Envirocrops

Final Report

March 2025

1. Executive Summary

1.1 Introduction

The Envirocrops project, funded by the UK Department for Energy Security and Net Zero (DESNZ), represents a strategic initiative to advance the deployment of sustainable biomass crops as part of the UK's renewable energy and carbon reduction goals. With increasing pressure to transition to cleaner energy sources and reduce dependency on fossil fuels, as well as for direct carbon dioxide removal, the Envirocrops project provides a vital platform to support informed decision-making for the adoption of biomass crops. This initiative focuses on enhancing the environmental and economic viability of biomass as a key resource in achieving net-zero carbon emissions.

1.2 Project overview

The Envirocrops tool is a free, user-friendly web-based application designed to assist farmers, land managers, investors, and policymakers in the cultivation and management of biomass crops such as miscanthus, short rotation coppice (SRC) willow, SRC poplar, short rotation forestry (SRF) eucalyptus, SRF poplar, industrial hemp, reed canary grass (RCG), and switchgrass. By utilising this tool, users can assess the suitability of various biomass crops for their specific land conditions (using postcodes or grid references), including factors such as soil type, topography, and climate. The tool is built around a robust decision-making framework that integrates site-specific data to optimise crop selection and enhance both yield and sustainability outcomes.

1.3 Objectives & impact

The Envirocrops tool is a key resource for farmers and landowners exploring biomass crop diversification. It offers:

- Informed Decision-Making: Actionable insights on crop yield, costs, and income potential.
- Maximise Profitability: Helping users boost productivity while ensuring economic and environmental sustainability.
- Accessible Knowledge: Simplifying biomass agriculture for all users.
- Climate Adaptation: Strategies to mitigate risks and adjust farming practices.
- Market Confidence: A science-backed tool for assessing biomass crop viability.
- Community Collaboration: A platform for farmers, researchers, and stakeholders to share best practices.

- Economic Projections: Estimating long-term revenue, cost savings, and greenhouse gas (GHG) reductions.
- Education & Tools: Gamified learning and user-friendly biomass-related resources.
- Sustainable Agriculture: Supporting crop diversification and eco-friendly practices.
- Optimised Biomass Cultivation: Guidance on crop selection for productivity and sustainability.
- UK Renewable Energy Goals: Encouraging homegrown biomass production.
- Net-Zero by 2050: Promoting low-carbon feedstocks for a future bioeconomy.
- Market Growth & Risk Reduction: Boosting confidence in biomass investments.

At the time of writing, the Enviorcrops web-app has achieved the following interactions:

- 12,978 website visits (7,375 unique visitors)
- 7,792 plays of the Cropper STEM game
- 466 user sign ups
- 106 profiles on the Find a Supplier Network.

1.4 Methodology & tool functionality

The Envirocrops tool integrates multiple datasets, including historical climate data, crop performance models, and soil analyses, to deliver a detailed comparison of biomass options. Its interface allows users to input specific parameters related to land characteristics and desired outcomes, and it generates recommendations for the most suitable crops. In addition, the tool includes a comprehensive database of suppliers, industry contacts, and regulatory guidance to support the complete lifecycle of biomass production from crop establishment to end use.

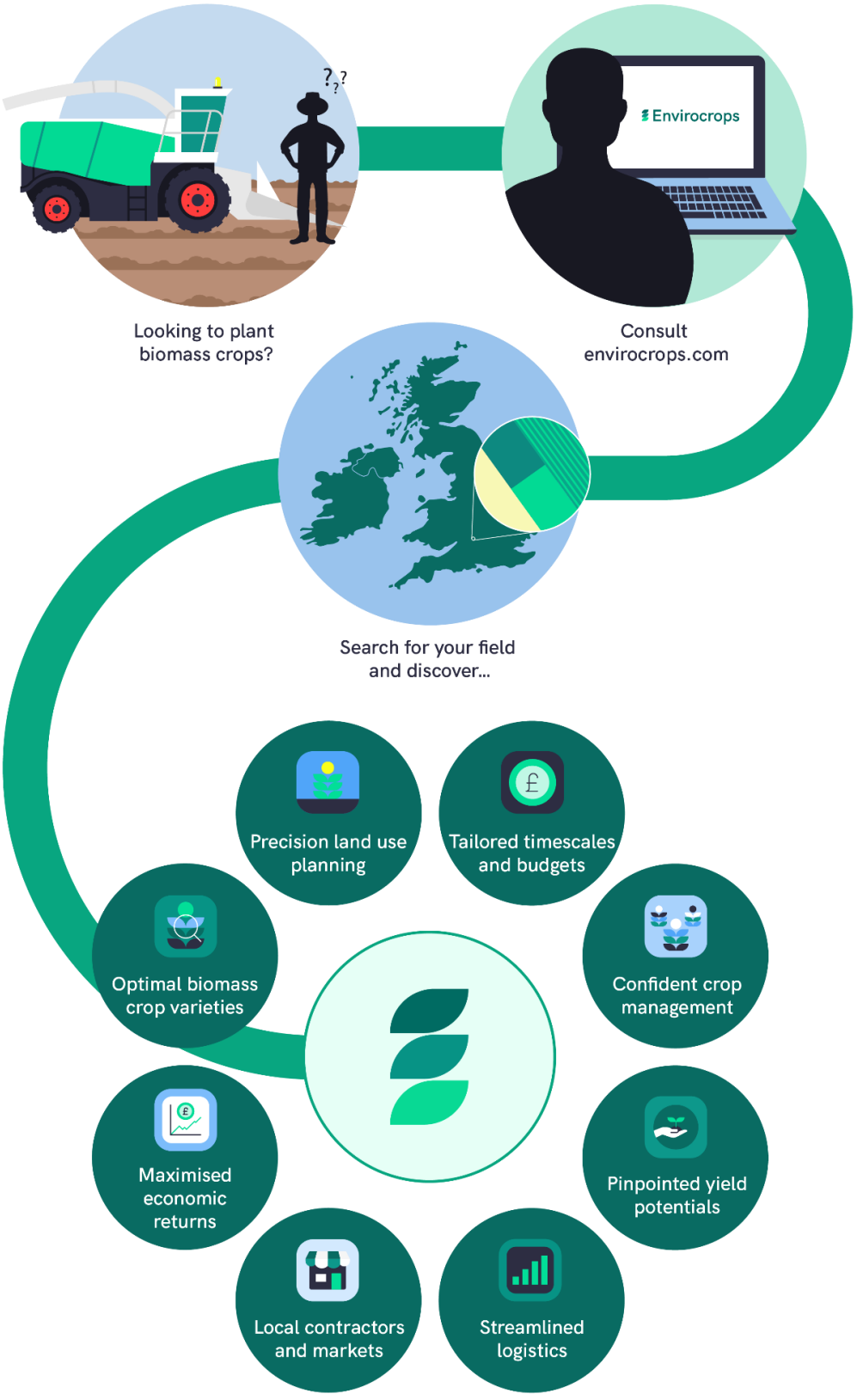
Beyond crop selection, the Envirocrops tool provides financial projections, highlighting potential cost savings from renewable energy production, as well as the ability to incorporate incentives such as the Renewable Heat Incentive (RHI). It also models environmental benefits, such as carbon savings and reductions in GHG emissions.

1.5 Future outlook

As the UK accelerates its efforts toward a low-carbon economy, tools like Envirocrops will play a critical role in scaling the adoption of bioenergy and fossil fuel free products. Continued development of the tool, incorporating real-time data and expanding its scope to new crops and EU / non-EU regions, will further enhance its value to stakeholders. Ultimately, the project seeks to solidify biomass as a competitive, sustainable resource in the UK's renewable energy and materials portfolio. This initiative, through its comprehensive toolset and practical guidance,

aligns with broader government strategies, supporting energy security and the decarbonisation of agriculture and energy systems.

1.6 Graphical abstract



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Glossary

Short Rotation Coppice (SRC) - SRC involves the planting of fast growing willows and poplars at very close spacings (6,600 - 16,600/hectare), SRC involves an intimate mixture of six varieties with different genetic backgrounds to reduce the risk of disease and pests. Harvesting takes place every 2-3 years. There are many uses for this crop in bioenergy and as a biomaterial.

Short Rotation Forestry (SRF) - SRF involves planting single stemmed trees over rotations of 5-20 years depending on the species chosen. Stocking rates can vary according to species. Typically, SRF poplar and Eucalyptus are planted at 1,666/ha (3m x 2m spacing). There are many uses for these crops in bioenergy and as a biomaterial.

Miscanthus - Miscanthus is a woody rhizomatous grass species which originated in SE Asia and was initially imported to Europe as an ornamental plant. It utilises the C4 photosynthetic pathway in contrast to the C3 pathway utilised by standard arable crops in Northern Europe (such as wheat, oilseed rape, potatoes). Miscanthus is planted at 20,000/ha and harvested annually. There are many uses for this crop in bioenergy and as a biomaterial.

Hemp - Hemp is an annual biomass crop known for its sustainability and versatility. Hemp is widely used in the production of textiles, biocomposites, biodegradable plastics, and as a source of phytochemicals. Hemp is planted as a seed in April - June and harvested roughly 5- 6 months later. Hemp grows quickly and can improve soil health by reducing erosion and providing organic matter.

Reed Canary Grass (RCG)- RCG (*Phalaris arundinacea*) is a hardy, perennial biomass crop. It is planted as a seed and remains a productive crop for up to 10 years. Often used in bioenergy production, it provides excellent ground cover and erosion control.

Switchgrass - Switchgrass (*Panicum virgatum*) is a perennial, warm-season grass originally from North America. It is planted as a seed and remains a productive crop for up to 10 years. It is highly versatile, with applications in bioenergy production and carbon farming due to its dense root system.

Abbreviations/Acronyms

ACT	Academic Consultancy Training
AFBI	Agri Food and Biosciences Institute
AI	Artificial intelligence
API	Application Programming Interface

BC	Biomass Connect
BECCS	Bioenergy Carbon Capture & Storage
BFI	Biomass Feedstocks Innovation programme
CCC	Climate Change Committee
CCS	Carbon Capture & Storage
CHCx3	Centre for High Carbon Capture
C4E	Crops for Energy
DESNZ	Department for Energy Security and Net Zero
DEFRA	Department for Environment, Food and Rural Affairs
ESF	SUNY College of Environmental Science and Forestry
ETI	Energy Technologies Institute
EU	European Union
EWCO	English Woodland Creation Offer
FaS	Find a Supplier
FCT	Farm Carbon Toolkit
GHG	Greenhouse Gas Emissions.
Ha	Hectare
IPC	International Poplar Commission
IPCC	InterGovernmental Panel on Climate Change
IP	Intellectual Property
IPO	Intellectual Property Office
ISO	International Organization for Standardization
KPI	Key performance indicators
LAMMA	Lincolnshire Agricultural Machinery Manufacturing Association
LCA	Low Carbon Agriculture Show
NFU	National Farmers Union
NFUE	NFU Energy
NGO	Non Governmental Organisation
NI	Northern Ireland
NRAC	Nature Recovery Additional Contribution

NZIP	Net Zero Innovation Portfolio
odt	Oven Dry Tonnes
PECAG	Perennial Energy Crops Advisory Group
PCR	Project change request
PM	Project manager / Project Management / Payment milestone
POA	Price on application
R&D	Research and development
RCG	Reed Canary Grass
RHI	Renewable Heat Incentive
SEO	Search Engine Optimization
SFI	Sustainable Farming Initiative
SRC	Short Rotation Coppice
SRF	Short Rotation Forestry
SFR	Sustainable Fuel Register
STEM	Science, Technology, Engineering and Mathematics
SUNY	State University of New York
TBC	To be confirmed
TRL	Technical Readiness Level
Q	Quarter
UK	United Kingdom
UI	User interface
US	United States of America
UX	User Experience
VA	Virtual assistant
VAT	Value Added Tax
WP	Work Package
yr	Year

2. Consortium Information

The Envirocrops project is made of four collaborative partner organisations. The Agri-Food and Biosciences Institute (AFBI), Crops for Energy (C4E), Calvium and National Farmers Union Energy (NFUE) (See Annex 1). In addition to the core collaborators, a consortium of experts within their fields (See Annex 2 Tables 9 & 10) have been utilised to help advance the Envirocrops web-app into the functional tool that it is.

2.1 Agri-Food & Biosciences Institute (AFBI)

AFBI is a research organisation in Northern Ireland focused on agriculture, food, and environmental science. It provides scientific research, innovation, and technical services to support sustainable farming, food safety, and environmental management. AFBI works across areas such as animal health, crop production, agri-environmental science, and bioenergy, offering evidence-based solutions to challenges in the agri-food sector and contributing to policy development and industry growth. AFBI has had a long standing affiliation with biomass crops and their uses, dating back to AFBI's predecessor institute (Department of Agriculture and Rural Development Science Service), producing high quality research within the field for over 40 years.

Location: AFBI's main headquarters is in Newforge Lane, Belfast, Northern Ireland. It also operates from several other locations, including Stormont, Hillsborough, and Loughgall.

Size: The institute employs around 650 staff members, including scientists, technicians, and support personnel.

Main Market Sector: AFBI operates primarily in the agri-food and biosciences sectors. Its research supports farming, food production, animal health, fisheries, and environmental protection, making it a key player in supporting sustainable practices in agriculture and food industries.

Brief History: AFBI was established in 2006 following the merger of the Department of Agriculture and Rural Development's Science Service with the Agricultural Research Institute of Northern Ireland. It was created to provide independent scientific advice, conduct research, and support government policy in agriculture, food safety, and environmental management.

AFBI plays a crucial role in addressing challenges like climate change, food security, and sustainable agriculture in Northern Ireland.

3. Project Background

The Envirocrops project is a groundbreaking initiative that aims to play a pivotal role in the United Kingdom's efforts to promote sustainable agriculture and energy production. Funded by the Department for Energy Security and Net Zero (DESNZ) under the Net Zero Innovation Portfolio[1], the project aims to harness the potential of biomass crops as a renewable resource that can support the country's transition to a low-carbon economy. With an increasing need to mitigate climate change and reduce dependency on fossil fuels, the development of renewable solutions and fossil fuel replacements has become a national priority (as outlined in the Powering Up Britain[2] and the Biomass Strategy[3]). The Envirocrops project is designed to address this need by providing a comprehensive digital tool that guides stakeholders through the process of cultivating and use of biomass crops, enabling informed decision-making at every stage.

Biomass, as a renewable source of biomaterials into the growing bioeconomy, offers the unique advantage of being both versatile and low-carbon when produced sustainably. However, its widespread adoption has been hindered by a number of barriers, including knowledge gaps, limited access to reliable data, and uncertainty about the economic viability of biomass crops. This is where the Envirocrops tool comes into play. It has been developed to address these challenges by providing a detailed, data-driven platform for stakeholders involved in biomass crop cultivation, from farmers to investors and policymakers. The tool serves as a decision-support system, offering insights into crop selection, yield predictions, environmental impacts, local contractors, and financial returns based on site-specific data.

The Envirocrops tool is an interactive web-based application that allows users to compare various biomass crops and determine the best options for their specific geographic and environmental conditions. Among the crops featured in the tool are miscanthus, willow, hemp, and short rotation forestry (SRF) that have been identified for their high energy potential and adaptability to different UK landscapes. The tool integrates comprehensive datasets, including climate information, soil characteristics, and crop performance models, enabling users to assess the potential outcomes of different crop choices.

The Envirocrops project is not only about advancing biomass adoption, it also contributes significantly to the UK's broader environmental goals. The UK has set an ambitious target of reaching net-zero carbon emissions by 2050[4], and biomass is a key component of this strategy. By replacing fossil fuels with renewable biomass for bioenergy and biomaterials production, the UK can significantly reduce its carbon footprint whilst also creating economic opportunities in rural areas. Biomass crops also offer additional environmental benefits, such as providing a means of flood mitigation and water quality protection and improving soil health and biodiversity, which align with the government's broader agricultural sustainability goals.

The Envirocrops project aligns with multiple national policies, including the UK's Clean Growth Strategy[5], which outlines the government's approach to decarbonising all sectors of the economy. Biomass is recognised in this strategy as an essential technology for decarbonising heat, power, and transportation. By supporting the wider adoption of biomass crops, the Envirocrops project helps to drive progress towards the clean growth targets and strengthens the UK's position as a leader in renewable energy innovation.

The success of the Envirocrops project is also driven by its collaborative nature. The tool was developed with input from a wide range of stakeholders, across the UK's four nations, including agricultural experts, biomass specialists, and technology developers, ensuring that it addresses the practical needs of its users. Ongoing feedback and data inputs are essential to keeping the tool up to date with the latest research, policy changes, and market trends. As the biomass sector evolves, the Envirocrops tool will continue to be updated to reflect emerging technologies, new biomass crops, and expanding market opportunities .

Looking ahead, the Envirocrops project has the potential to expand its reach beyond the UK, offering valuable lessons and technologies for other countries seeking to leverage biomass as part of their bioeconomy and net-zero strategies. The tool's modular design makes it adaptable to different geographic regions and crop types, and its emphasis on data-driven decision-making sets a high standard for biomass planning and implementation.

In conclusion, the Envirocrops project will be an essential part of the UK's bioeconomy transition, providing a critical resource for advancing biomass as a sustainable and economically viable solution for decarbonisation and climate change adaptation. By equipping stakeholders with the tools and knowledge to make informed decisions, Envirocrops is helping to unlock the potential of biomass to deliver both environmental and economic benefits on a large scale.

4. Project Overview

4.1 Aims & objectives

The Envirocrops project aims to promote the sustainable adoption of biomass crops for renewable energy and fossil fuel replacement, supporting the UK's transition to a low-carbon economy. It provides a data-driven tool to help farmers and land managers assess the suitability of biomass crops such as miscanthus, willow, hemp, and short rotation forestry, ensuring better land utilisation and higher yields. The project contributes to the UK's net-zero target by encouraging the cultivation of carbon-negative biomass resources for clean energy and sustainable materials. Additionally, it offers financial insights on biomass projects, fostering economic viability and environmental benefits. By linking users with industry suppliers,

Envirocrops strengthens the biomass supply chain and serves as a resource for academics and policymakers to inform financial interventions and policy frameworks.

The Envirocrops tool is a key resource for farmers and landowners exploring biomass crop diversification. It offers:

Benefits to individual users

- Helps users make informed decisions by providing insights on crop yield, costs, revenue potential, and environmental impact.
- Supports economic viability and profitability with financial projections, including long-term revenue, cost savings, and greenhouse gas reductions.
- Guides farmers and land managers in selecting the most suitable biomass crops, such as miscanthus, willow, hemp, and short rotation forestry, based on soil type, climate, and intended use, allowing for better land utilisation and higher yields.
- Promotes sustainable and efficient farming by encouraging crop diversification, environmentally friendly practices, and improved land use. The project seeks to provide a reliable, data-driven tool that helps users assess the suitability of biomass crops like miscanthus, willow, hemp, and short rotation forestry (SRF). By providing detailed information on the ecological and economic benefits of these crops, the tool encourages more widespread, sustainable cultivation.
- Makes biomass agriculture more accessible through gamified learning and user-friendly tools.

Broader Impact of the Tool

- Strengthens market confidence and growth by offering a science-backed tool that assesses biomass crop viability, reduces investment risks, and supports market expansion.
- Contributes to the UK's net-zero targets by promoting biomass as a carbon-negative resource that helps reduce emissions.
- Encourages the use of biomass as a sustainable alternative to fossil fuels in energy production and the reduction of petroleum based products. The project could plat a vital role in the UK's strategy to achieve net-zero emissions by 2050. Biomass crops, when grown sustainably, are carbon-negative resources. In addition, biomass crops can help replace single use plastics and other fossil fuel derived materials. The tool thus supports the national clean energy agenda by facilitating the adoption of renewable biomass resources.
- Enhances the biomass supply chain by connecting users with industry suppliers to create a more resilient and cohesive market.

- Fosters collaboration by providing a platform for farmers, suppliers, researchers, and stakeholders to share best practices, drive innovation, create a cohesive biomass crop market, and form a more resilient supply chain.

The Envirocrops project aims to accelerate the adoption of biomass crops by providing a comprehensive, science-based tool that supports both sustainable land use and biomass crop production. This tool is integral to achieving the UK's long-term environmental and economic goals.

4.2 Schedule, deliverables, & financial information

The full project schedule is included in Annex 3 (Table 11) and highlights the deliverables, their description, original scheduled cost from the schedule 3 document, and actual cost. At the time of writing this report, the figures in PM6 could be subject to change.

5. Lot 1 Technical requirements

5.1 The design & development of the innovation

5.1.1 Web app conception

The original concept for the web app was to build on the feasibility study outputs (tables, calculators, spreadsheets etc) that have been developed and refined by C4E over the last 20 years. The key improvement on these tools was to make them freely available and agile. When such information is used in a report it is static and represents a snapshot in time. The Envirocrops tool enables users to return to the app and look again and again at their liberty so as things change they can see the new financial state of affairs.

The sort of things that can change that will affect the economic outcomes include:

- Prices of commodities (both the biomass crops and food crop counterfactuals)
- Innovations are introduced (e.g. new machinery reduces costs and new varieties enable increased yields)
- Geopolitical events impact on markets positively or negatively
- Grants and incentives are introduced or removed

- New markets and contracts for biomass crops become available.

As the tool was built based on the consultancy services offered by C4E, it is eminently sensible to relate potential savings from using Envirocrops compared to the price of consultancy services provided by C4E. A typical feasibility study carried out by C4E for a farmer looking at the biomass crop options and the potential use in a biomass boiler is £950 plus VAT. A feasibility study for a landowner such as a power station, waste management company or water company is in the range £3,500-£5,000 plus VAT. The availability of Envirocrops will not always fully replace the advice of a consultant as some users will inevitably prefer to use the tool as an initial no-cost pre-feasibility and then rely on additional advice especially when large investment sums are involved. However, in all cases Envirocrops will be highly accessible, completely free and enable users to refine and reduce the number of options available.

5.1.2 Web app and Cropper game design and development

The Envirocrops web application (as seen in Figure 1) and the Cropper game were developed using a structured software engineering approach, ensuring they were user-friendly, scalable, and aligned with the needs of key stakeholders. The development process followed industry best practices, including requirements analysis, system architecture design, iterative development, user testing, and deployment.

