields, eliminating double handling and improving efficiencies through the whole supply chain.

"There is no way the UK can scale up to even thousands of hectares a year with the machinery limitations currently faced on farms"

Latest

As of February 2024, the project – in collaboration with robotics and automation specialist System Hydraulics – has designed and built prototypes for three new innovations that meet its main objectives.

The innovations include sensing, satellite, and camera technologies – with software and machine learning also under development to enable machine processes, data feedback and management.

The three innovations are:

- **Rod harvester** (for planting material): A robotic implement designed to harvest longer rods and process them down to 20cm, before preparing them into compact bales of 600-800 cuttings each. This will significantly reduce labour intensity and improve productivity; increasing operational hours and output, maximising transport and storage; and generally improving efficiencies.
- **Rod planter**: A robotic implement that can plant cuttings from loaded bales into prepared ground – logging each plant's coordinates. This will reduce labour from five people per machine to one person overseeing four to five robots. This creates more attractive job roles with higher skill and pay.
- **Willow Bot**: An electric base vehicle with tracks which can work over uneven terrain. It will carry the harvester and planter and act as the 'brain' of the robotic system, while removing reliance on fossil fuels.

"It takes five people to operate the 'step planter' machinery typically used in willow production – that's a challenge for an industry facing labour shortages"

"I'm staggered when I look at where we've come from and where we are with the project now – it's just snowballed"

Next Steps

The project's three prototypes – rod harvester, rod planter, and Willow Bot - are being further developed to incorporate lessons learned from consultation, research and development, and technical testing.

Next steps will see field trials take place, and by late spring 2024 the project hopes to have the tracked harvester operational for testing.

Beyond the BFI's end date (March 2025), Jamie would like to develop crop protection and management applications using the data – like individual cutting coordinates – generated by the current innovations.

The team will continue to collaborate, innovate, and explore end uses for willow. At present, willow chip for combustion is of relatively low value and that needs to increase to achieve commercial success. The project will therefore look to explore alternative end user avenues like composting, biorefinery, animal feed, and cosmetics.

To learn more about the Net Zero Willow project, or to get involved, please contact:
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