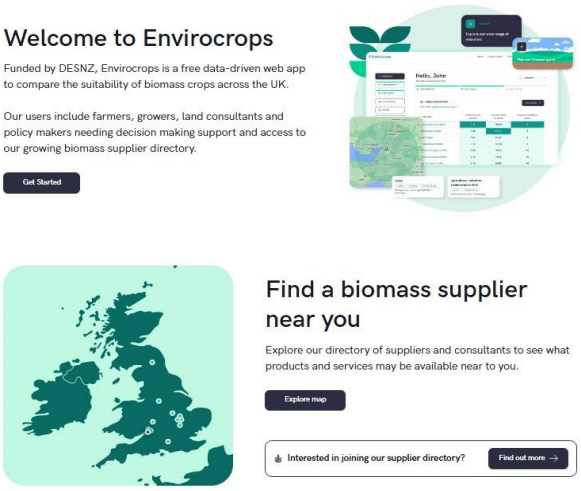

Figure 1: *The Envirocrops.com homepage.*

Envirocrops web application

1. Requirements gathering and user research

The initial phase of development involved extensive consultation with farmers, land managers, consultants, and policymakers to determine the specific challenges they faced when considering

biomass crops. Workshops, surveys, and prototype testing were conducted to define core functionalities and ensure the app aligned with user needs.

2. System architecture and technology stack

The web application was designed as a progressive web app (PWA) to ensure cross-platform compatibility, enabling access on desktops, tablets, and mobile devices.

- The frontend user interface (UI) was built using React.js and TypeScript, chosen for their efficiency, maintainability, and ability to create a dynamic, responsive experience.
- The backend was implemented using Next.js framework, providing a lightweight and scalable server-side solution.
- A MySQL database was selected to store all user-provided data, including information about their own growing scenarios and user preferences.
- All textual information is stored in a CMS powered by Strapi, ensuring maximum flexibility in terms of displayed content
- The app integrates a GIS (Geographic Information Systems) model to make location-based yield estimations

3. UI/UX design and user experience optimisation

A key focus was creating an intuitive and visually appealing interface. The design followed user-centred design (UCD) principles, ensuring that:

- The navigation structure was simple and logical.
- Users could enter basic data (e.g., postcode, land area) with minimal effort.
- The results were presented in a clear and engaging manner, using charts, infographics, and interactive elements.
- A progressive disclosure approach was used to provide detailed insights without overwhelming users.

Wireframing and prototyping:

The UI was first designed using Adobe Illustrator and Sketch, allowing for iterative feedback cycles before full development began.

4. Development, testing and deployment

- The software was developed iteratively using an Agile approach.
- The system underwent rigorous testing, including unit tests with Jest, integration testing, usability testing, and security audits.
- The final system was deployed using Docker containers over Digital Ocean droplets to ensure scalability and reliability.

Cropper game design and development process

1. Game concept and mechanics design

Cropper was designed to be both engaging and educational, using gamification principles to teach players about the complexities of biomass crop cultivation. The development team

worked closely with agricultural experts to ensure the in-game mechanics reflected real-world decision-making processes.

Key mechanics included:

- Players advance through a 10-year simulation, making strategic choices on crop selection, land management, and financial investments.
- Players must balance costs, labour, and environmental conditions to maximise their yield and profitability.
- Randomised weather changes, pest infestations, and government policy shifts, challenging players to adapt.
- Success is measured by scoring systems based on overall biomass yield and financial returns.

2. Game engine and development tools

Engine choice: The game was built using React, following industry-leading web standards to ensure performance and accessibility

- Graphic assets for the UI were designed in Adobe Illustrator and Sketch, ensuring a clean and engaging visual style.
- Game scores are saved using a MySQL database

3. Playtesting and user feedback

Extensive playtesting was conducted with:

- Agriculture students and STEM learners to validate the educational aspects.
- Farmers and landowners to assess realism and relevance.
- Casual users to refine gameplay balance and engagement.

4. Deployment and future updates

- The game was optimised for web-based play, hosted via the Envirocrops platform.

As state in the sections above, the web abb and the game took several forms before being released publicly. The technology readiness level is listed in Table 1 below, highlighting prototype development over the course of the project.

Table 1: Web application technical readiness level (TRL) timeline.

Release	TRL Level	Release date
Phase 1 Proof of concept web app	TRL 6 Technology model or prototype demonstration in a relevant environment. Demonstrations and focus groups with the proof of concept to obtain industry, professional and potential user feedback	2021
Cropper game https://envirocrops.com/play	TRL 9 Actual technology qualified through successful mission operations. The Cropper game has been used by real users at events, in academic settings and by industry.	Dec 2022, Last updated in 2024.
Alpha release	TRL 8 Actual technology completed and qualified through test and demonstration. Demonstrations and focus groups with the proof of concept to obtain industry, professional and potential user feedback.	March 2023

Release	TRL Level	Release date
Beta release	TRL 9 Actual technology qualified through successful mission operations. Envirocrops.com web app has been thoroughly demonstrated to, tested by and reviewed by a myriad of user types including the core project team, subcontractors, wider stakeholders including PECAG, the monitoring officer(s), DESNZ programme lead. Users can sign up, enter their information and generate an array of guidance data based on their requirements e.g. yield prediction or land required. Additional features such as the marketplace for biomass products and services, Find a Supplier (FaS) network/directory, and best practice guidelines are all available in this release.	March 2024 Last updated October 2024
Production release	TRL 9 Actual technology qualified through successful mission operations. Envirocrops.com production release contains updates, bug fixes and tweaks to Beta based on feedback received in Year 3. The Envirocrops.com product is live and is being used by real users.	March 2025

5.2 Key features of the tool

The Envirocrops tool provides tailored recommendations by combining user inputs such as postcode, and intended use (e.g., heat a farm, a home, or supply a district heating network, or power station), allowing the user get location and proejct specific results. With modelled data on soil, climate, and other variables. It offers projections on crop yields, economic returns, and environmental benefits to support data-driven decisions and reduce investment risks. Financial modelling features provide cost-benefit analyses, including energy revenue and carbon savings, showcasing biomass as a profitable option. The tool also connects users with suppliers,

contractors, and markets via a Marketplace, with plans to incorporate comparisons for crops grown with and without future financial support schemes.

In summary, Envirocrops has 11 key features:

- Economic and logistical calculators
    - Enables users to gain output information comparing eight different biomass crops in three different user goals as a producer, self supplier, end user.
- Postcode yield predictor
    - Enables users to estimate the modelled yield data for the field location that they want to plant. It uses modelled yield figures for 2,855 1 km grids across the UK.
- Simple calculators
    - Allows users to get specific headline figures for different user goals and some aspects relating to logistics
- Carbon calculators
    - Calculators that allow users to see the carbon reduction from replacing fossil fuels with biomass fuels and growing biomass crops compared to current land use.
- Legislation calculators
    - Provides legal information on what a user needs to do before planting and when they use the products.
- Crop types
    - Simple, concise pages of information on each crop type and a slider allowing users to see the stature of different crops throughout their cropping cycles.
- Best practice Guidelines (BPGs)
- News features
- Articles
- Find a Supplier (FaS)
    - Enables "suppliers" to be listed on the site and provide information about what they do relating to biomass crops.
- Marketplace
    - Lists all the products and services offered by suppliers listed on the site.

Please see Annex 4 (Table 12) for an overview of all the key features of the web app, how they work and how they will help users. The decision making process indicating how the web app evolved is described in Annex 5 Table 13.

5.3 Demonstration & results

As part of the Phase 2 kick off meeting it was decided that the quantitative key performance indicators (KPIs) for the project should be the number of overall visitors to the web app and the

number of game plays of Cropper. The comparison of the project's performance against these targets is outlined in Table 2. In addition we have included additional quantitative metrics which were not part of the original KPIs.

Table 2: Evirocrops.com online engagement figures compared to original KPIs.

KPI Description	Project target	KPI met	Latest figures
Visitors (not signed in)	5,000	Achieved	**12,978** visits (**7,375** unique)
Game plays of Cropper	1,000	Achieved	**7,792 plays**
Users (registered)	None set. We will continue to drive potential users to sign up. Commercialisation opportunities could help increase user numbers (Section 6).	Not applicable	**466 users**
Suppliers in FaS Network	None set. We aim to have 75-100 suppliers by the end of March 2025.	Not applicable	**94 live**

5.4 Contribution to increasing sustainable UK biomass supply

Global priorities are increasingly focused on addressing climate change, with a growing recognition that it requires action across all sectors. A sustainable biomass crop supply chain represents a critical component of the UK's efforts to transition towards a bioeconomy. As reliance on petrochemical-derived carbon diminishes, biomass will serve as the primary source of biogenic carbon for producing chemicals, materials, energy, and biofuels such as sustainable aviation fuel (SAF), methane, and methanol.

Envirocrops plays a vital role in overcoming barriers to expanding the UK's biomass supply. It addresses the lack of reliable, independent information for farmers, landowners, and biomass organisations by providing regionally specific data on the costs, benefits, and logistics of biomass cultivation. With features like “Marketplace” and FaS, Envirocrops offers access to resources, information, and networks critical for the development of a sustainable biomass sector.

Envirocrops has established a robust network of suppliers, researchers, and stakeholders strategically positioned across the UK. This network ensures consistent, well-informed support for the sector. Collaboration with Lot 1 projects such as Willow Energy (Net Zero Willow), Rothamsted Research (Accelerated Willow Breeding Deployment AWBD), New Energy Farms (TEMPEC), IBERS (Miscanspeed) and Terravesta (OMENZ) ensures that the information provided is accurate, contemporary, and relevant. This will be further developed as we work with a new set of partners as part of the Centre for High Carbon Capture Cropping (CHCx3) project which covers other crops such as hemp and flax (see Sections 6.4 and 7.4.3).

Envirocrops is particularly impactful as a gateway tool for farmers and landowners exploring biomass crops. By offering free, impartial, and comprehensive resources, it enables users to evaluate potential crops like willow, miscanthus, hemp, and reed canary grass, along with expected yields, costs, profits, and environmental benefits. This accessibility reduces the need for high up-front cost feasibility studies, making biomass cultivation a viable option for a broader audience.

The integration of biomass crops into UK agriculture offers multiple benefits, including:

- Environmental Gains - Biomass crops support carbon sequestration, biodiversity, and soil health while reducing reliance on fossil-based resources.
- Economic Opportunities - Biomass crops provide raw materials for renewable energy, bedding, chemicals, and more, fostering new markets and businesses within the bioeconomy.
- Land Diversification - These crops offer an innovative approach to repurposing underutilised or marginal land sustainably.

Envirocrops is designed to support all parts of the supply chain - growers, traders, project developers and end-users by upskilling users who may have little to no prior knowledge of biomass. By lowering entry barriers and encouraging exploration, the platform positions biomass crops as a cornerstone for the UK’s sustainable development. Although fiscal incentives and market opportunities for biomass crops remain limited, Envirocrops provides the foundation for significant sector growth. By increasing awareness, education and accessibility, the tool enables informed decision-making, which can lead to increased biomass cultivation, the establishment of new businesses and the development of a sustainable, bio-based economy in the UK.

We have no way of accurately knowing if anyone who has used the web app has gone on to plant biomass crops currently. As decisions on perennial biomass crops can be formulated over a number of years it is likely to be too soon to see any upturn. However, we can use the analytics to indicate a value of the knowledge exchange provided and consultancy fees avoided. If we assume that just 10% of our unique visitors are land managers, traders or end users that have used the web app to help them shape a business decision, then that equates to 306 people/businesses. If we also assume that they have gained answers to their questions similar in value to those provided by the basic C4E feasibility study (costing £950), then we can monetise this benefit to our target audience as a saving of £290,700. This could be viewed as a substantial initial payback on the £1.57 million (exc. VAT) invested by DESNZ in the project.

5.5 Key successes

In creating Envirocrops we are aspiring to be an information and decision making portal that is widely recognised for its credibility, rigour, impartiality and knowledge exchange potential. We have achieved this with almost all of our target audiences in the following ways:

- We are moving towards getting all of the main organisations within the nascent biomass crops sector on our FaS facility. Currently we have 94 suppliers onboarded with the intention of having 125 listed by the end of the project. We are working with suppliers and offering support to make sure that profiles are well developed and their most important products and services listed. The rapid increase in the number of suppliers indicates that our presence is welcomed by the industry and academic organisations. The association we have created with Farm Carbon Toolkit also vindicates the favourable industry view of Envirocrops as they are the most popular UK carbon calculator with 16,000 unique users[6].
- We are fully engaged with and accepted by academic organisations through the networks of Biomass Connect and the Centre for High Carbon Capture (CHCx3) project. The fact that we have already achieved some follow up funding (as part of the latter consortium) to continue Envirocrops post March 2025 bears testament to the favourable view that we are held in by academic organisations.
- We have collaborated with Government departments and devolved bodies during the development of the project. Throughout the phase 2 process we have had 12 meetings with DEFRA officials representing the Forestry Innovation remit. Kevin Lindegaard of Crops for Energy has participated in meetings, consultation events and responses to the Scottish and Welsh Government. It is early days but we are building bridges with key contacts within policy teams. As such, most policymakers in the sector will be aware of Envirocrops.

- We have gained interest from academic organisations and industry participants from beyond the UK. We were invited into a consortium to participate in a successful bid for US Department of Energy funding (see section 6.4) and gained much attention when we participated in and presented at the 27th Session of the International Poplar Convention (IPC) Fast-Growing Trees for Climate Change Mitigation and Adaptation: Pathways to Climate Resilience and Carbon Neutral Societies, that took place from 22-25 October 2024 in Bordeaux, France, This indicates that what we are doing is a world class innovation and that people are interested in working with us to replicate the platform in their countries.
- We have managed to gain interest from the next generation of decision makers. The Cropper STEM game has been designed to provide a fun and engaging way of upskilling people, particularly students and young farmers. We cannot be sure of the demographic of individual game players. However, we do know that there are 20,000 agricultural students in the UK. The game has currently been played by 2,250 unique users. If we assume that the majority of game players are young then this would suggest an 11% impact on an important target group. We have seen a large spike in game plays following promotion of the game on the Olly Blogs YouTube channel. Olly Harrison is very popular with young farmers (145,000 subscribers) and statistics suggest that the 16-24 year old age group is the most likely group to play online games (83%) it is safe to assume that he has influenced this demographic more than others[7]. Furthermore, we have used the tool with students from Berkshire College of Agriculture and Royal Agriculture University and colleagues (not part of the consortium) have used the tool for training at Queen's University Belfast, Bishop Burton College and Myerscough College.

5.6 Persistent barriers

Below is listed some of the key challenges and barriers faced by the project and how they were overcome.

Evidence Base

Project aspirations:

- A core objective of the web app was to enable users to input a postcode or grid reference and obtain yield estimates for various crops in that location. Achieving this required:
    - Updated yield models for SRC willow and miscanthus from the University of Aberdeen.
    - Yield data from academic institutions, industry, and farmers.

    - Acceptance that, due to limited trial and commercial data for some crops, generic yield estimates would be necessary.

Key challenges included:

- In the alpha and beta releases, postcode data was problematic, as fields near urban areas, lakes, or forests (within a 1 km² area) often returned no results.
- Updated models assessed crops in isolation rather than in comparison to alternatives. Testing showed that miscanthus consistently outperformed SRC willow.
- Yield data from the commercial sector was difficult to obtain, as some organisations were reluctant to disclose grower locations.

Mitigation strategies:

- The commercial release removed restrictions based on current land use, allowing yield estimates at any location. This serves as a temporary solution.
- The miscanthus vs. SRC willow discrepancy will be addressed as additional data is integrated, particularly from Biomass Connect demonstrator sites, where 11 biomass crop types are grown under identical conditions.
- Data gaps have been addressed by collaborating with other projects (e.g., acquiring willow and miscanthus data from CHCx3) and leveraging a PhD student to measure willow stem diameters at multiple sites.

Carbon modelling

Project aspiration: An important feature of the web app was the ability to compare the carbon savings of biomass crops against conventional agriculture, considering both above-ground carbon storage and below-ground sequestration. This functionality was expected to appeal to farmers increasingly interested in carbon monetisation.

Early challenges included:

- The complexity of carbon modelling.
- A lack of in-house expertise and capacity within the project team.
- The high cost and time constraints associated with hiring a dedicated specialist.

Mitigation strategies:

- Engaged postgraduate students from Wageningen University's Academic Consultancy Training course, resulting in a comprehensive review of carbon farming science and policy.
- Established a collaboration with the Farm Carbon Toolkit, integrating their carbon calculator with the biomass yield data via an API link. This integration will be further developed in the CHCx3 project.

User engagement

Project aspiration: The project aimed to engage a broad audience, including both experts and novices, to maximise user feedback and uptake.

Engagement proved challenging due to:

- A limited pool of biomass crop professionals, many of whom were already involved in other BFI projects or management boards, reducing their availability for in-depth feedback.
- A general lack of incentives for farmers to adopt biomass crops, leading to widespread ambivalence. However, policy changes or market developments could drive increased interest in the future.

Mitigation strategies:

- Provided a day rate for PECAG participants and adopted a flexible membership approach.
- Relied more on internal project team and subcontractor feedback.
- Utilised the Cropper game as an engagement tool, particularly for students, by offering training sessions, prizes, and merchandise.
- Promoted the web app extensively through events, print and social media, and international presentations.
- Engaged influencer Olly Harrison ("Olly Blogs") to promote the Cropper game and web app.
- Conducted stakeholder interviews, published on YouTube, with support from a student advisor.
- Proactively reached out to supply chain companies, integrating them into the Find a Supplier Network.

As a result, awareness of Envirocrops within the target audience has significantly increased.

User Experience

Project aspiration: The web app aimed to simplify a complex subject, providing users with a one-stop shop for biomass crop information. Initially, the economic calculators were designed to function similarly to a price comparison tool.

Persistent barrier to innovation: Comparing crops with different growth cycles (1, 3, 5, 8+ years) proved challenging. While the tool provides useful comparisons, it became evident that different biomass crops are not directly equivalent, making economic analysis more nuanced.

Mitigation Strategies:

- Developed standalone calculators for quick assessments.
- Exploring options to allow users to compare a subset of crops (e.g., miscanthus vs. willow or miscanthus vs. reed canary grass) rather than all options at once.

Project Management

Project aspiration: Maintaining team continuity was a key goal, though challenging within a three-year project.

Persistent barrier to innovation: Staff turnover impacted both the project team and external partners. There were two DESNZ project leads, three monitoring officers, and four different NFUE leads for the outreach work package.

Mitigation strategy: Effective project management and detailed handovers ensured continuity despite personnel changes.

Commercialisation and legacy

Project aspiration: The original commercialisation strategy aimed to generate revenue through high user engagement, leading to income from transactions, advertising, and subscriptions—ultimately achieving financial self-sufficiency.

Persistent barriers to innovation: The lack of government incentives for biomass crops has limited adoption of the web app. While user numbers are strong, they remain insufficient to sustain a revenue model based on monetised activities.

Mitigation strategies:

- Pivoted towards positioning Envirocrops as a knowledge exchange platform for biomass-related R&D projects. By integrating research outputs from initiatives like CHCx3, the platform ensures project findings reach a wider audience even after individual projects conclude.
- This approach supports long-term sustainability, allowing Envirocrops to expand while maintaining existing content.
- The consolidated resource will improve SEO rankings, increase user engagement, and potentially enable revenue generation over time.
- Initial discussions with SUNY suggest interest in replicating Envirocrops features internationally at a fraction of the original development cost.

5.7 Impact of the innovation on greenhouse gas emissions

It is too early to measure the impact of the Envirocrops web app on greenhouse gas emissions (GHG). As mentioned in Section 5.4 it can take land owners several years to make the decision to plant a perennial biomass crop; these crops remain in the ground for a minimum of 20 years and therefore it is not a decision that is taken lightly.

However, over the course of the project, we set out a number of potential scenarios where biomass crops could play a role in facilitating the transition to a bioeconomy and meeting some key environmental targets covered by existing UK government policy:

- Reduction in phosphorus pollution by 2038 (by using buffer strips of biomass crops to prevent phosphorus rich runoff from land reaching water courses)
- Phasing out the use of peat in professional horticulture by 2030 (by replacing peat with materials processed from wood fibre from biomass crops)
- Reduction in GHG from livestock (by using willow as a feed supplement reducing the amount of digestive GHGs produced by ruminants)
- Single use plastic ban from 2023 (by using biomass crop feedstocks to produce sustainable alternatives).

Envircrops has the predictive carbon savings feature, developed in conjunction with FCT. As an example, based upon this calculator, if a farmer was to use the tool to plant high input cattle grazing and silage land into SRC will, they would abstain a potential carbon savings of 91.72 tCO_2e per hectare over the next 20 years. If they planted 10 ha, which would be the estimated amount of land required to make it financially viable, this would equate to 917.20 tCO_2e per hectare over the next 20 years. However this is only based on changing a single system to a single biomass crop, hence extremely speculative. For Envirocrops to contribute significantly to GHG reduction, this requires the uptake of biomass crops in industry to encourage planting.

What should be noted, the carbon calculator is supposed to be an estimate of the potential savings. The user can then proceed on to the FCT tool to get a whole farm carbon analysis which can help with looking in to their life cycle analysis. Currently consumers of biomass are primarily limited to consumption for energy, if more biomass was being utilised for other avenues, such as biocomposites and long lasting building materials, this would be an easy prediction of how much GHG removal has occurred, but has not been explored in this iteration of the web app.

In our view, Envirocrops is in a prime position to create GHG calculators for these sectors. These calculators could be used by stakeholders to test what incentives are affordable and acceptable to farmers. Farmers who use the calculators and subsequently decide to plant biomass crops for these purposes would therefore facilitate the large-scale decarbonisation of agriculture and horticulture sectors whilst also improving water quality and reducing waste. As such, Envirocrops could be a major enabler to achieving significant GHG reductions and helping the UK meet NZ targets.

5.8 Lessons learned

The Envirocrops.com production release can provide users with the information they will require to successfully grow a variety of biomass crops. Table 3 highlights some of our key learnings gathered during the delivery of the web app.

Table 3: Breakdown of lessons learned from developing the Envirocrops web app.

Area	Description	How challenges were overcome
User adoption	1. Research with potential users including growers, land owners, farmers, and consultants, confirms that external factors including financial risk, lack of support schemes are major obstacles to planting. 2. Sustainability/environmental benefits alone are not enough to drive mass uptake of biomass crop planting (farmers will only act once subsidies support these elements). 3. Factors impacting the early adoption of the Envirocrops.com biomass predictions calculator (listed in points 1 and 2) are beyond the control of the project team.	The team have advocated for financial incentives, explored alternative funding sources and tried to connect farmers and end-users through in person events, and now via the marketplace and FaS list.
UX/UI design	1. The design process was difficult for all contributors to understand, leading to the redesign of some features once developed. Complex user interface (UI) design changes are always demonstrated and discussed in detail before proceeding with development. 2. It can be difficult to understand feedback without being a biomass industry expert. The project team meets weekly and/or bi weekly to ensure collaborators have access to experts when required. 3. Design accuracy in the UI for farming tools, crop heights etc is imperative.	Used wireframes and prototypes, involved end-users as early as possible, and scheduled expert review sessions with the PECAG to improve design accuracy.

Area	Description	How challenges were overcome
User testing Cropper	1. We have made minor updates to the Cropper game to help improve usability in academic settings e.g. adding a leaderboard in year 3 2. The target age for the game was increased during year 1 due to concerns regarding the complexity from various feedback sources	The team provided tutorials at agri-colleges, and also collaborated with educators at Queen's University Belfast to enhance usability.
User testing Web app	1. Comparison of all the crops is quite difficult to display. Different stakeholders have preferences for their crop/sub industry. 2. Presenting all the information can be too much information.	Implemented customisable views, simplified comparisons, additionally this was assisted through PECAG meetings.
Content Creation	1. Content refers to all text and images which can be found on Envirocrops.com or any supporting materials - this has sometimes presented difficulties with tone of voice, branding, image quality and image sourcing.	Any issues have been dealt with. Quality control of content is an ongoing and iterative process. This was achieved by creating a brand guide, implement a structured approval process, and create a high-quality image library.

Area	Description	How challenges were overcome
Demonstrations	1. Demonstrations of the web app can be difficult at events due to: a. Technical - Wifi, screen/laptop visibility b. Time needed for a full platform demonstration c. Popular seminars on trending topics or freebies from other exhibitors 2. Cropper game has been very well received at demonstration and training events e.g. Berkshire College in 2023 3. Virtual demonstrations need planning to ensure the discussion is on helpful and constructive topics to support the project.	This was overcome by conducting pre-event tech checks, developing informative video displays and banners, and using incentives, such as branded gloves and wellyboot bags, to attract and retain audience interest.
Analytics/ KPIs	1. The analytics show promising growth in the number of visitors, but the user sign ups which allow a user to go through the biomass calculators are not increasing at the speed we had originally hoped. 2. Growing the Envirocrops community is key to achieving the project aims, and so the analytics monitored must also include: a. Number of supplier sign ups b. Number of Cropper game plays	This is an ongoing issue that could be tackled by streamlining the sign-up process to create more interest in the app form the landing page, running targeted marketing campaigns, and building a strong user community.

Table 4: Impact of promotional events on website traffic

Event	Impact
Newsletter Dec 2022	648 pageviews, 500 uniques (+100%)
LCA show Feb 2023	1,705 pageviews, 584 uniques

Event	Impact
British Farmer and Grower Article 03/2023	2,189 pageviews, 731 uniques (+17.2%)
Olly Blogs first mention 12/5/2023	8,518 pageviews, 3,711 uniques (+476.7%)
Groundswell Jun 2023	1,799 pageviews, 966 uniques
Competition launch 08/2023	1,341 pageviews, 659 uniques
Confor woodland show 21-22/9/2023	698 pageviews, 350 uniques
Training at BCA 10/2023	5,078 pageviews, 1,481 uniques (+177.3%)
Woodheat conference 10/11/2023	1,278 pageviews, 637 uniques
LCA show 6-7/3/2024	3,037 pageviews, 1,650 uniques (+170.2%)
Berkshire young farmers 28/03/2024	2,233 pageviews, 1,383 unique
Groundswell 26-27/06/2024	1,473 pageviews, 957 unique pageviews (+6.9%)
IPC Bordeaux 25-28/10/2024	4,757 pageviews, 2,731 uniques (+18.1%)
Biomass Connect Demonstration Event 7/11/2024	3,526 pageviews, 2,177 uniques
Olly blogs second mention 18/11/2024	4,189 pageviews, 2,539 uniques

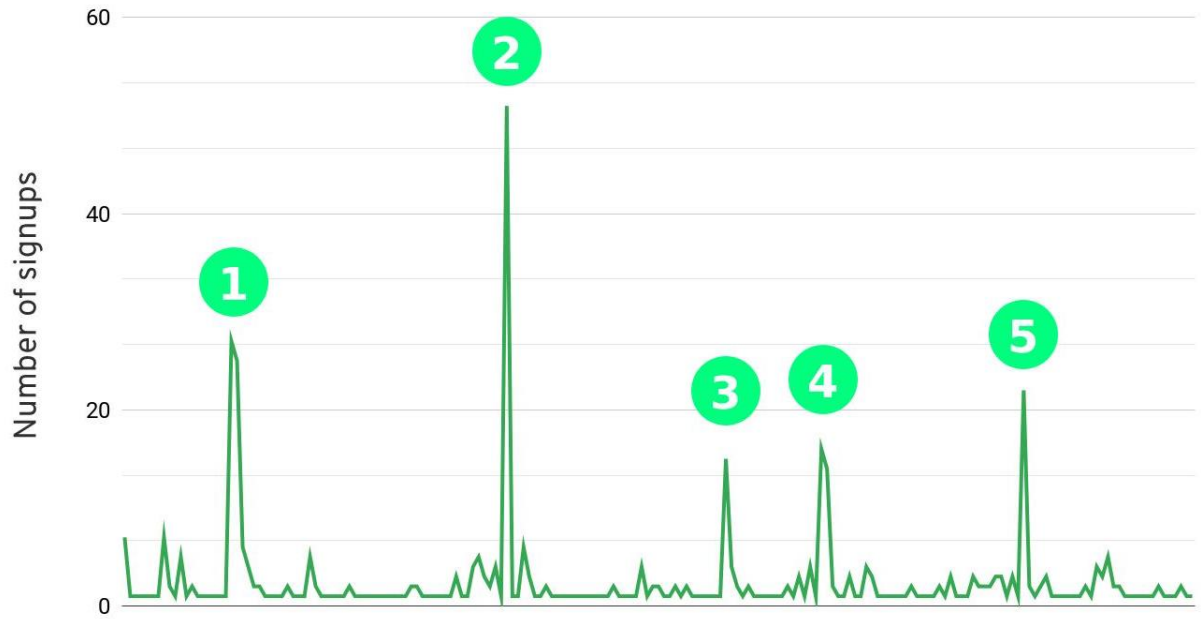

Figure 2: *Impact of promotional events on web app signups over time.*

1. Olly's first blog mention, 12/05/2023
2. Competition launch, 08/2023
3. LCA show, 06-07/03/2024
4. Groundswell, 26-27/06/2024
5. Biomass Connect Demonstration Event, 07/11/2024.

6. Commercialisation

The commercialisation exploration for Envirocrops considered a variety of revenue streams, with outcomes guiding the development of web app features and online resources. End user and industry professional feedback has been recorded via feedback forms and meetings, with findings also supporting the refinement of the cropper game and the user interface of the web app.

Post DESNZ funding, Envirocrops.com will prioritise revenue from the following channels:

1. Promoted products will be the first paid-for feature.
   Once set up, any organisation with a supplier account will be able to purchase a promotion directly in the web app on a per product basis.
2. Partnership and project opportunities as described 6.4 Alternative commercial opportunity exploration and Table 8: Follow on funding achieved during the project.

6.1 Exploration of membership fees

Research into similar tools and services including Magic Map and NFU membership highlights commercial channels which are similar to the Envirocrops.com offering, but indicates that there is a viable market gap for a free product like Envirocrops.

The Envirocrops project team, supported by desk research, conversations with industry professionals and interested farmers and growers, decided that charging membership fees to use the tool in 2025 would be counter-productive to the project aims and objectives outlined here (4.1 Aims and Objectives).

Growing the user base of Envirocrops, Find a Supplier network and associated marketplace products, will ensure Envirocrops.com is positioned as the leading resource for biomass crop information, support, contacts and supplies in the UK. We plan to keep operating as a free tool until 2026 when we will reevaluate the commercial potential of the platform.

If Envirocrops cannot secure future funding to maintain the platform via projects, a nominal membership fee could be introduced to users who wish to access the complex calculators. We can also introduce a yearly subscription fee for companies to join the supplier network.

The Advisory Group feedback form 2024 (20 responses)

- 12/20 do not pay for similar industry membership services
- Several responses cited costs as being a deciding factor on whether they were members of an industry org e.g
    - ‘quite expensive’
    - ‘fabulously run industry organisation. and cheap too’
- When asked if they would pay for access to Envirocrops.com
    - No - 15 responses
    - Yes - 5 responses
    - Comments made cited costs, and whether this is a tool growers would reliably revisit and reuse the calculators and therefore need an ongoing membership, or whether that is better suited to the marketplace users e.g suppliers.

We have consistently heard through all outreach activities that our target user group is financially driven, above other benefits such as farm carbon reduction. Without financial incentives to use the tool, the uptake of users exploring biomass crop planting is low in the UK.

A subscription fee for the suppliers could be introduced provided the benefits are proven to the suppliers such as product listing on an easy to use website with a growing network of X+ unique visitors per month. Analytics are in place to support this, however the success is reliant on traffic increasing significantly.

6.2 Exploration of paid-for features

This investigation included an assessment of monetising the **Find a Supplier** feature, which has been refined based on feedback from suppliers onboarding and the advisory group, including the product categories and the ability to promote specific products and services within the marketplace, which will be a paid-for feature.

The suitability rating in Table 5 below is based upon how easily the feature can be incorporated into the app, the likelihood to be used by users and severity of the risks associated.
Please note that the suitability score is not indicative of potential revenue**.**

Table 5: Summary of paid for features and their suitability.

Feature in Envirocrops.com	Suitability as a paid-for feature	Comments	Outcome
Promoted products and services in the marketplace *Please note: Promoted products are separate to the calculators and appear in the marketplace only. 'Promoted' will be a paid for add on for time sensitive products - it is not an endorsement. It is the same concept as a 'sponsored' result on Google, Facebook Marketplace, Ebay etc.*	5/5	This will require a payment method adding which can be achieved by integrating a payment option such as Stripe. A payment method could be implemented very quickly (<5 days) for low costs. Functionality to promote a product is available for free to all existing suppliers however we recognise this will need limits as the network grows.	Payment likely to be implemented in 2025/2026

Feature in Envirocrops.com	Suitability as a paid-for feature	Comments	Outcome
The ability to add additional scenarios into the dashboard	2/5	Originally we thought this would be an opportunity to gain additional interest from consultants. We decided at this stage that having this as a free option is preferred.	There is not enough call on consultants to make this a saleable option at present.
Access to additional resources Please note e.g. blogs, new calculators	0/5	To help support the planting of biomass crops, the resources available should be free and easy to use.	Not applicable
Pay per transaction costs	1/5	Enviropcrops.com cannot stop platform users from going direct to the supplier, to avoid fees. It is predicted that this would not scale up with usage and would be difficult to justify the transaction fees for future or repeat purchases. Risks: 1. The value of a transaction may need to be a % of the purchase a. This makes sales revenue much more difficult to predict b. Speaking with farmers and suppliers at events in years 1-3, this would be a barrier to entry as they are losing revenue to Envirocrops.com	The legal risks cannot be mitigated satisfactorily to enable Envirocrops to proceed with implementing transactional fees at this time.

Feature in Envirocrops.com	Suitability as a paid-for feature	Comments	Outcome
		c. It would be difficult to build a business on unpredictable revenue streams such as transactional fees, without proving the suppliers' and buyers' habits for these products and services which is unavailable for biomass products and services. 2. If member costs are implemented, a supplier is less likely to justify additional costs when making a purchase via Envirocrops.com 3. Who pays the transaction fee? Is this the purchaser, supplier or both? 4. Legal risks - if the supplier does not deliver to the specification 5. Default on payment, or processing of returns or faulty goods 6. Option to pay outside of the system means repeat sales will be unlikely to occur 7. In order to manage payments, we would need to force all buyers to log in or have a 'guest checkout'.	

Feature in Envirocrops.com	Suitability as a paid-for feature	Comments	Outcome
Pay per click fees for suppliers	4/5	Further exploration planned to explore charging fees for visitors clicking through to a suppliers website via Envirocrops.com supplier network using Matomo analytics to predict potential income value and give insight into whether a membership fee would provide higher return. In addition, we need to discuss this with existing and potential new suppliers to determine if this is a potential income stream beyond March 2025	Possible future commercial option if supported by analytics and further discussion with suppliers.

6.3 Revenue predictions

Considering the findings in Table 5, the best commercial route forward in terms of achievable revenue with the least risk during 2025/2026 is to implement paid for promotion on products and services, whilst continuing to grow the supplier network.

Table 6 is based upon 100 sales per year being made through the Envirocrops.com platform. This would be where a user searches, finds and proceeds to make a payment within the web app, and Envirocrops would charge a fee for each transaction. It highlights the limited benefit of implementing a fee per transaction business model, in comparison to the less risky paid for promotion which could offer similar or high revenue without the legal risks.

Table 7 is based upon 25% of the suppliers currently in the system promoting 4 products per year, or alternatively 100% of the suppliers in the network promoting 1 product per year. We are capturing analytics to create supporting data to market this feature to existing suppliers in 2025/2026.

Table 6: Estimated revenue potential from transaction fees on Envirocrops.com.

Cost Options (per transaction)	**Revenue over 1 year** (1 sale per supplier, 100 suppliers)	**Revenue over 5 years** (5 sales per supplier, 100 suppliers)

£5.00	£500	£2,500
£10.00	£1,000	£5,000
% of transaction cost (assuming 10% fees) £500 transaction, £50 per transaction fee	£5,000	£25,000

Table 7: Estimated revenue potential from product promotion fees on Envirocrops.com.

Paid Promoted Products	**Revenue over 1 year** **(25 suppliers promote 4 products per year)**	**Revenue over 5 years** **(25 suppliers promote 4 products per year)**
£10.00 per promotion per week	£1000	£5,000
£25.00 per promotion per month	£2500	£12,500

Exploration

Keeping Envirocrops.com hosted and supported beyond March 2025 is a target of the project team.We do not predict a significant surge in new UK based Envirocrops.com calculator users, driven largely by a lack of any financial security and support for growers of biomass crops.

Based on limited users and findings outlined in section 6.1, it is too high risk to rely on membership fees e.g farmers, landowners etc. Paid for promotion presents as the most suitable commercial channel with the lowest risk to Envirocrops.com at this time, with a roadmap to introduce supplier listing fees in 2026 as traffic to the marketplace and supplier network increases.

We have been able to identify new opportunities to create new features for a new audience e.g. Willow production for sustainable aviation fuel (with SUNY). The following commercial

opportunities have come from industry events and networking activities supported by the project.

Table 8: Follow on funding achieved during the project.

Funding details	Value	Notes
Centre for High Carbon Capture Cropping (CHCx3) (See section 7.4.3)	£194,000 until April 2027. Confirmed	C4E is a partner in this project. Calvium are sub-contractors to C4E and NIAB (the project lead). The funding will mainly be used to augment carbon tools and cement the links with Farm Carbon Toolkit (who are also partners). The funding is secured and will support the transition period from March 2025 to April 2027.
State University of New York (SUNY) - project called Advancing Commercialization through the Monitoring, Measurement, and Verification of Large, Established Willow Biomass Crops (See Annexes 10 & 11)	Up to $99,960 USD as part of an $8 million project funded by the U.S. Department of Energy (DOE) Bioenergy Technologies Office (BETO).	An opportunity to prove that the Envirocrops team can work with a new audience to produce a willow-only Cropper game and calculator access. We will copy the Cropper game source code and make minor changes suitable for the USA audience. We will make a change to the source code to allow for users to log into the USA willow-only version of the tool. The funding bid was announced as successful on 10 Dec 2024 and is now in the contract negotiation stage.

Beyond these immediate activities, there are many other opportunities that we will explore to keep Envirocrops expanding and improving such as:

- Offering bespoke services to stakeholders enabling them to use existing and new calculators for testing farmer interest in new sustainable farming incentives through focus groups.

- Creating links with other countries that are looking to follow the UKs lead in developing a biomass crops sector – e.g. creating versions of Envirocrops that include local crops, currency, in different languages, details of incentives, legislation and markets.
- Embracing emerging markets for biomass crops – Beyond Bioenergy (for examples see Annex 13 Table 21).
- We can build calculators to order from specific clients that could benefit their business investment decisions.
- We can create calculators hidden behind paywalls that might be useful for a range of entrepreneurs looking to invest in new market opportunities for biomaterials.
- We can be part of the knowledge exchange and outreach of environmentally focussed projects (UK, EU and worldwide) enabling results on any new development that involves a biomass crop, to be disseminated to land owners.

7. Secondary Project Benefits

7.1 Dissemination activities undertaken including media coverage

Throughout the Envirocrops project, a range of dissemination activities were undertaken to build awareness and encourage uptake of biomass crops. These activities, which included media outreach, events, and digital campaigns, aimed to reach various agricultural stakeholders, policymakers, and the general public. Engagements spanned direct interactions at agricultural events, collaborations with industry, influencers, training sessions, and targeted media campaigns.

Key Engagement channels & impact:

- Envirocrops reached approximately 4,000 attendees through participation in key events such as the Low Carbon Agriculture Show, NFU Conference, and World Biogas Expo. Speaking slots and leaflet distribution effectively engaged farmers, advisors, and sector experts on biomass crop applications.
- Collaborations with influencers like Olly Harrison significantly boosted engagement. His May 2023 Twitter post drove a 23.8% increase in site visits, while his October 2024 vlog generated 35,000 views, leading to a 1,580% surge in Cropper game plays.
- Articles in Student Farmer magazine and NFU newsletters reached a combined audience of over 50,000. Notably, the July 2024 FaS campaign increased signup page visits by 600%, and a full-page StudentFarmer feature drove a 105.6% boost in marketplace

traffic. Even though the increaser in traffic to the marketplace, no transactions have occurred as a result.

Please see Annexes 7 and 8 Tables 19 and 20 in the appendices for a full list of all activities, alongside their impact.

7.2 IP generated from the project

As part of PM6, C4E's Virtual Assistant (VA) Sally Hansen has developed an Intellectual Property (IP) plan for the project. Initially, we are seeking to clarify ownership within the consortia. We are taking steps to set up a Community Interest Company (CIC). This will be a 50:50 partnership between C4E and Calvium. AFBI, as a Government research body is not permitted to be part of a CIC but will have an advisory role. The application process will involve submitting the following documents through the Government Gateway:

- Community Interest Statement (see Annex 12)
- Purpose of the CIC
- Activities to Achieve the Purpose
- Articles of association
- Memorandum of association

As part of the process to set up a CIC, AFBI has requested the completion of a Technology Disclosure Form. This requires the apportioning of IP developed as part of Phase 1 and Phase 2 of the project. We have considered four options for distribution of the IP and the current plan is to apportion it as follows:

- AFBI 30%
- C4E 30%
- Calvium 30%
- NFUE 10%

The intention is to apply for trademarks for the logos, branding and project name. This requires a search of trademarks to confirm the Enivorcrops idea, name, and design is original and not infringing on others' IP. The UK Intellectual Property Office (IPO) database will be utilised for this.

7.3 Number of jobs created & improving skills/experience in the sector

Envirocrops has created 1 full time higher scientific officer role at AFBI for the continual project management over the 3 years. This has been a key role for developing a postgraduate student into an experienced and skilled worker within the sector.

Overall, the Envirocrops project has created work for 13 members of the key consortia (see Annex 2 Table 9). The majority of this work has been carried out by members experienced within the field, however, due to the technological nature of the project, has expanded members' field of work into a novel domain.

Additionally, paid work has been created for 10 C4E subcontractors (see Annex 2 Table 10). Again many of the sub-contractors here were contracted to carry out specific technical tasks, hence are already well versed within the sector. However, the same applies here as above, due to the technical nature of the project.

In addition to this, a student advisor (Will Rowe of Berkshire College of Agriculture) was brought on board and has been a key asset to the advisory group and has participated greatly within WP3 on outreach. The Envirocrop's student advisor has gained massively from the experience, through networking with the members of the team and peripheral network within the sector. Facilitating this has been a key highlight for the project.

7.4 New partnerships formed

7.4.1 Biomass Connect

The relationship between Envirocrops and Biomass Connect has been strong throughout this project. Envirocrops has exhibited, presented and attended all of the Biomass Connect open days. Due to the overlap of certain staff in both of these projects, this partnership has the opportunity to remain and strengthen post March 2025. The link with the Biomass Connect Demonstration sites will facilitate the association of Envirocrops to develop the messaging and understanding of an emerging biomass crops sector.

7.4.2 Wageningen University- Academic Consultancy Training (ACT) Programme

One of the initial objectives of the Envirocrops project was to explore the potential to build a carbon sequestration calculator. We were aware of scepticism in the scientific community about this and felt we needed to do a literature review on the subject. We identified an effective and

mutually beneficial way of doing this background research by engaging with the Wageningen University Academic Consultancy Training (ACT) programme.

This enabled Envirocrops to appoint a team of six postgraduate students of varying disciplinary backgrounds, ranging from natural sciences to economics, to tackle the topic of carbon sequestration from all angles. The aim of the 8 week project was to try and understand the capacity for soil carbon sequestration with biomass crops and how this might contribute to targets and requirements within relevant policies in the EU regarding CO_2 removal and storage through these processes.

The consultancy team comprised Caroline Loe, Tú Tran, Klara Harres, Edwin Geling, Derek te Bokkel and Fabio D'Alessandro and was coached by Jean-Paul van Rie. A report called *Soil Organic Carbon - Sequestration through Biomass Crops*[14] was produced which helped shape our thinking on how to incorporate this essential part of the tool. As a result of this we approached the Farm Carbon Toolkit.

7.4.3 Farm Carbon Toolkit

The Farm Carbon Toolkit (FCT) supports farmers in reducing their carbon footprint and enhancing sustainability. They offer a free, farm-specific carbon calculator to track emissions and soil carbon levels, along with soil health monitoring tools to promote carbon sequestration. FCT also provides workshops, training, and advisory services, guiding farmers toward regenerative and low-emission practices. Through partnerships in research and policy, FCT keeps its tools aligned with current environmental science to foster sustainable agricultural transitions.

The partnership formed with FCT has led to a fruitful relationship of sharing of resources and industry expertise. This has allowed Envirocrops to incorporate aspects of the FCT calculator data within the Envirocrops web app by integrating FCT's Application Programming Interface (API).

This integration has expedited the carbon calculator deliverable considerably and created a more rigorous tool overall.

7.4.4 The Centre for High Carbon Capture Cropping (CHCx3)

CHCx3 is a four-year project which runs from April 2023 to March 2027 that has been awarded £5.9 million of funding by Defra under the Farming Futures R&D Fund: Climate Smart Farming. This forms part of Defra's Farming Innovation Programme, delivered in partnership with Innovate UK.

The project combines research, education, and outreach to support climate-adaptive practices that mitigate emissions, enhance carbon sequestration, and improve resource efficiency. Through workshops, on-farm trials, and collaborations with local farmers, CHCx3 aims to equip communities with practical tools and knowledge to manage the impacts of climate change effectively.

This is a large consortium project (23 partners) led by NIAB. C4E, FCT and Rothamsted Research are amongst partners with Calvium as sub-contractor meaning there is a great deal of commonality with existing activities. Some of the crops covered are already covered by Envirocrops (Miscanthus, SRC willow and hemp) whilst several new crops are also incorporated (flax, cover crops, herbal leys). Through joining in a synergistic collaboration much knowledge will be shared and gained on both sides. Data produced by the CHCx3 project, such as soil carbon sequestration and crop yields, will be shared with the Envircrops team helping to produce a more precise tool. The development of the tool will help facilitate the uptake of planting of more biomass crops allowing for more data to be created which will continue to augment yield and soil carbon models.

7.4.5 State University of New York (SUNY)

Professor Tim Volk's research group at SUNY College of Environmental Science and Forestry (ESF) focuses on sustainable biomass production, renewable energy, and ecosystem restoration. Known for research on fast-growing SRC willow crops for biomass energy, the group also advances agroforestry practices to improve soil health and carbon sequestration. Their work includes restoring degraded landscapes to enhance water quality and biodiversity, as well as engaging with local communities and stakeholders to implement sustainable land use and energy solutions.

In July 2024 Calvium and C4E were invited by SUNY to be part of a bid to the US Department of Energy's Regional Resource Hubs for Purpose-Grown Energy Crops[3]. The success of the bid was announced on 10 December 2024 and will provide Envirocrops with a budget of $100,000 to build a mini version of Envirocrops that focuses solely on SRC willow and creates a new version of Cropper. The 3-year project will run from Jan 2025-Dec 2028.

The SUNY bid is one of six projects awarded funding in order to meet the federal government's Sustainable Aviation Fuel (SAF) Grand Challenge[15]. The other projects focus on a wide range of biomass crops including switchgrass, Miscanthus, sorghum, oilseeds and brassicas (Camelina and Carinata). This project therefore provides a foothold for Enviorcrops into the US market. We will be approaching other projects to see if they would be interested in using the US version of Envircrops as a mechanism for disseminating information on these crops as well, similar to the UK version. (For more information see Annexes 10 and 11).

7.5 Supply chain development

Envirocrops aims to significantly contribute to supply chain development within the biomass industry by offering an accessible consultancy tool that streamlines several key elements for biomass crop adoption. The sub sections below provide information on some of the ways it is supporting supply chain growth.

7.5.1 Streamlining decision-making for farmers and landowners

Efficient crop selection

Envirocrops provides data-driven recommendations on which biomass crops (e.g., miscanthus, willow, hemp) are best suited for specific climates, soil types, and local regulations. This reduces the time and risk associated with crop selection, allowing farmers to make informed decisions that align with both market demand and environmental conditions.

Simplifying planning & market access

By forecasting potential yields, costs, and carbon savings, the tool will help farmers estimate profitability. This clarity around financial and market aspects lowers entry barriers for new participants in the biomass sector, fostering an expanded and resilient biomass supply base.

7.5.2 Providing end-to-end guidance to align with market standards

Yield and quality optimisation

Envirocrops educates farmers on best practices for maximising yield and quality, which helps ensure that the biomass produced meets industry standards. Meeting these standards is essential for the downstream bioenergy, biochar, and bioproducts industries, which rely on consistent and quality raw materials.

Integrating with existing carbon calculators

By offering tools to calculate on-farm carbon savings, Envirocrops prepares farmers to enter the emerging carbon markets. This integration strengthens the biomass supply chain, as participants can not only produce biomass but also learn about carbon and emissions savings and become educated about the potential for trading carbon credits, offering the opportunity for a potential additional revenue stream and encouraging sustainable practices.

7.5.3 Enhancing transparency & accessibility across the biomass sector

Easy to access & up-to-date information

Because Envirocrops is currently a free, publicly accessible tool, it serves as a valuable information hub, uniting multiple stakeholders (farmers, landowners, bioenergy producers, and consultants) around a standardised knowledge base. This broad accessibility accelerates industry-wide alignment on best practices, regulations, and crop availability, making supply chains more transparent and efficient.

Supporting government & private sector collaboration

Through alignment with DESNZ and DEFRA policies, Envirocrops aims to inform users about government incentives, funding programs, and sustainability guidelines. This alignment facilitates smoother collaboration between the private sector and policy makers, promoting a structured expansion of the biomass supply chain in line with the UK's net-zero goals.

7.5.4 Fostering innovation & growth in the biomass supply chain

Incentivising biomass production

Envirocrops has been developed to provide easy to access information, quickly in an easily digestible format, reducing the initial pressure on biomass crop consultants. This is required for a large-scale uptake of biomass crops by stakeholders.

Thus, increasing the potential for biomass crop planting to help reach the Climate Change Committee's (CCC) recommended expansion of land used for biomass crops in the UK of around 23,000 hectares each year[4]. Envirocrops supports the adoption of biomass crops, which in turn supports demand for equipment, processing facilities, and logistics in rural regions.

Developing a central hub for the biomass market

The Envirocrops marketplace and suppliers list is creating a central space for selling biomass crop services and products. Currently, most trading of biomass crop services and products are carried out on a local, small scale and by actors with websites with relatively low search engine optimization (SEO) rankings. For example, this can make it hard for potential producers of biomass to find contractors to plant, manage and harvest their crops. Furthering this, growers of biomass crops can find it difficult to find a buyer. And vice versa, consumers of biomass can find it hard to find local suppliers of raw material. Hence, Envirocrops, through digitising the biomass crop market, will act as a refined search engine facilitating the trade of biomass services and products, allowing for the expansion of the sector.

Catalysing R&D and new market development

The tool's data insights on crop performance and market trends can guide further R&D in biomass applications. For example, insights on new crops becoming viable for biomass could stimulate R&D investments in biofuel production or biochar manufacturing, contributing to supply chain diversity and resilience. This information has been gathered verbally through

industry involvement and networking, therefore not based on research, hence hard to back up with data.
However, by reducing the barriers to entry and providing clear, practical guidance, Envirocrops is not only making biomass farming more viable for individuals but also enabling growth across the entire biomass supply chain, from crop production to end-product commercialisation.

8. Project Management

8.1 Recruitment activities

The award of funding to Envirocrops necessitated the need for AFBI to recruit a project manager. Soon after the start of the project we set up an advisory group, termed the perennial energy crop advisory group (PECAG). Here we enlisted a range of biomass crop stakeholders from different sectors. This then allowed us to carry out advisory group meetings to acquire essential feedback, helping the timely progression of Envirocrops.

Further recruitment was undertaken to find a suitable student advisor. This was carried out through communication with agricultural colleges. Several students at different stages in education applied. The successful candidate, Will Rowe of the Berkshire College of Agriculture, was then recruited to join our PECAG.

Some PECAG members were more proactive and easier to engage with than others and any feedback tended to be fairly superficial rather than in depth. As a result, in the latter stages of the project, it was decided to limit feedback sessions to biomass crops experts.

8.2 Structuring & scheduling of project

Structuring of WPs is as follows:

- Task 1: Project management and reporting
- Task 2: Information gathering
- Task 3: Outreach
- Task 4: Design of spreadsheet calculators and decision trees
- Task 5: Web App development

Please see Annex 3 Table 11 for the structuring and delivery dates of all the deliverables, split by 6 monthly payment milestones.

8.3 Key risks & mitigations, & detail of any risks that materialised into issues

During the project, several risks emerged that required immediate mitigation and were subsequently closed and as such, they either did not materialise into issues or were fully addressed through proactive measures. Key risks included challenges with personnel, project structure, and budget allocation, each of which had the potential to impact project timelines, effectiveness, and resource availability.

8.3.1 Complexity of project structure

Another significant risk was the complexity and size of the project team, which included numerous people and multiple organisations. The risk stemmed from potential inefficiencies in coordination and communication, which could have hindered effective collaboration across the project. Mitigation actions involved clear role definitions and streamlined communication protocols, which proved effective. Consequently, any issues were resolved, allowing the team to operate smoothly without adverse impacts on project outcomes.

8.3.2 Farmer engagement

Envirocrops had difficulty engaging with high numbers of farmers as a result of the lack of interest in Biomass crops. This has meant that we have not been able to get as much testing done by our largest target audience. This has pushed the team to carry out inhouse testing and recruitment of our extensive consortia, which allowed testing to proceed as planned. This timely intervention addressed potential delays and secured project timelines.

8.3.3 Budget realignments

The need for budget adjustments have been identified mid-project, primarily to accommodate evolving priorities and streamline costs. The team proposed consolidating funding requests through a single large Project Change Request (PCR), which facilitated efficient reallocation of funds. By managing the budget adjustments as a coordinated action, the project minimised financial risks while preserving resources for essential activities.

A risk management table has been kept and updated throughout the project. Further information about the associated risks can be obtained from the Risk Register Excel spreadsheet submitted in the Sept 2024 quarterly report.

8.4 Lessons learned

The project revealed several critical lessons for future planning and execution, particularly for projects involving multiple stakeholders, extensive outreach, and complex task coordination. By applying these insights, future management of the project can be enhanced in terms of efficiency, adaptability, and alignment with strategic goals, benefiting both project teams and funders.

8.4.1 Early planning, clear roles & continuous management

Establishing a structured kickoff and management plan at the outset was instrumental. Early identification of project needs, including key personnel, streamlined progress even amid recruitment challenges. Ensuring clear role assignments and establishing structured communication protocols among multiple organisations enhanced cross-collaboration.

8.4.2 Flexibility & innovation in participant engagement & testing

Leveraging existing partner networks facilitated efficient volunteer recruitment, reducing reliance on feedback from difficult to manage sources. The team's adaptable approach to testing, including remote and flexible scheduling options, enabled continuity despite limitations.

8.4.3 Streamlined budget & resource management

Co-ordinating budget adjustments through a single Project Change Request (PCR) streamlined the financial reallocation process, minimising delays. Transparency with funders about resource needs helped sustain project momentum despite shifting priorities. However, going forward, further transparency and an easier and faster PCR system would be beneficial.

9. Conclusions & Next Steps

Envirocrops will prove to be a transformative tool in the advancement of the UK's biomass industry, demonstrating significant value in facilitating the adoption of biomass crops and supporting sustainable farming practices aligned with the nation's net-zero goals. By providing an accessible, data-driven consultancy platform, Envirocrops has successfully streamlined the decision-making process for farmers, landowners, land managers, and agricultural consultants, lowering entry barriers and fostering a more robust and resilient supply chain for biomass production.

The tool has achieved its primary objective of delivering accurate, impartial, and up-to-date insights on biomass crop options, aiding users in optimising crop choices, and estimating financial viability. Envirocrops is attempting alignment with DEFRA and DESNZ policies, and has been in a continual dialogue with DEFRA to try and make the app as relevant as possible to the agricultural sector in the UK. Hence, positioning Envirocrops as an invaluable resource that bridges industry knowledge with policy support, thus facilitating a smooth and scalable transition to sustainable biomass farming.

Envirocrops has not only empowered users to explore the economic and environmental benefits of biomass crops but also contributed to the broader bioeconomy by providing foundational data for innovations in bioenergy, bioresources and in the future - on farm carbon savings. The platform has encouraged supply chain growth by fostering transparency, consistency, and quality across production processes, ensuring that biomass crops meet industry standards. Furthermore, the tool is available and scalable as and when the market demand encourages growth of the crops to facilitate the mass uptake of planting by farmers.

As Envirocrops continues to evolve, we look forward to expanding its capabilities, incorporating new crop types and refining its analytics to further support the development of a circular, sustainable economy in the UK. This project has laid a strong foundation, setting the stage for future growth and innovation within the biomass sector. Furthering this, great interest has been shown in the Envirocrops web app from stakeholders in the US. This foundational knowledge created by the Envirocrops project can be adapted and applied to the local policy and funding scope. Helping to garner greater interest in the web app and potentially allow for the expansion of the UK biomass sector into the global market and supply chain. The adoption of Envirocrops in the global market would then encourage biomass crops to contribute to the global net-zero targets.

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Annexes

Annex 1. Project Sub-Contractors

Crops for Energy (C4E)

Crops for Energy is a UK-based consultancy specialising in biomass crops such as willow and miscanthus. C4E provides expert advice, project development support and management services, and training to landowners, farmers, and businesses interested in growing, utilising and trading biomass crops and their deployment in the bioeconomy and multifunctional environmental protection measures. C4E helps clients navigate the technical, financial, logistical and environmental aspects of projects involving biomass crops and is committed to the expansion of this sector in the UK.

Location: Crops for Energy is based in Bristol, United Kingdom.

Size: It is a small consultancy firm, comprising of Kevin Lindegaard.

Main Market Sector: The company works within the bioeconomy sector. It specialises in promoting and consulting on biomass crops, such as willow, miscanthus, and other biomass sources that can be used for bioenergy, fossil fuel replacements (bioeconomy) and environmental protection measures.

Brief History: C4E was set up in 2004. For the first decade, the main focus of the consultancy was on the use of biomass crops for bioenergy. In more recent years the remit has expanded to deal with more biomass crops and a wider range of uses and environmental applications. C4E has produced hundreds of feasibility studies for a client base comprising farmers, local authorities, airports, waste management and water companies and conservation bodies. The outputs and calculators developed by C4E over the last two decades form the basis of the Envirocrops web app. C4E has been involved in projects that inform policy such as the EU Rokwood project and several projects on behalf of the Energy Technologies Institute (ETI). C4E wholly owns and runs the Sustainable Fuel Register (SFR), a compliance service for non-wood fuels used in Renewable Heat Incentive (RHI) accredited biomass projects.

Calvium

Calvium is a leading digital agency combining expertise in research, experience design, software engineering and mobile innovation.

Calvium are experts in designing and developing robust mobile, web apps and platforms that deliver business critical services and engaging customer experiences. By improving

business processes, team productivity and customer engagement we help our clients to thrive in a mobile world. From creating app solutions that improve operational performance for Rolls-Royce Aerospace, to exploring new audiences for The Environment Agency – Calvium are leaders in the field of digital innovation.

Location: Calvium is based in Bristol, United Kingdom.

Size: 20–50 employees specialising in digital solutions.

Main Market Sector: Calvium operates in the digital technology and smart cities sector, with a focus on designing bespoke digital experiences, apps, and platforms. The Calvium client base is wide – demonstrating the impact of mobile and web apps across all sectors. Whether working within the realms of sustainable agriculture, the arts or engineering, for each client Calvium brings together a bespoke team whose collective experience and skills match those required for the successful delivery of the project.

Brief History: Formed in 2009, Calvium are proven experts in delivering bespoke services including product innovation, consultancy, research and platform development.

Calvium is proud to be approved through many affiliations, credentials and frameworks such as G-Cloud, Cyber Essentials Plus and ISO 27001.

NFU Energy

NFU Energy is one of the UK's leading and trusted providers of sustainable energy solutions, offering a diverse array of services designed to meet the evolving needs of agricultural and horticultural enterprises, as well as public and private sector organisations. Being a part of the National Farmers' Union (NFU) means NFU Energy understands farmers and knows what support they need to assist them to maximise savings, minimise carbon and generate income through innovative solutions tailored to their unique energy goals.

NFU Energy offers a range of services, from securing competitive energy contracts to assisting customers with renewable technology; complex energy regulations and compliance requirements, NFU Energy plays a key role in promoting energy innovation in agriculture and horticulture.

Location: NFU Energy operates from Stoneleigh Park, Warwickshire, United Kingdom.

Size: 50–100 employees, providing energy-related services primarily to the agricultural and horticultural sector.

Main Market Sector: While rooted in its agricultural heritage with being part of the NFU group of companies, NFU Energy has transcended its unwavering expertise to various sectors spanning beyond agriculture alone; however, it keeps a special focus on the agricultural and horticultural sectors.

Its commitment to environmental responsibility and cutting edge technologies means NFU Energy strives to ensure its customers make a positive impact by adopting energy efficiency measures and reducing their carbon footprint.

Brief History: Originally known as FEC Energy Ltd, NFU Energy became a subsidiary of the National Farmers' Union in 2019 and rebranded to reflect its close link to the UK's largest representation body for agriculture and horticulture . It has since become a key advisory and service provider for energy management, efficiency, and renewable energy projects within the UK's farming community.

Annex 2. Jobs created within key consortia

Table 9: Jobs created and consortia members

Job Holder	Organisation	Role	Pre-existing Role?
Chris Jonhston	AFBI	Project Lead	Yes
Callum Williams	AFBI	Project Manager	No
Ashley Cathcart	AFBI	Scientific Advisor	Yes
Kevin Lidegaard	C4E	Project Lead/Manager	Yes
Roisin Alvy	Calvium	Digital Solutions Consultant	Yes
Matty Bateman	Calvium	Senior Project Manager	No
Fernando Sanchez	Calvium	Developer	Yes
Saliha Ahmed	Calvium	Design Lead	Yes
Sam Turner	Calvium	Project Manager	No
Gemma Bower	NFUE	Marketing Manager	Yes

Job Holder	Organisation	Role	Pre-existing Role?
Molly Bourne	NFUE	Marketing	Yes
Ceri-Anne Kinsella	NFUE	Head of Marketing	Yes
Eirrin Rusbridge	NFUE	Technical Advisor	Yes
James Allen	Save Energy Now	Technical Advisor	Yes

Table 10: C4E Subcontractors

Job Holder	Organisation	Role	Pre-existing Role?
Will Macalpine	Rothamsted Research	Technical Advisor	Yes
Jamie Rickerby	Rickerby Estates	Technical Advisor	Yes
Will Jackson	Poplar Tree Company	Technical Advisor	Yes

Job Holder	Organisation	Role	Pre-existing Role?
Astley Hastings	University of Aberdeen	Scientific Advisor	Yes
Mike Cooper	Miscanthus Nurseries	Technical Advisor	Yes
Lucy Wiltshire	Freelance	Technical Advisor	Yes
Bryan Elliott	Eucalyptus Renewables	Technical Advisor	Yes
Will Rowe	Student Advisor	Technical Advisor/Outreach	No
Sally Hansen	The Singing VA	Virtual Assistant	Yes
Matthew Lingard	Matt Lingard Video	Video Editor	Yes

Annex 3. Schedule, deliverables, financial information & lessons learned

Table 11: Schedule, deliverables and financial information

PM	Deliverable	Details	Description (inc. outputs)	Delivery Date	Actual Cost	Schedule 3 Cost
1	**1.1**	Project management plan	Kick off meeting; Project management plan	30/6/22	£14,942.86	£24,336.80
	1.2	Project start KPIs	Completion of template KPI spreadsheets	30/6/22	£0.00	£0.00
	1.3	Project management & co-ordination Q1 & Q2	Ongoing project management; MO meetings; Stage gate reviews, Quarterly progress updates; Change requests i(f required)	30/9/22	£16,263.65	£26,114.80
	2.1	Best practice guidelines for SRC, Miscanthus, Poplar and Eucalyptus	Update of Best Practice Guidelines to include land preparation, establishment, management, harvesting, storage, transport etc	31/7/22	£25,752.63	£21,008.29
	3.1	Recruitment of Industry advisory group (PECAG) & user forum	Recruit important practitioners to sit on PECAG group for twice yearly meetings; Produce list of individuals who will help test the app (farmers, power station fuel procurement, local authorities etc)	31/8/22	£21,118.42	£27,904.22

PM	Deliverable	Details	Description (inc. outputs)	Delivery Date	Actual Cost	Schedule 3 Cost
	4.1	Pathways for free app	Simplify some calculators from Phase 1 in order to provide users with a very simple user experience. Particular emphasis on the amount of land required or what you can produce from a defined land area.	31/7/22	£18,922.18	£13,381.37
	5.1	STEM game design and UAT changes	Produce an educational STEM game (Science, Technology, Engineering, and Mathematics) which we will aim at secondary school children and teachers; Make changes to the proof of concept web app based on phase 1 user testing; Soft launch; first production release & basic content management system (CMS)	15/10/22	£174,451.82	£179,183.55
2	**1.4**	Project management & co-ordination Q3 & Q4	Ongoing project management; MO meetings; Stage gate reviews, Quarterly progress updates; Change requests i(f required)	31/3/23	£70,751.30	£55,751.30
	2.1b	Best practice guidelines for SRC, Miscanthus, Poplar and Eucalyptus	100% completion of - Update of Best Practice Guidelines to include land preparation, establishment, management, harvesting, storage, transport etc	31/7/22	£0.00	N/A

PM	Deliverable	Details	Description (inc. outputs)	Delivery Date	Actual Cost	Schedule 3 Cost
	2.2	Best practice guidelines for other crops - Hemp, Reed Canary Grass	Web research and discussion with practitioners to create Best Practice	30/11/22	£19,696.58	£19,696.58
	2.3	Site visits & report on info gathering	Site visits to sites dealing with PECs covered by the app with particular emphasis on new PECs being added; Opportunity to meet face to face with practitioners to discuss potential of app	31/12/23	£20,508.03	£23,406.16
	2.4	Yield information gathering and incorporation into yield model - Year 1 results	Assemble yield information from trials and commercial growers; summarise and normalise data into spreadsheets, discussions with modeller; incorporation of data into yield models; creation of new models where appropriate	31/3/23	£11,772.92	£12,102.60
	3.2	Yr 1 PECAG meetings	Meetings to gain industry input and direction for the app - particular emphasis on commercial elements and new policy direction	28/2/23	£8,777.53	£16,242.14

PM	Deliverable	Details	Description (inc. outputs)	Delivery Date	Actual Cost	Schedule 3 Cost
	3.3	Participation in Lot 2 Demonstration events - Yr 1; Short report on Outreach activities Yr 1	Attend and demonstrate the web app to participants, assist people using the web app, and collect feedback. Report on outreach activities to include type of engagement activities engaged in, locations, participants and outcomes	31/3/23	£45,572.70	£48,075.14
	4.2	Pathways for additional PECs	New spreadsheet calculators for different types of PEC e.g. hemp	30/11/22	£12,278.17	£15,337.13
	4.3	Economics/logistical calculators	Very detailed economic costing tools for how much it costs to establish, manage, harvest, store and transport di erent PECS; Calculators for logistics - space required; transport journeys required, amount of ash produced etc)	31/1/23	£12,337.65	£12,336.79
	4.4	Carbon sequestration calculator	Detailed carbon savings tool providing details of GHG reduction compared to suitable counterfactuals based on PEC type and previous land use.	31/3/23	£2,864.23	£12,321.37

PM	Deliverable	Details	Description (inc. outputs)	Delivery Date	Actual Cost	Schedule 3 Cost
	4.5	Regulatory steps - in the field	Flow diagrams for what needs to be done before planting and during and after the plantation lifetime	31/3/23	£6,544.97	£7,740.47
	5.2	Alpha release	Update of the proof of concept web app product and STEM game; First iteration of Production System; preparation for a free vs. paid subscription model.	31/3/23	£201,196.00	£202,900.72
3	**1.5**	Project management & co-ordination Q5 & Q6	Ongoing project management; MO meetings; Stage gate reviews, Quarterly progress updates; Change requests i(f required)	30/9/23	£32,351.86	£52,399.35
	1.6	Yr 1 KPIs	Completion of template KPI spreadsheets	30/9/23	£0.00	£0.00
	4.6a	Regulatory steps biomass utilisation	Flow diagrams for obligations to be met when trading and using the different PEC fuels (sustainability and quality)	31/5/23	£3,517.50	£3,870.23

PM	Deliverable	Details	Description (inc. outputs)	Delivery Date	Actual Cost	Schedule 3 Cost
	4.7	Report on spreadsheet calculators and decision trees	Report with instructions and assumptions made; reasonings why certain pathways were taken and other avoided	31/7/23	£6,074.39	£8,525.80
	5.3	Beta design changes	Further design and development iterations; Feature refinement and support; Establish ticket request system and management of roll out; Development time, publish changes to test site each month for review; Amendments and sign o	15/10/23	£92,421.88	£94,735.42
4	**1.7**	Project management & co-ordination Q7 & Q8	Ongoing project management; MO meetings; Stage gate reviews, Quarterly progress updates; Change requests i(f required)	31/3/2024	£45,708.87	£52,165.15
	2.5	Yield information gathering and incorporation into yield model - Year 2 results	Assemble yield information from trials and commercial growers; summarise and normalise data into spreadsheets, discussions with modeller; incorporation of data into yield models; creation of new models where appropriate	31/3/2024	£15,810.26	£10,844.43

PM	Deliverable	Details	Description (inc. outputs)	Delivery Date	Actual Cost	Schedule 3 Cost
	3.4	Yr 2 PECAG meetings	Meetings to gain industry input and direction for the app - particular emphasis on commercial elements and new policy direction	31/1/2024	£12,107.18	£25,765.88
	3.5	Participation in Lot 2 Demonstration events, Other outreach activitiesYr 2; Short report on Outreach activities Yr 2	Attend and demonstrate the web app to participants, assist people using the app, and collect feedback. Report on outreach activities to include type of engagement activities engaged in, locations, participants and outcomes	28/2/2024	£54,986.40	£38,137.28
	4.4a	Carbon tool engagement / discovery deliverable	Detailed carbon savings tool providing details of GHG reduction compared to suitable counterfactuals based on PEC type and previous land use.	31/3/2024	£10,003.83	N/A
	4.8	Further modifications to spreadsheet calculators and decision trees Yr2 Q7+8	Modifications to spreadsheet calculators based on user feedback, new information that becomes available, any mistakes that are discovered etc	31/3/2024	£16,863.43	£11,956.16

PM	Deliverable	Details	Description (inc. outputs)	Delivery Date	Actual Cost	Schedule 3 Cost
	5.4	Beta release	Advanced commercialisation Discovery and UI design ; Workshop with analytics and forum evidence to develop ideas; Test commercial developments with users and modify based on feedback	31/3/2024	£87,208.41	£101,967.93
5	**1.8**	Project management & co-ordination Q9 & Q10	Ongoing project management; MO meetings; Stage gate reviews, Quarterly progress updates; Change requests i(f required)	30/09/2024	£38,898.13	£54,677.59
	1.9	Yr 2 KPIs	Attend and demonstrate the web app to participants, assist people using the app, and collect feedback. Report on outreach activities to include type of engagement activities engaged in, locations, participants and outcomes	30/09/2024	£0.00	£0.00
	3.7a	New Outreach deliverable - Shows/Participation in lot 2 demonstrations	Outreach for PM5 - attendance at shows to gain users and suppliers, attendance at lot 2 demonstration events and online outreach	30/09/2024	£33,011.97	N/A

PM	Deliverable	Details	Description (inc. outputs)	Delivery Date	Actual Cost	Schedule 3 Cost
	4.4b	Exploration of carbon and alternative calculators	Mini report highlighting which calculators would be a useful addition to the tool; Spreadsheets of preliminary data for novel calculators; notes from meetings regarding new calculators; And commencement of integration with Farm Carbon toolkit	30/09/2024	£14,842.94	N/A
	4.6b	Regulatory steps biomass utilisation	Creation of flow diagrams, instructions and assumptions made and mini report of regulatory steps.	30/09/2024	£0.00	N/A
	4.9	Further modifications to spreadsheet calculators and decision trees Yr3 Q9+10 (Inc underspend from D4.5 and D4.6 for modifications and completing legal requirements to app)	Modifications to spreadsheet calculators based on user feedback, new information that becomes available, any mistakes that are discovered etc	30/09/2024	£8,755.07	£5,303.34
	5.5	Commercial product	Advanced commercialisation Development; Final web app design, Development time, publish changes to test site each month for review;	15/10/2024	£113,029.12	£129,565.07

PM	Deliverable	Details	Description (inc. outputs)	Delivery Date	Actual Cost	Schedule 3 Cost
			Amendments and sign o			
6	**1.10**	Completion of draft report	Draft final report for Phase 2 suitable for technical review	4/11/2024	£12,785.25	£8,925.00
	1.11	Project management & co-ordination Q11 & Q12	Ongoing project management; MO meetings; Stage gate reviews, Quarterly progress updates; Change requests i(f required)	14/3/2025	£17,722.72	£23,255.00
	1.12	Completion of final report, project closure	Draft final report for Phase 2; Redacted report	31/3/2025	£30,362.16	£34,690.13
	1.13	Project end KPIs	Final KPIs spreadsheet	31/3/2025	£ -	£ -

PM	Deliverable	Details	Description (inc. outputs)	Delivery Date	Actual Cost	Schedule 3 Cost
	2.6	Yield information gathering and incorporation into yield model - Year 3 results	Assemble yield information from trials and commercial growers; summarise and normalise data into spreadsheets, discussions with modeller; incorporation of data into yield models; creation of new models where appropriate	14/3/2025	£15,949.72	£9,924.75
	2.7	Update of BPGs		14/3/2025	£15,691.96	£0.00
	3.6	Yr 3 PECAG meetings	Meetings to gain industry input and direction for the app - particular emphasis on commercial elements and new policy direction	28/2/2025	£15,448.79	£32,688.22
	3.7b	Participation in Lot 2 Demonstration events - Yr 3; Short report on Outreach activities Yr 3	Attend and demonstrate the web app to participants, assist people using the app, and collect feedback. Report on outreach activities to include type of engagement activities engaged in, locations, participants and outcomes	14/3/2025	£37,799.51	£41,192.37

PM	Deliverable	Details	Description (inc. outputs)	Delivery Date	Actual Cost	Schedule 3 Cost
	4.4c	Exploration of carbon and alternative calculators	Integration with Farm Carbon Toolkit with 9 month usage licence for API. Allowing for information to be shared across the two tools.	31/3/2025	£500.00	£0.00
	4.10	Further modifications to spreadsheet calculators and decision trees Yr3 Q11+12	Modifications to spreadsheet calculators based on user feedback, new information that becomes available, any mistakes that are discovered etc	14/3/2025	£6,678.46	£1,025.84
	5.6	Commercial release, hosting, glitch sorting	Feature refinement and support; management of ticket request system: Amendments and sign o	14/3/2025	£116,048.38	£113,930.19

Annex 4. Description of the key features within the Envirocrops tool

Table 12: Key features in the Envirocrops tool

Element of the app	Type of feature	What it does	Outputs	How it will help users	How we might improve the offer as things develop
1. Economic and logistical calculators	Calculators	Enables users to gain output information comparing eight different biomass crops in three different user goals as a ▪producer ▪self supplier ▪end user. Users can edit input information if they wish to.	The following information is produced: ▪Production costs (in p/kWh, £/tonne and £/GJ) ▪Profit per hectare (£/ha/year) ▪Amount of land required for a particular project (ha) ▪Return of investment (years) ▪Costs of establishment, management & harvesting ▪Cost and profit over lifetime ▪Estimated annual yields ▪Years to achieve self-sufficiency or to achieve peak yield ▪Storage space required	Provides users with the key information that they need in order to narrow down the crop choice for their land and/or proposed use. It also enables them to understand the economic implications over a 20+ year horizon and understand the processes and fine detail of managing different biomass crops.	Like any comparison website we will iterate to improve the user experience as we get feedback. The current calculators produce a wealth of information which might be confusing to some users. We have iterated to make some of the pathway outputs simpler as a first look with the facility to look more in depth if the users wish to. We have begun this process by developing simple calculators (see 3 below).

Element of the app	Type of feature	What it does	Outputs	How it will help users	How we might improve the offer as things develop
			▪Land take within a 50km radius Users can download the data.		
2. Postcode yield predictor	Calculators	Enables users to estimate the modelled yield data for the field location that they want to plant. It uses modelled yield figures for 2,855 1 km grids across the UK.	The postcode data provides an average yield for the lifetime of the crop (dry tonnes/ha/year) and this figure feeds into the economic and logistical calculators. The results can be seen in the dropdown	This is mainly useful where users wish to get good estimates of yield for a particular crop on a particular piece of land.	In later iterations we will enable users to click on the map and get instant yield data for different crop options. This isn't doable at the moment. Yield information for different crops will

Element of the app	Type of feature	What it does	Outputs	How it will help users	How we might improve the offer as things develop
			box "Click to view how we estimated figures"		come online as Biomass Connect sites are harvested.
3. Simple calculators	Calculators	New feature as part of the Commercial Product release allowing users to get specific headline figures for different user goals and some aspects relating to logistics.	Headline information is produced for user goals: ▪Small to medium scale use (e.g. self supply or local supply) ▪Large scale use (e.g. power station) ▪How much can I produce (from a given area of land) Logistical calculators for ▪Yield implications of different moisture contents ▪Storage space required ▪ Number of vehicles required to transport biomass	These will provide a first look at key information pertaining to the practical side of production and the supply chain. The simple calculators for user goals provide important information on the amount of land required to achieve a particular goal. Logistical calculators will enable users to understand if the production/use of a particular biomass crop fits in with their lifestyle, facilities, site layout and procedures.	Need to get feedback from PECAG before speculating on this.

Element of the app	Type of feature	What it does	Outputs	How it will help users	How we might improve the offer as things develop
			▪Ash produced from combustion		

Element of the app	Type of feature	What it does	Outputs	How it will help users	How we might improve the offer as things develop
4. Carbon calculators	Calculators	Calculators that allow users to see the carbon reduction from ▪replacing fossil fuels with biomass fuels ▪growing biomass crops compared to current land use. The latter is a new feature as part of the Commercial Product release which benefits from a link up with Farm Carbon Toolkit.	The user goal that looks at heating properties enables users to see the carbon savings of using biomass fuels compared to using traditional fossil fuels in tonnes CO2/year and equates to the number of family cars that would be taken off the road. The second output will allow users to get a comparison of carbon footprint for their current land use and their choice of biomass crop replacement in terms of a potential emissions savings over 20 years in tonnes of CO2e.	These outputs will provide information that will help decarbonise elements of the economy (in the first instance heating and food production). The calculators will inform: ▪companies interested in carbon reduction and corporate responsibility ▪Farmers who wish to reduce their farm's GHG emissions ▪End users looking to source farm products with a low carbon supply chain ▪Carbon traders interested in carbon offsetting and insetting	Need to get feedback from PECAG before speculating on this.

Element of the app	Type of feature	What it does	Outputs	How it will help users	How we might improve the offer as things develop
5. Legislation calculators	Calculators	Provides legal information on what a user needs to do before planting and when they use the products.	There are two calculators. One tells the user what they will need to do before planting based on the location of their land and the proposed size of plantation. The other is geared towards people wishing to use biomass crops as a fuel in biomass boilers and what they need to do in order to stay within the rules.	Keep users compliant and fulfilling environmental regulation such as Environmental Impact Assessment (EIA) and air quality.	Need to get feedback from PECAG before speculating on this.
6. Crop types	Resources	Simple, concise pages of information on each crop type and a slider allowing users to see the stature of different crops throughout their cropping cycles.	Includes basic information such as: ▪Strengths and weaknesses ▪Height ▪Ideal soil type ▪Lifetime and rotation length ▪Crop risk e.g. pests & disease ▪Uses ▪How it is planted	Users will get an instant understanding of the who, what, when, why and how of each crop.	As the project develops we will make short YouTube films on each of the crops.

Element of the app	Type of feature	What it does	Outputs	How it will help users	How we might improve the offer as things develop
			▪Height ▪Ideal soil type Each crop type featured includes numerous pictures.		
7. Best practice Guidelines (BPGs)	Resources	Updated BPGs for: ▪Miscanthus ▪Short Rotation Coppice (SRC) willow New BPGs for ▪Hemp ▪Reed Canary Grass ▪Switchgrass ▪Short Rotation Forestry (SRF) & SRC poplar ▪SRF Eucalyptus	Online long reads and downloadable booklet pdfs. The online versions have contents pages allowing users to click to the place that they wish to read. The main sections are: ▪Pre-planting ▪Planting ▪Post planting establishment ▪Harvesting ▪Post harvest	These documents represent the most up to date manuals for these crops. This one stop shop of information will make Envirocrops a valuable resource for farmers, academics, students and policy makers.	We realise that these days it is not enough to provide a book or a leaflet and expect people to read this information. Although this format will work for some, most people will want the information in bite sized chunks (as delivered in the Crop info. resource in line 6 above) . This is why

Element of the app	Type of feature	What it does	Outputs	How it will help users	How we might improve the offer as things develop
			Each section has sub sections that go into specifics. Each publication is 30-50 pages long.		beyond our commercial release we'll be incorporating an AI chat bot so that users can ask a question and get an immediate answer without wading through lots of text.
8. News features	Resources	Bite sized information on latest news.	Short articles linked to YouTube videos which explain more about what Envirocrops does.	Used in conjunction with social media outlets (Envirocrops Youtube channel, LinkedIn and Instagram) enabling users to stay up to date with latest developments.	As the project develops we will make short YouTube films on each of the crops.
9. Articles	Resources	Larger, in depth articles that provide a greater depth on the rationale for features of the web app.	Articles to include: ▪User guidance ▪Expert opinion pieces ▪Interviews with biomass protagonists	Provide greater understanding about using the web app and context based on expert views.	Greater content that enables Enviorcrops to become an even greater source of biomass crops information.

Element of the app	Type of feature	What it does	Outputs	How it will help users	How we might improve the offer as things develop
			▪Links to publications and events of interest		
10. Find a Supplier (FaS)	Online directory	Enables "suppliers" to be listed on the site and provide information about what they do relating to biomass crops.	The FaS feature allows companies and organisations to show their ▪contact details ▪logo ▪website address ▪list their products & services ▪show Google reviews. For each product they add they will get one of several lozenges relating to service type and crop type they are involved with. Users can search suppliers based on these lozenges	This feature acts as a streamlined search engine enabling users to find the right sort of people, companies, products and offers at all parts of the supply chain – irrespective of whether they are a grower, trader or end user of biomass crops. Envirocrops.com therefore provides a platform for small companies in particular to get noticed by engaged users.	As we develop post our phase 2 funding, we will be offering an Approved Supplier rubber stamp, enabling companies to demonstrate their expertise and to ensure we provide our Envirocrops.com users access to the best contractors.

Element of the app	Type of feature	What it does	Outputs	How it will help users	How we might improve the offer as things develop
11. Marketplace	Online marketplace	This feature lists all the products and services offered by suppliers listed on the site.	The Marketplace is where suppliers can advertise specific products and services, and promote time-limited offers.	Many companies working in the biomass crops sector are micro businesses or SMEs. Many small companies struggle to get noticed online due to having poor SEO rankings. Envirocrops has intuitive search filters and provides an excellent shop window for these suppliers by putting their products in front of a captive audience who are interested in these offers.	Currently, the marketplace is a FREE resource. We will continue to explore ways in which the marketplace can be monetised.

Element of the app	Type of feature	What it does	Outputs	How it will help users	How we might improve the offer as things develop
12. Cropper	Game	Cropper is a STEM game. STEM stands for Science, Technology, Engineering and Maths. The game sets players a goal of trying to produce a threshold yield whilst making a profit.	The game includes the following features: ▪Colourful, dynamic animation with engaging sound effects ▪Spin the wheel generators to provide chance elements ▪Multiple choice questions ▪Opportunities to get basic help or expert help ▪Dynamic calculators showing the tonnage harvested and income generated ▪Explanations when you make a mistake ▪Leaderboard	In no more than 20 minutes players are able to find out all the dos and don'ts the benefits and drawbacks and opportunities of these crops, as well as the impact of things you can't control like the weather. An important feature is that would-be growers can learn whilst not risking their own money. Another fringe benefit of Cropper is that it upskills the next generation of decision makers. Many of the farmers and policy makers of the 2030s and 2040s will be students today.	The current game only covers Miscanthus and SRC willow. It would be advantageous to develop a game with more land use options but this will require funding to achieve.

Figure 3: *Pages from the Envirocrops web-app home page.*

Welcome to Envirocrops

Funded by DESNZ, Envirocrops is a free data-driven web app to compare the suitability of biomass crops across the UK.

Our users include farmers, growers, land consultants and policy makers needing decision making support and access to our growing biomass supplier directory.

Get Started

Find a biomass supplier near you

Explore our directory of suppliers and consultants to see what products and services may be available near to you.

Explore map

Interested in joining our supplier directory? Find out more →

What we do

Utilising calculators, decision trees and digital mapping, Envirocrops will provide farmers, project developers and industry decision makers, tailored information.

Read more →

- Identify biomass crop types and varieties suited for your land and goals
- Estimate land size required to achieve your desired yields
- Determine production timescales and costs using real yield data from our growing network
- Ongoing support from planting through to harvest.
- Users supply yield data to continuously improve our predictions

Take on the Cropper challenge!

The local government has chosen your farm to grow a biomass crop and produce enough fuel to heat a local school. Play our Cropper game to see if you have what it takes to grow a biomass crop!

Play

Figure 4: *Pages from the Envirocrops web-app crop information pages and resources section.*

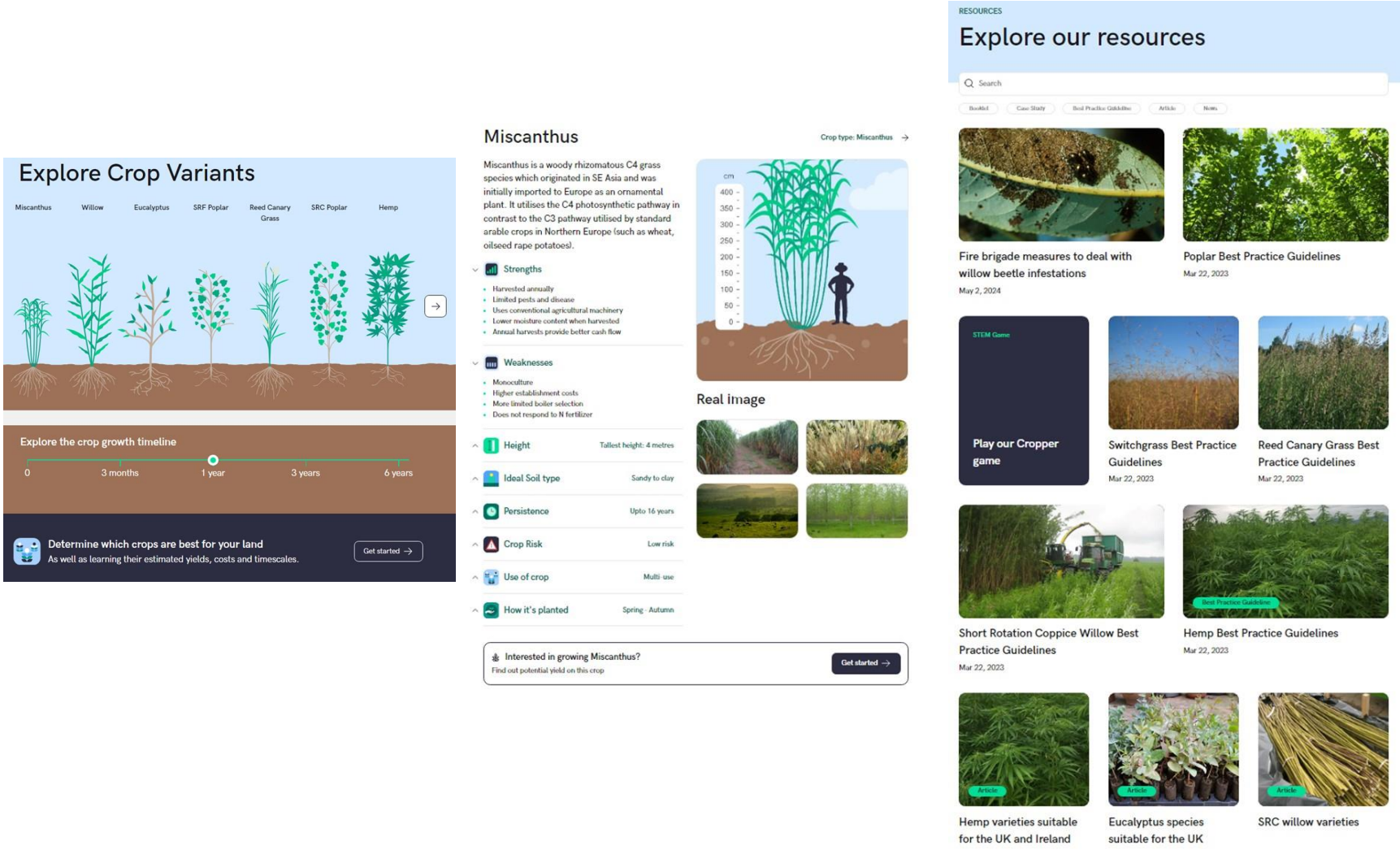
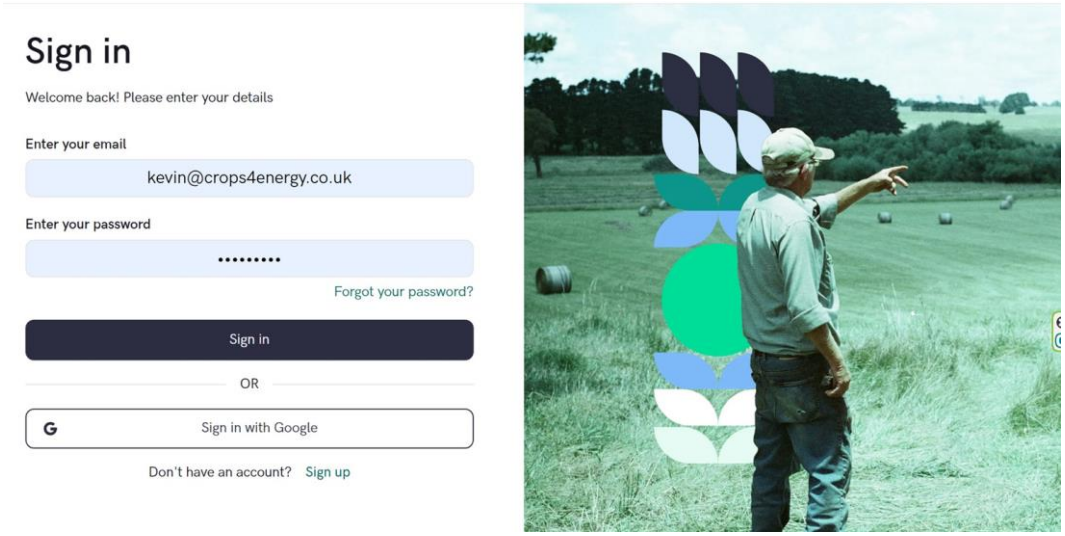


Figure 5: *Imagery used on the Envirocrops website.*



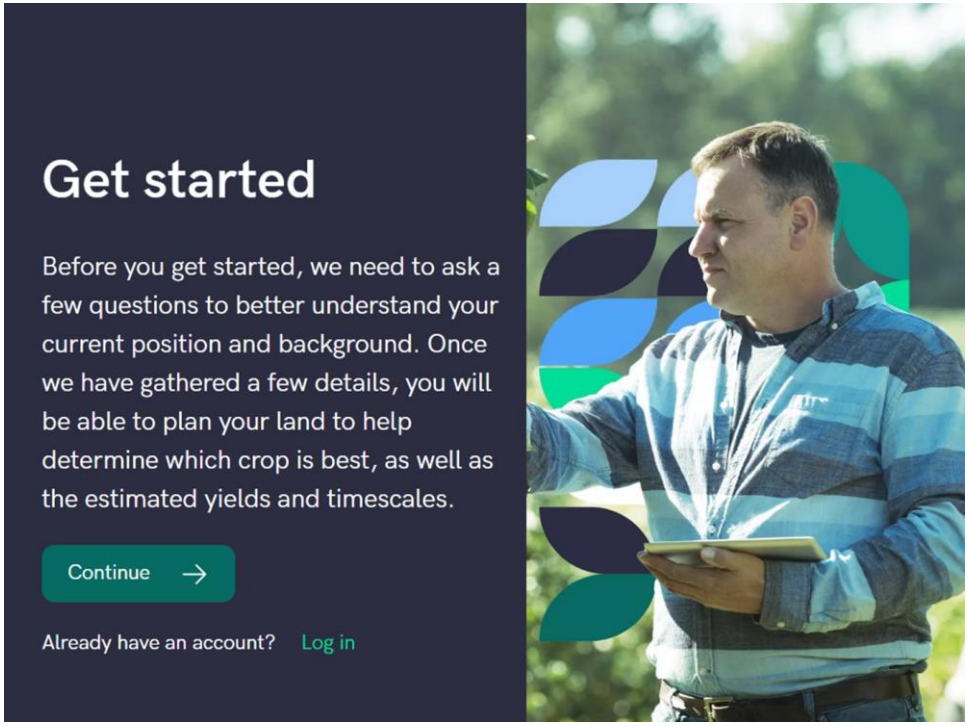
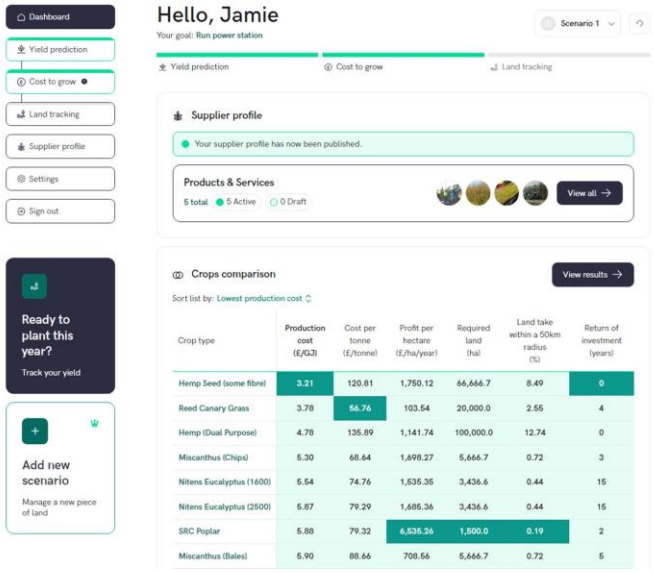
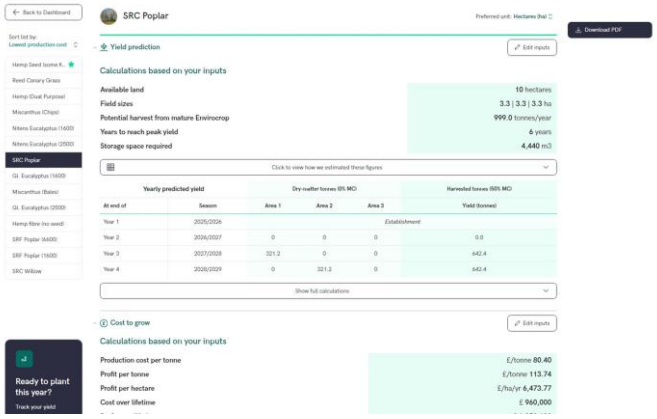


Figure 6: *Pages from the Envirocrops web-app calculators.*





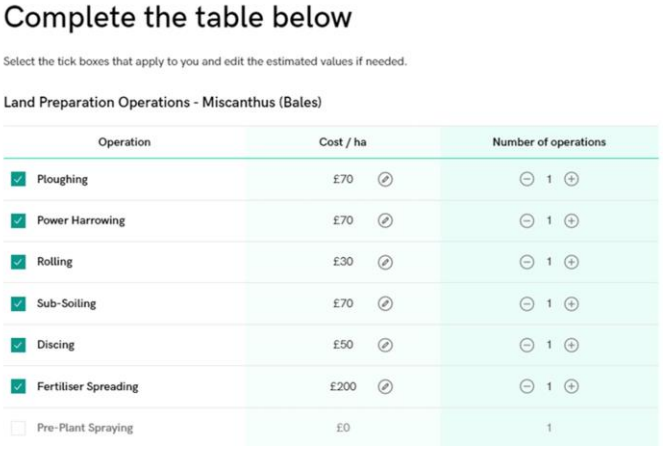
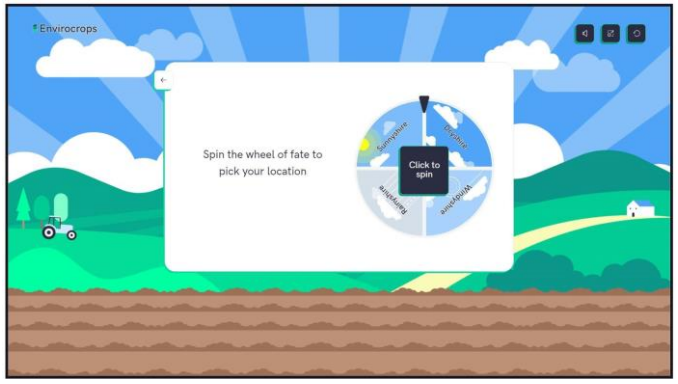
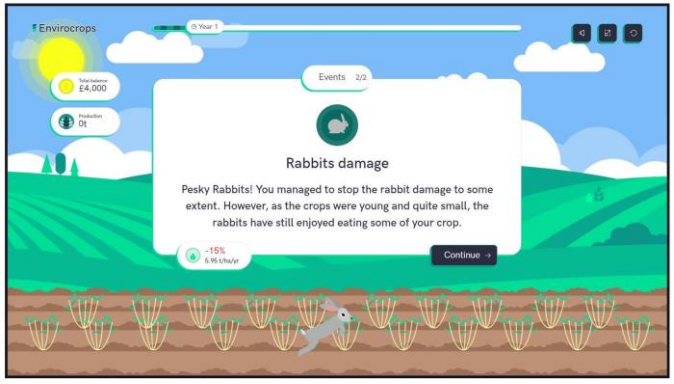
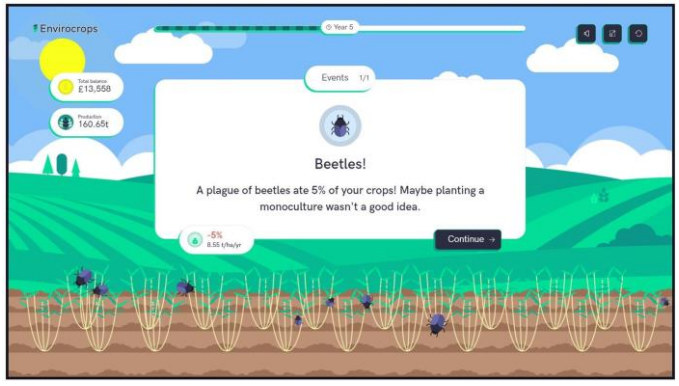


Figure 7: *Views from the Cropper game.*







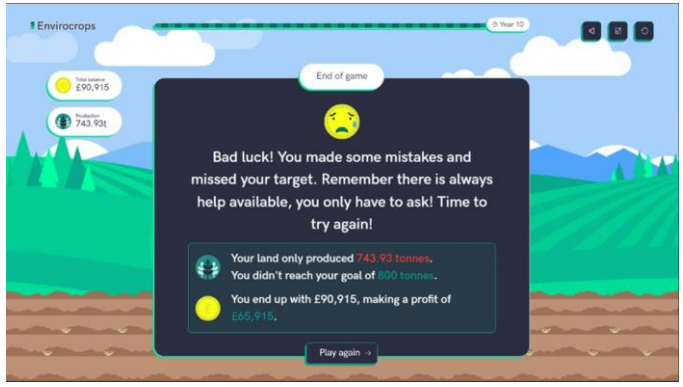
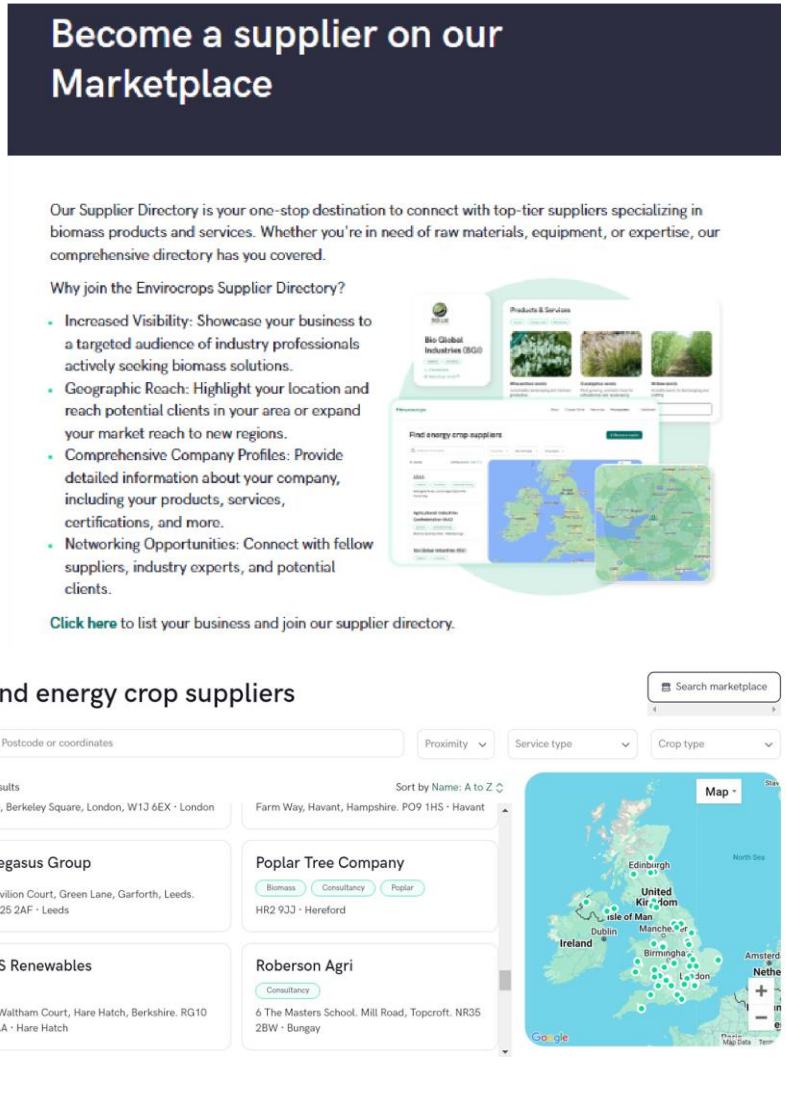
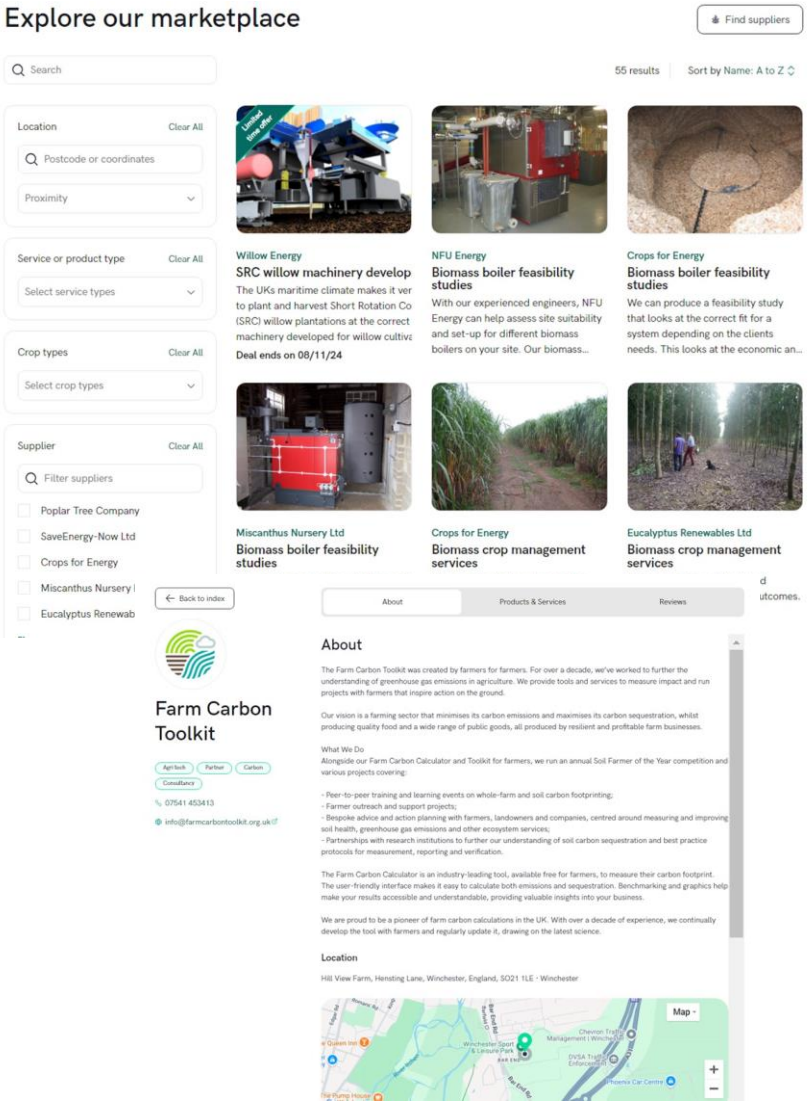


Figure 8: *Pages showing the Envirocrops FaS and Marketplace.*





Annex 5. Evolution of the web app & Lessons learned

Table 12: Evolution of the app

Deliverable(s)	Web App update	Date of release	What was new	What influenced this inclusion	What was improved	What influenced this improvement
D5.1 & 5.2	Alpha release	3/31/2023	Sign up form and newsletter subscription	Phase 1 feedback; Internal team discussions	n/a	n/a
			Main economic calculators for SRC willow, Miscanthus			
			Simple carbon calculator as part of heating a building scenario			
			Cropper Game			
			Postcode yield predictor based on modelled data			
			Resources section populated with updated best practice guidelines for			

Deliverable(s)	Web App update	Date of release	What was new	What influenced this inclusion	What was improved	What influenced this improvement
			SRC Willow, Miscanthus, Eucalyptus			
D5.3 & 5.4	Beta release	3/31/2024	New crops added as part of economic outputs - Eucalyptus, Poplar, RCG, Switchgrass and Hemp	Internal team discussions	UX of dashboard improved and some section names changed e.g. Yield prediction, cost to grow	Feedback from PECAG
			FaS portal incorporated and partner organisations added	Internal team discussions	Cropper game leaderboard added	Feedback from PECAG; Externally completed feedback forms
			Land tracking feature allowing users to add yield details	Feedback from PECAG		
			Add new scenario feature allowing more than one scenario to be shown per user	Feedback from PECAG		

Deliverable(s)	Web App update	Date of release	What was new	What influenced this inclusion	What was improved	What influenced this improvement
			Download pdf feature allowing economic results for each crop to be saved to a user's computer or smart device.	Feedback from PECAG		
D5.5	Updates to Beta release	From 1/4/2024 to 15/10/2024	Crops comparison table on dashboard	Internal team discussions Feedback from PECAG	Big push to add suppliers and products	Internal team discussions
			Marketplace feature	Internal team discussions	More information about Cropper features	Internal team discussions
			Crop types pages and and crop growth timeline animation	Internal team discussions; Feedback from PECAG		
			Project partnerships logos listed (CHCx3, Farm Carbon Toolkit)	Internal team discussions		

Deliverable(s)	Web App update	Date of release	What was new	What influenced this inclusion	What was improved	What influenced this improvement
D5.5 & D5.6	Commercial release	3/14/2025	Simple calculators providing headline info for three main user scenarios	Internal team discussions	Updated BPGs, branded BPGs and ability to download these	Feedback from PECAG
			Simple logistical calculators added (Moisture content, storage and transport and ash content)	Internal team discussions	New resource information based on outputs of BFI projects	Feedback from PECAG; BFI lot 1 interaction
			Farm Carbon Toolkit API link and calculator added	Initially, a report by Wageningen students on the Academic Consultancy Training course; Internal team discussions; Feedback from PECAG	Improvements to FaS and marketplace search - requires suppliers to list products in order to get lozenges	Internal team discussions
			Waste water calculator added	Internal team discussions	Update of postcode yield	Internal team discussions

Deliverable(s)	Web App update	Date of release	What was new	What influenced this inclusion	What was improved	What influenced this improvement
					model information	
			Legislative calculators added	Internal team discussions	Change to economic calculators allowing outputs to reflect discounting, inflation and Net Present Value.	Stage gate feedback from external assessor; feedback from PECAG
					Additions of Youtube clips and other resources (news and articles)	Internal team discussions

Table 14: Lessons learned

Lesson learned	Type	Could this be improved by external or internal means	How things might have been done better
Schedule 3 budget took a great deal of time to produce and get signed off at the start of the project. This became virtually obsolete and difficult to cross reference against as soon as first change request was made	DESNZ design of scheme	External	This process should have only been formalised once the contract was signed making it a more accurate document that we were able to follow.
An immediate PCR and holding milestone were inevitable as the first three months of the project were spent on contract negotiations and sorting out the schedule 3. This meant that everything started late and the schedule 3 was out of date as soon as we started the project in earnest in late July 2022.	DESNZ design of scheme. AFBI internal delays	Internal & External	There should be an initial period when the project has been awarded the funding and negotiations can take place so that the project can stay on track and limit PCRs which impact on the project getting a head of steam and make work for MOs and DESNZ. In addition, this should be an eligible project cost as the time spent on the schedule 3 document was exhaustive.
The start of the project is critical. The project was hurt by the delayed start and a lack of project management capacity at AFBI. A vacant position often cannot be advertised for until the contract is	DESNZ design of scheme AFBI internal delays	Internal & External	As above. This would reduce the time waiting for a role to be filled and reduce the impact on the project.

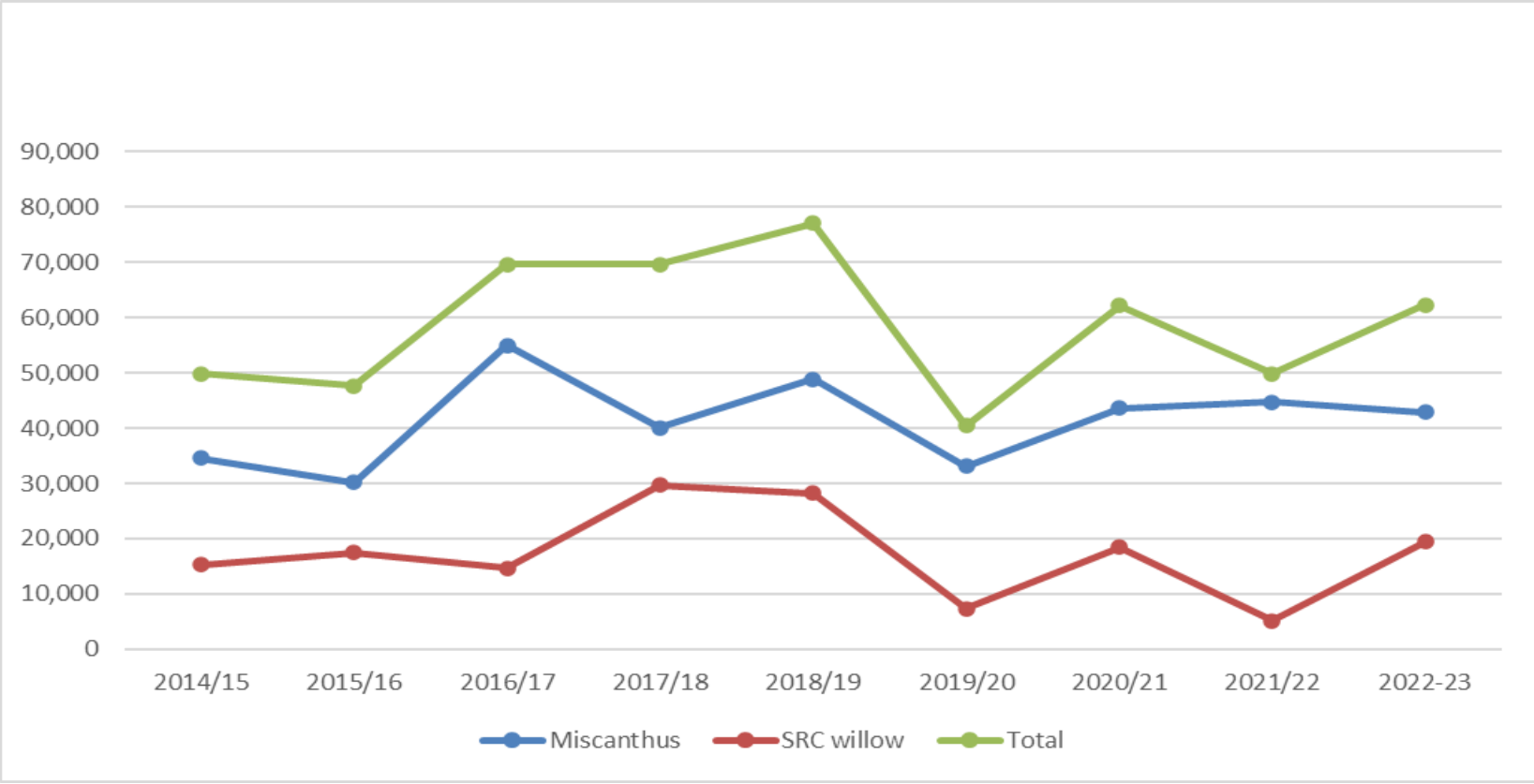
Lesson learned	Type	Could this be improved by external or internal means	How things might have been done better
signed. Doing so would be a risk that an employer is unlikely to take.			
Carrying over the budget from one financial year to another. This at first was said to not be permissible but then was changed.	DESNZ design of scheme	External	This meant that we had to work extremely hard in the first two payment milestones. A more pragmatic approach following the late start would have allowed us to get the alpha release done in a more measured way. Rushing things through is likely to increase Risk Register ratings and is obviously advantageous to avoid.
Some partners/individuals/sub-subcontractors did not engage in the project as much as was hoped.	Project management	Internal	All partner and contractor activity descriptions should have been drawn up precisely and agreed and signed by all parties in order for everyone to know exactly what activities they were in charge of and individual activities that they were supposed to do.
Weekly meetings were useful but not all actions were minuted	Project management	Internal	Weekly meetings needed a set protocol right from the start with a dedicated chair. If an AI minute taker had been as accessible at the start, this would have been ideal.

Lesson learned	Type	Could this be improved by external or internal means	How things might have been done better
It would have been useful to have an internal monitoring officer that was asking the same questions as the external MO - this would have made for more seamless overall project management	Project management	Internal	An overall project manager concentrating on minuting activities, chasing up actions, tracking timescales and spend, doing PCRs and project reports would be ideal. In a perfect world this individual would have no or little involvement in delivering the project activities. Additionally, consistency in MO's and DESNZ staff would help with the overall project management.
PCR delays caused a lot of anxiety, work and stress. It also was a significant drain on project costs	Project management	Internal	Due to the lengthy period between submitting a PCR and that going through the AEA Monitoring Officer and then to DESNZ, by the time we got a response, we had had to sometimes move on anyway, change the sequence of what we did, take calculated risks and smooth over some threats to "down tools". In hindsight, we would avoid complex and multifaceted PCR requests, possibly by including simpler ones but more of them.
Although On-line meetings are very handy, it's no substitute for meeting people in real life. working relationships and easy encouraged contact is vital	Project management	Internal & External	More in person meetings. At least the first time someone new starts from say AEA or DESNZ. In person as soon as starting the role as possible. All subsequent comms are facilitated by this human aspect.

Annex 6. Biomass crops use in UK power stations 2014-2023

Figure 10 & Tables 15-18

Figure 10: *Trend in annual tonnage of biomass crops used in UK biomass power stations over the last decade.*



Data for the above graph was obtained from the datasets listed below:

Table 15: Amount of SRC willow & Miscanthus used in UK power stations 2014-2023.

Biomass crop amount (tonnes)	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022-23
Miscanthus	34,514	30,118	54,925	40,007	48,804	33,131	43,628	44,690	42,903
SRC willow	15,318	17,464	14,658	29,633	28,201	7,334	18,463	5,148	19,377
Total	49,832	47,582	69,583	69,640	77,005	40,465	62,092	49,838	62,280

Table 16: Inclusion rate of SRC willow & Miscanthus biomass in UK power stations 2014-2023.

Annual biomass requirement of all biomass plant (tonnes) 6,967,000	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022-23
Total energy crops	**49,832**	**47,582**	**69,583**	**69,640**	**77,005**	**40,465**	**62,092**	**49,838**	**62,280**
% inclusion rate	0.72	0.68	1.00	1.00	1.11	0.58	0.89	0.72	0.89

Sources:

Biomass Sustainability Dataset 2014-15 https://www.ofgem.gov.uk/publications/biomass-sustainability-dataset-2014-15

Biomass Sustainability Dataset 2015-16 https://www.ofgem.gov.uk/publications/biomass-sustainability-dataset-2015-16

Biomass Sustainability Dataset 2016-17 https://www.ofgem.gov.uk/publications/biomass-sustainability-dataset-2016-17

Biomass Sustainability Dataset 2017-18 https://www.ofgem.gov.uk/publications/biomass-sustainability-dataset-2017-18

Biomass Sustainability Dataset 2018-19 https://www.ofgem.gov.uk/publications/biomass-sustainability-dataset-2018-19

Biomass Sustainability Dataset 2019-20 https://www.ofgem.gov.uk/publications/biomass-sustainability-dataset-2019-20

Biomass Sustainability Dataset 2020-21 https://www.ofgem.gov.uk/publications/biomass-sustainability-dataset-2020-21

Biomass Sustainability Dataset 2021-22 https://www.ofgem.gov.uk/publications/biomass-sustainability-dataset-2021-22-scheme-year-20

Biomass Sustainability Dataset 2022-23 https://www.ofgem.gov.uk/publications/biomass-sustainability-dataset-2022-2023-scheme-year-21

Table 17: Breakdown of SRC willow biomass used in individual UK power stations 2014-2023.

Plant	Plant capacity (tonnes)	SRC (tonnes)									Biomass crop inclusion range %
		2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022-23	
Iggesund	650,000	8,371	8,736	6,949	16,196	18,712	3,358	15,720	3,426	19,252	0.5-2.9
Land Energy	53,000	0	620	1,182	0	5,654	3,510	1,439	0	125	0-10.7
Brigg	261,000	0	158	1,203	12,648	3,835	466	593	1,517	0	0-4.8
Snetterton	279,000	0	0	0	789	0	0	0	22	0	0-0.3
Sleaford	240,000	0	0	0	0	0	0	712	182	0	0-0.3
Drax	4,900,000	6,947	7,950	0	0	0	0	0	0	0	0-0.16
Wilton 10	245,000	0	0	5,324	0	0	0	0	0	0	0-2.2
Totals	**6,628,000**	**15,318**	**17,464**	**14,658**	**29,633**	**28,201**	**7,334**	**18,463**	**5,148**	**19,377**	

Table 18: Breakdown of Miscanthus biomass used in individual UK power stations 2014-2023.

Plant	Plant capacity (tonnes)	Miscanthus (tonnes)									Biomass crop inclusion range %
		2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022-23	
Brigg	261,000	0	5,167	26,130	27,594	23,758	23,179	30,978	29,109	29,229	2-10
Snetterton	279,000	0	0	469	11,757	20,970	9,381	10,256	12,212	12,142	0.2-7.5
Drax	4,900,000	33,245	24,413	25,750	0	0	0	0	0	0	0-0.67
Elean	211,000	1,269	538	2,576	656	4,076	571	2,394	2,914	1,532	0.3-1.9
Eye	128,000	369	0	0	0	0	0	0	0	0	0-0.3
Sleaford	240,000	0	0	0	0	0	0	0	455.2	0	0-0.19
Totals	**6,019,000**	**34,514**	**30,118**	**54,925**	**40,007**	**48,804**	**33,131**	**43,628**	**44,690**	**42,903**	

Annex 7. Dissemination Activities PM1 - PM2

Table 19: Dissemination activities PM1 - PM2

Outreach	Date	Description / Activity
Visit from the Department of Agriculture, Environment and Rural Affairs (DAERA) Permanent Secretary	1 Sept 2022	Meeting with AFBI Executive Management team, included a presentation on the project
EU Interreg CatchmentCARE	5 Sept 2022	Presentation to EU Interreg Catchment CARE Technical Committee
AFBI Internal Seminar	8 Sept 2022	Opportunities for NI's Agricultural Sector to decarbonise Energy (Anaerobic Digestion & Biomass Crops)" – NetZero 2050
EU Interreg CatchmentCARE	22 Sept 2022	Presentation to EU Intereg CatchmentCARE Partners and External Stakeholders
Northern Ireland Interdepartmental Biomethane Working Group	7 Oct 2022	Visit and presentation
BiFOR Face project at Birmingham City University	7-8 Oct 2022	Discussions with Joel James MS (Shadow Minister for Social Partnership, Welsh Senedd)
CIWEM evening Webinar. Agri-Management Approaches Northern Ireland	19 Oct 2022	Reference to BEIS Biomass Innovation and individual projects including Envirocrops and Biomass Connect.

Outreach	Date	Description / Activity
IrBEA Conference	11 Oct 2022	Envirocrops exhibited
Farm Business Innovation Show	2-3 Nov 2022	Envirocrops presence on the NFU and NFU Mutual stand
The Farmer Network Event, Wigton, Cumbria	8 Dec 2022	Envirocrops presence
NFU Central Induction	9 Dec 2022	Networking event for new members of NFU sta - opportunity to promote Envirocrops to NFU member advisers
Farm Walk - Miscanthus Nurseries	13 Dec 2022	Demo of Envirocrops and the Cropper game - 25 attended - engaged with farmers and local Government: The EnviroCrops team invites you to two Farm Walks | NFU Energy
Farm Walk - Willow Energy, Carlisle	15 Dec 2022	Demo of Envirocrops and the Cropper game - 10 attended - farmers and the Envirocrops consortium: The Envirocrops team invites you to two Farm Walks | NFU Energy
Lincolnshire Agricultural Machinery Manufacturing Association (LAMMA) event	10-11 Jan 2023	Envirocrops presence and leaflets handed out on the NFU and NFU Mutual stand
Exhibited at Low Carbon Agriculture Show	7-8 Feb 2023	Event showcasing low carbon practices, technology and energy solutions for a profitable and sustainable farming future.
NFU Conference	21-22 Feb 2023	Across two packed days, delegates heard from industry leaders, experts and political heavyweights on the future of agriculture and horticulture. Envirocrops exhibited on the NFU

Outreach	Date	Description / Activity
		Energy stand at the event
Farm Walk - Eucalyptus, North Curry, Somerset	7 March 2023	Demo of Envirocrops and the Cropper game - 16 attended - engaged with farmers, consultants, local Government, Forestry Commission: Eucalyptus Farm Walk - learn all about this super energy crop | NFU Energy
Farm Walk - Poplar, Lulham, Hereford	8 March 2023	Demo of Envirocrops and the Cropper game - 16 attended - engaged with farmers, farm managers, BBC radio, land owners: Poplar Farm Walk - learn all about this excellent energy crop | NFU Energy
World Biogas Expo	28-29 March 2023	Envirocrops presence on the NFU Energy stand - the event brings latest biogas technologies from around the world, as well as delegates from an anticipated 100 countries, to discuss what needs to happen to deliver biogas' potential this decade.

Annex 8. Dissemination Activities PM3 - PM6

Table 20: Dissemination activities PM3- PM6

Outreach	Date	Description / Activity	Analytics
Farmer influencer Olly Harrison shares social post	12-May-23	Social post promoting the Cropper game: Olly harrison 🥤🍔🚿AccidentalYoutuber on X: "Just played this game thought I was doing well till it flooded anyone else beat 1000t of miscanthus ? https://t.co/jFuKoCEnRO @NFU_Energy https://t.co/0TpMLvljn5" / X	32 unique visits on the same day. 338 uniques over two weeks, or a +23.8% increase. Hits to the /game and /play URLs were up a combined 51 views, which is a +136.4% and +87.5% increase respectively.

Outreach	Date	Description / Activity	Analytics
Sponsorship of Olly's Combine Charity Run	4-8 June 23	Farmer Influencer Olly Harrison organised a Combine Charity Run, travelling from John o'Groats to Lands End in a combine harvester to raise awareness of charities Mind and Children With Cancer. Envirocrops sponsored the event as it was a perfect opportunity to build brand awareness amongst Olly's huge social following - 140k+. We also had a large Envirocrops logo on the side of the safety vehicle that drove alongside the combine.	137 visits (+87.7%) increases across the board. /app +26 (+1300%), /resource +26 (+520%), resources +19 (+475%). /play +42 (9.6%) /game +19 (4.3%)
Olly Harrsion YouTube vlog	21-Jun-23	Kevin features on Olly's vlog at 4:15 mins talking about Envirocrops: DAY 1 CEREAL#OLLYBLOGS #AnswerAsAPercent 1179 - YouTube	30k views
Groundswell 2023	28-29 June 23	Envirocrops exhibited at Groundswell. The objective across the two-days was to engage with visitors and educate them about biomass crops and Envirocrops. As an incentive to sign up to Envirocrops newsletter, the team were giving away eucalyptus plug plants, miscanthus rhizome and willow.	155 hits to the homepage, 99 unique visits (+33.8%), /resources and /resource were up +21 and +14 (+525% and +700%) respectively.

Outreach	Date	Description / Activity	Analytics
Energy & Farm Diversification Show, Tipperary	20-Jul-23	Exhibitor stand at a well attended farmer event at Gurteen College in Ireland, engaging with 50-100 farmers. Envirocrops was also promoted in speaking slots.	11 visits
NFU Energy web article	30-Aug-23		43 page views
NFU Energy Byte e-newsletter	8-Sep-23	50 word insert sent to 4,037 subscribers: September's Energy Byte	45 clicks
NFU Student & Young Farmer e-newsletter	8-Sep-23	50 word insert sent to 4,000+ subscribers	5 clicks
StudentFarmer magazine full page article	22-Sep-23	Promotion of competition with the NFU Student & Young Farmer membership magazine. Page 44 - STUDENT FARMER https://issuu.com/studentfarmer/docs/september_2023 SEPTEMBER 2023 by STUDENT FARMER - Issuu	/app gained 58 views, +11 uniques (+137.5%). /game 42 views, +9 uniques (+56.3%). /signup +4 uniques (+133.3%)

Outreach	Date	Description / Activity	Analytics
Agroforestry Show	6-Sep-23	Presentations by Kevin Lindegaard and Chris Johnston as part of a biomass session, engaging with 60+ people. Additional discussions with other organisations were had whilst at the show	51 visits, 7 hits to /signup which is a +200% increase
Biomass Connect event North Wyke	28-Sep-23	Envirocrops delivered a presentation to 30 attendees, which was also followed by a crop walk providing the opportunity to network with attendees	21 visits that weekend
Training at Berkshire College	Oct-23	Half day training with Level 1, 2 and 3 agricultural students - 40 total, plus five members of sta . This involved demos of the app and encouraged plays of the Cropper game amongst students	Likely in combination with the below
Speaking slot at Wood Heat Conference	24-Oct-23	Speaking slot at the annual Wood Heat Conference organised by the REA and attended by policy makers and most protagonists in the biomass heat sector - 80 conference participants	64 visits (+128.6%) over the three day period. 40 and +18 on /play and /game respectively. +38 on /resource and /resources
Speaking slot at CHCx3 event	10-Nov-23	Crops to Products Conference as part of Agri Tech week. Presentation on Envirocrops to 60 participants including farmers, agricultural businesses and CHCx3 partnership	45 visits over the period, but increased page specifics: /game +9 (+128.6%) /play +8 (+160%) /signup +6 (+600%)

Outreach	Date	Description / Activity	Analytics
NFU Energy Supplement featured in NFU magazines - full page article	11-Nov-23	Article on the opportunities highlighted in the Biomass Strategy and info on Envirocrops: NFU Energy: Winter 2023/2024 by NFU Energy - Issuu	Readership 46,000+ Likely in combination with the below
NFU Energy Byte e-newsletter	10-Jan-24	50-word insert on Envirocrops sent to 4,528 subscribers: January's Energy Byte	10 clicks
Low Carbon Agriculture Show 2024	6-7 March 24	Envirocrops exhibited at the Low Carbon Agriculture Show. The main objective was to launch the FaS Directory and encourage signups. Those that signed up to the Directory were incentivised with a welly boot bag	73 unique visits (+121.2%) and 95 hits on the /marketplace pages (15.1%)
StudentFarmer magazine Q&A with Will Rowe	14-Mar-24	Q&A feature with Will Rowe, Student Advisory Member on his participation in the Envirocrops project and the benefits of biomass crop production. Page 37 - STUDENT FARMER - MAY 2024 by STUDENT FARMER - Issuu	29 unique visits. 91 views on /marketplace. +19 uniques to /marketplace which is a +105.6% increase

Outreach	Date	Description / Activity	Analytics
Presenting on the Agri Tech E webinar	18-Mar-24	Kevin Lindegaard gave a presentation called Biomass Connected talking about the BC, Envirocrops and CHCx3 projects - 20 attended	24 unique visits (+100%)
Presentation to Windsor & Maidenhead Young Farmers	28-Mar-24	Will Rowe, Student Advisory Member gave a presentation to 28 young farmers on his involvement in Envirocrops and demonstrated the web app (40 in attendance including parents)	28 Cropper game plays
Argus Biomass Conference	23-Apr-24	The largest international biomass conference in Europe. Attended by Kevin Lindegaard who spoke on behalf of Envirocrops on the Biomass Connect panel. 100 people listened to the presentation and panel discussion. Leaflets given out to delegates	32 unique visits for a three-day period (+77.8%). /marketplace +10 (+500%), /app +4 (+100%). Inbound from search increased, too: Google +12 (+300%), DuckDuckGo +3 (+100)
NFU Energy Supplement featured in NFU magazines - full page article	May 24	Launch of FaS Directory article included within the NFU Energy Supplement mailed out to all NFU members: NFU Energy Supplement - Summer 2024 by NFU Energy - Issuu	Readership: +46,000

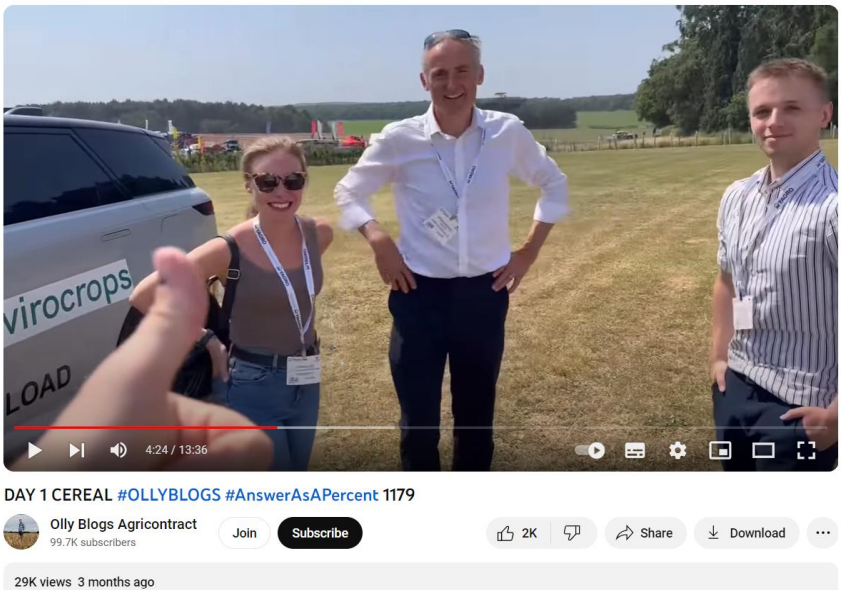
Outreach	Date	Description / Activity	Analytics
Groundswell 2024	26-27 June 24	Attended the Biomass Connect lot 1 hub to gather more stakeholders, suppliers and buyers of biomass crops and their products, with the objective of growing our FaS Directory. 40 companies were engaged with at the event.	/become-supplier increased by +14 (+5.5%) but also /signup +6 (+600%) /sign in +5 (+500%) and /start +3 (+300%).
NFU Energy Byte e-newsletter (FaS Directory)	8-Jul-24	50-word insert promoting the FaS Directory sent to 4,528 subscribers: July's Energy Byte	39 clicks
Royal Welsh Show	22-25 Jul 24	Networking and engagement with NFU members on the NFU Cymru stand showcasing Envirocrops web app, Cropper game and FaS Directory. Envirocrops was also present on the Biomass Connect stand	105 unique visits for that week (+114.3%). Increases to /marketplace (specifically /suppliers) got +34 uniques (+566.7%) and /play increased by +10 (+500%).
Biomass Connect Demonstration Event Herts	12-Sep-24	Exhibited and speaking slot at the Biomass Connect Demonstration Event - ~50 attendees	30 visits (+30.4%), /marketplace +3 (+300%)
Biomass Connect Demonstration Event Devon	26-Sep-24	Exhibited and speaking slot at the Biomass Connect Demonstration Event - ~50 attendees. 3 welly boot bags given out as raffle prizes and 10 keyrings given to potential suppliers.	

Outreach	Date	Description / Activity	Analytics
Visit to Sydney House Farm willow grower with farming influencer Olly Harrison	18-Oct-24	Featured in Olly's vlog, which also included a direct link to Cropper Game on his YouTube channel. The video has had 35k views: WILLOW FARM WITH JOHN DEERES THE BRITISH FARMING AWARDS AnswerAsAPercent 1676 - YouTube	MASSIVE increase! 272 unique visits (+151.9%), inbound search from Google +44 clicks (+220%). /play increased by 220 views, +158 uniques (+1580%) and /game +38 uniques (+237.5%)! /marketplace also gained 420 total views, +135 uniques (+195.7%)
International Poplar Convention in Bordeaux	22-25 Oct 24	Presentations by Kevin Lindegaard in the Communications technical session (15 viewers); Additional web app and game run through (35 attendees); Leaflet and keyring in registration bags; poster displayed; 7 boot bags distributed as raffle prizes	Too early to state full impact but visitors from France went up by 20 during the week which is a +2000% increase! International conference, so there is a strong likelihood that there will be a spike in numbers from other countries as people return home.
Biomass Connect Showcase, Warwick	7-8 Nov 24	Promotional stand exhibited. by Kevin Lindegaard gave a Powerpoint presentation and also sat on a panel with Chris Johnston. PECAG members Will Rowe and John Hawkins also featured. https://www.biomassconnect.org/technical-articles/presentation-kevin-lindegaard-the-role-of-decision-support-and-information-tools-in-successful-scaling-up-of-the-biomass-industry/	150 people attended the Showcase. 758 visits, 3,526 pageviews, 2,177 uniques.

Outreach	Date	Description / Activity	Analytics
Biomass Connect webinar - *Tools for the Biomass Trade*	23 Jan 25	Roisin Alvy introduced the Envirocrops web app. Lizzy Parker of Farm Carbon Toolkit also presented. The full webinar can be viewed at: https://www.biomassconnect.org/new-media/#webinars	36 people attended the webinar. 5 views of the recording on YouTube (uploaded 29 Jan 25).

Annex 9: Shows, events & outreach

Olly Harrison Combine Challenge and Cereals (June 2023)



Groundswell and Energy & Farm Diversification Show (July 2023)

Confor Woodland Show (Sep 2023)

Annual site visit with DESNZ and DEFRA representatives at Fernhill Farm (Nov 2023)

Berkshire College of Agriculture training (Oct 2023)

With the Wageningen University ACT students and coach Jean-Paul van Rie at the Renewable Energy Centre at AFBI Hillsborough (Jan, 2024)

LCA show (March 2024)

Argus Biomass (May 2024)

Envirocrops welly boot bag, gilet and key rings.

Groundswell (July 2024)

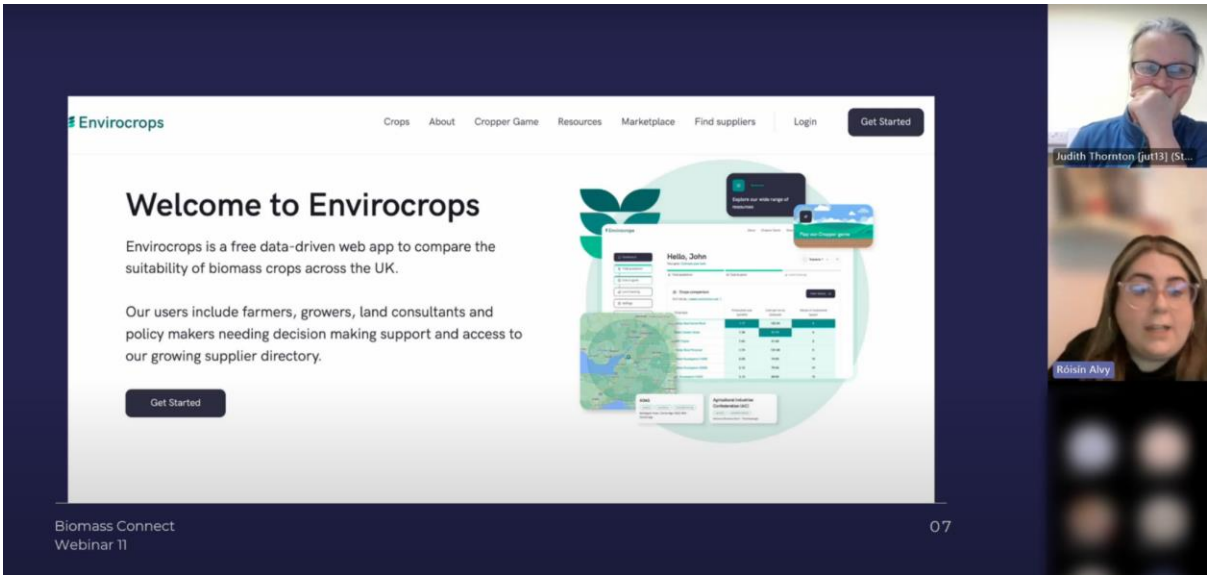
Biomass Connect - BGI Demo Event (Sep 2024)

Project team commercialisation meeting (Sep 2024)

International Poplar Convention in Bordeaux (Oct 2024)

Biomass Connect Showcase (Nov 2024)

Biomass Connect webinar (Jan 2025)


Envirocrops
Crops
About
Cropper Game
Resources
Marketplace
Find suppliers
Login
Get Started
Welcome to Envirocrops
Envirocrops is a free data-driven web app to compare the suitability of biomass crops across the UK.
Our users include farmers, growers, land consultants and policy makers needing decision making support and access to our growing supplier directory.
Get Started
Hello, John
Biomass Connect
Webinar 11
07
Judith Thornton [jut13] (St...
Róisín Alvy

Annex 10. SUNY Press release

Press Release: SUNY ESF Awarded $8 Million to Advance Low-Carbon Energy Crop Innovation

SYRACUSE, N.Y. – Jan. 16, 2025

The SUNY College of Environmental Science and Forestry

(ESF) has been awarded $8 million by the U.S. Department of Energy (DOE) Bioenergy Technologies Office (BETO) to spearhead advancements in willow biomass crops, a low-carbon intensity, purpose-grown energy crop. This initiative is pivotal in accelerating the nation's transition to a clean energy bioeconomy.

This funded project builds on 40 years of research and development at ESF with willow biomass crops. Shrub willow grows rapidly on low quality open land and is a low carbon biomass source that can be used to make biofuels like sustainable aviation fuel, bioproducts like biodegradable plastics, and bioproducts like wood-based insulation. Willow also provides a host of other benefits like improving soil health and soil carbon levels, enhancing landscape biodiversity, and creating new jobs in rural areas.

The funding is part of a broader $52 million DOE investment across six university and industry projects. These efforts aim to build a robust domestic supply chain of alternative carbon sources critical to producing biofuels and bioproducts. By fostering innovation in renewable carbon resources, these projects are expected to reduce net emissions in the transportation and industrial sectors while simultaneously driving growth in the U.S. agricultural industry.

ESF's project, "Advancing Commercialization Through the Monitoring and Verification of Large, Established Willow Biomass Crops," seeks to eliminate barriers to the expansion and commercialization of shrub willow crops and quantify their environmental benefits. Key innovations include:

- Utilizing UAV precision management technologies
- Developing new planting systems to lower planting costs
- Improving genetic varieties of willow
- Creating a prototype harvester that is effective in smaller fields

This project presents the opportunity to study a large-scale, commercially managed short-rotation woody crop system during the latter half of its 20-25-year lifecycle. Additionally, the ESF team will collect, analyze, and share critical sustainability data associated with willow production to inform future practices.

"By advancing technologies for cultivating and utilizing shrub willow, we are reducing greenhouse gas emissions and providing a sustainable alternative to fossil fuels," said Dr. Timothy Volk, lead researcher on the project. "These efforts not only benefit the planet but also create new job opportunities in rural areas."

The inter-disciplinary project involves researchers from across ESF's academic departments and essential partners at other organizations. ESF Co-PIs on the project are: Drs. Russell Briggs, Tristen Brown, Mark Eisenbies, Jenny Frank, Cole Cross, Obste Therasme, Nathan Young, and Mr. Karl Hallen from the Department of Sustainable Resources Management. Dr. Deepak Kumar from the Department of Chemical Engineering, and Jason Kohlbrenner, Department of Environmental Studies. Key partners in the development and implementation of this project include Argonne National Lab, Calvium and Crops for Energy in the United Kingdom, CNY Drone Service, Ramo, School of Integrative Plant Sciences at Cornell University, and SUNY Grows.

By investing in this research, DOE advances its long-term objective of developing technologies that harness renewable carbon resources to expand the production of bioenergy, renewable chemicals, and sustainable materials. The selected projects will generate data and findings to support the growth of low-carbon intensity, purpose-grown energy crops across diverse agronomic and geographic landscapes. These crops include microalgae, switchgrass, Miscanthus, high biomass sorghum, Carinata, Camelina, pennycress, and shrub willow.

About SUNY ESF

The SUNY College of Environmental Science and Forestry (ESF) is dedicated to the study of the environment, developing renewable technologies, and building a sustainable and resilient future through design, policy, and management of the environment and natural resources. Members of the College community share a passion for protecting the health of the planet and a deep commitment to the rigorous application of science to improve the way humans interact with the world. The College offers academic programs ranging from the associate of applied science to the Doctor of Philosophy. ESF students live, study and do research on the main campus in Syracuse, N.Y., and on 25,000 acres of field stations in a variety of ecosystems across the state.

Annex 11. SUNY Project description

Advancing Commercialization through the Monitoring, Measurement, and Verification of Large, Established Willow Biomass Crops

The Research Foundation of SUNY with Place of Business at SUNY-ESF,

PIs: Dr. T.A. Volk, F. Allard, Dr. E. Fabio, Dr. R. Briggs, Dr. T. Brown, Dr. T. Dorholt, Dr. M.Eisenbies, Dr. J. Frank, Dr. C. Gross, K. Hallen, Dr. D. Kumar, Dr. O. Therasme, Dr. N. Young, Dr. L.B. Smart, Dr. Y. Jiang, Dr. C. Zumpf, Dr. J. Quinn, R. Alvy, K. Lindegaard.

Team: State University of New York College of Environmental Science and Forestry (ESF); Ramo NY, Cornell University, Argonne National Lab, Crops for Energy, Calvium, CNY Drones

This project will leverage 350 ha of existing willow biomass that were planted between 2006–2013 in central and northern NY under the USDA Biomass Crop Assistance program. Our commercial partner, Ramo, is taking over land leases to provide annual income for growers and access for this project. This is a unique opportunity to understand the dynamics of a large-scale, commercially managed SRWC system in the second half of its 20-25 year life cycle (the willow plants are 12 to 16 years old). These fields will be managed by Ramo for a variety of markets, providing an opportunity to collect operational and sustainability data that represents commercial scale operations of older willow crops. We will work with companies that are developing uses and markets for willow biomass ranging from mulch to peat replacement in the horticulture industry to sustainable aviation fuel and renewable diesel producers. The diversity of markets will provide opportunities for the rural workforce and stability for organizations that want to expand the production of willow across the landscape.

The project team has almost 200 combined years of experience working with willow including research and development, breeding and selection, crop management and harvesting, pre-commercial expansion and market development. This project will build on years of successful collaboration among project partners to:

- Address barriers to the expansion and commercialization of willow biomass crops by collecting and sharing essential data on the management and sustainability impacts from established commercial scale willow biomass crops,
- Implement innovative practices, such as new planting methods, precision management with UAVs, new genetic material, and a new small scale harvesting system, that together

will improve the effectiveness of willow crop management, improve yields, reduce costs, and lower the carbon intensity of the crop,

- Measure and share data on a variety of environmental and sustainability attributes in willow and develop systems to monetize some of these values, such as carbon sequestration, for willow growers
- Conduct life cycle (LCA) and techno-economic analyses (TEA) using data collected to document impacts and facilitate commercialization;
- Work with a range of partners to develop current, near, and long term markets for willow biomass that will support expansion across its growing region in the US.

This project will collect commercial-scale operational and sustainability data across a wide swath of existing willow biomass crops managed by our commercial partner, Ramo. The data collected will add to our understanding of the commercial management of the system across diverse topographic settings, while implementing innovations and improvements to reduce costs and energy inputs, lower carbon intensity, and encourage the development of near- and long- term markets. This project will facilitate the certification of willow for sustainable aviation fuel and other renewable biofuels pathways as well as open access to carbon markets to generate additional value to growers.

Annex 12. Community Interest Company Statement

ABOUT ENVIROCROPS

The purpose of the proposed Envirocrops CIC is to:

- Provide a decision making platform on a wide range of crops that can be planted for an extensive number of end uses and environmental benefits
- Be applicable to a wide network of people (particularly farmers, land owners and land managers) and small and large organisations (both public and private)
- Enable a central online facility providing viable information and facilitating knowledge sharing
- At every point of the value chain - growing, managing, processing
- On the wider environmental benefits of these crops
- On new developments and innovations
- That aims to proactively inform the policy framework for biomass and other environmental crops
- Produce guidance and other tools that are high-quality, accessible and easy-to-understand and use
- Be informed by the peer reviewed academic outputs and farmer experience enabling the use of scientifically robust data / information and to be driven by consensus
- Work collaboratively and creatively with others, striving for clear and consistent communication in our projects.
- Aim for the highest levels of accuracy and integrity in our work and provide information and our assumptions in an objective and impartial way and give a fair and balanced report of our findings.

Activities to achieve the Purpose of the Envirocrops CIC include

- Sourcing funding in order to refine existing tools and introduce new ones (particularly ones that can bring about environmental benefits based on climate change adaptation and mitigation) and improve the evidence base for our assumptions
- Developing overseas links to applying Enviorcrops learnings to other geographic areas beyond the British Isles
- Incorporation of accurate and up to date information that aims to
  - Improve the evidence base and precision of our tools and de-risking long term investment choices

    - Evolve as markets and economics change, policy measures are introduced and innovations developed.
- Working closely with other organisations and initiatives that share our core values such as
    - Biomass Connect
    - Farm Carbon Toolkit.

Annex 13. Aspirations for calculators to incorporate in the upcoming years

Table 21: Aspirations for calculators

Potential calculator	What will it involve	Who is it targeted at	Is it stand alone	How easy is it to do	Commercialisation potential	Can we be sure of the validity of information? i.e. how certain are we of the science that backs up the calculator?
Labour requirement to hand plant	Simple calculator that would give an indication of how many hours it would take to manually plant a specific area	Small holders, academic organisations planting trials (by knowing this information they could budget accordingly)	Yes	Easy	None	Yes. Based on many years of trial plantings and the logistics of this.

Potential calculator	What will it involve	Who is it targeted at	Is it stand alone	How easy is it to do	Commercialisation potential	Can we be sure of the validity of information? i.e. how certain are we of the science that backs up the calculator?
Labour requirement to hand harvest	Simple calculator that would give an indication of how many hours it would take to manually harvest a specific area	Small holders, academic organisations (by knowing this information they could budget accordingly)	Yes	Easy	None	Yes. Based on many years of harvesting trial plots and the logistics of this.
Bioremediation - heavy metal removal	Simple calculator that would give an indication of the amount of heavy metals that could be removed each year	Owner/managers of contaminated land; academics; policy makers	Yes	Relatively easy	This could be targeted at projects that are trying to get academic funding. This would be a major technology transfer box ticked. Many plants not considered as biomass crops are bio accumulators so there	There is data out there. No doubt it is site specific and therefore any calculator produced would be a ready reckoner and need caveats. There is nothing like this out there so it would be a useful tool that could become refined over many years.

Potential calculator	What will it involve	Who is it targeted at	Is it stand alone	How easy is it to do	Commercialisation potential	Can we be sure of the validity of information? i.e. how certain are we of the science that backs up the calculator?
					would be a potential to expand the remit of the web app. Ultimately this could become a paid for feature.	
Bedding production	Simple calculator to work out how much land is required to produce x amount of bedding for a particular type of animal	Livestock farmers, smallholders, permaculture enthusiasts, zoo keepers, amalgamators, processors	Yes	Relatively easy	Paid for feature	The information is almost certainly available, but we don't know it.
Compost production	Simple calculator to work out how much land is required to	Compost producers, waste	Yes	Relatively easy	Paid for feature	We have most of this information

Potential calculator	What will it involve	Who is it targeted at	Is it stand alone	How easy is it to do	Commercialisation potential	Can we be sure of the validity of information? i.e. how certain are we of the science that backs up the calculator?
	produce x amount of compost, mulch etc	management companies,				
Number of units of particular products that can be produced	Simple calculator to work out how much land is required to produce x units of packaging, insulation etc	Processors, project developers	Yes	Difficult	This could enable us to become part of a bioeconomy project where we build something to order. Ultimately this could become a paid for feature.	We know that products exist, but most have been made at a small scale. There are a lot of unknowns.
Pharmaceutical extraction	More advanced calculator to work out the estimated amount of extractives that could be produced from a certain area of	Academics, processors, policy makers, producers of pharmaceuticals	Yes	Difficult	This could enable us to become part of a bioeconomy project where we build something to order. Perhaps a useful addition to Bio Will 2 or similar project.	We have variety specific data for willow from the Bio Will project and there are plenty of academic papers on this subject.

Potential calculator	What will it involve	Who is it targeted at	Is it stand alone	How easy is it to do	Commercialisation potential	Can we be sure of the validity of information? i.e. how certain are we of the science that backs up the calculator?
	land or amount of feedstock.				Ultimately this could become a paid for feature.	
Non planted land area calculator	Every time you plant a biomass crop there are areas left unplanted (headlands, rides etc). A field could be picked, and a polygon created that would enable the unplanted area to be calculated. These areas are usually the bits that are eligible for SF schemes.	Farmers, scheme regulators, policy makers	Yes	Difficult	Developing this would make us very interesting to DEFRA and devolved agencies as schemes are rolled out. It's the sort of thing we should offer to DEFRA and get them to pay us to deliver it.	Yes, there are plenty of aerial mapping systems available
Agroforestry design/	Mapping application to help design buffer	Farmers, scheme	Yes	Difficult	Developing this would make us very	We would need to liaise with DEFRA, devolved agencies and

Potential calculator	What will it involve	Who is it targeted at	Is it stand alone	How easy is it to do	Commercialisation potential	Can we be sure of the validity of information? i.e. how certain are we of the science that backs up the calculator?
Buffer strips/ Shelterbelt design	strips and agroforestry integration in farm fields	regulators, policy makers, water companies			interesting to DEFRA and devolved agencies as schemes are rolled out. It's the sort of thing we should offer to DEFRA and get them to pay us to deliver it.	other stakeholders. Delivering this would make us an intrinsic part of the delivery of government incentives
Flood mitigation	Mapping application providing an indication of the best places to plant biomass crops in order to reduce the impact of flood events.	Local authorities, Environment Agency and devolved equivalents, insurance companies, water companies	Yes	Very difficult	This could enable us to become part of the project already pitched to DEFRA on long term flood mitigation trials. Paid for feature but not possible for the foreseeable future.	No, this is a long-term aspiration that would need to be based on roll out and monitoring of trails and modelling of results.

Potential calculator	What will it involve	Who is it targeted at	Is it stand alone	How easy is it to do	Commercialisation potential	Can we be sure of the validity of information? i.e. how certain are we of the science that backs up the calculator?
Willow variety mixture choice selector	Not all willow varieties yield well everywhere. Also, in order for long term health and safeguarding of the plantation mixtures of varieties need to be used. A simple choice graphic could be developed based on location , variety suitability and mixture compatibility.	New growers, contractors	Yes	Relatively easy	None	Yes, Rothamsted have produced a sheet which provides the sort of information that we would use as the baseline: https://www.biomassconnect.org/wp-content/uploads/2023/10/SRC-Willow-Variety-Selection2023.pdf
Eucalyptus species choice selector	Not all willow varieties yield well everywhere. Also, in order for long term health and	New growers, contractors	Yes	Easy (in theory)	None	We have a pretty good idea of Eucalyptus tolerance to extremes but the changeable climate means that some things we think we know are

Potential calculator	What will it involve	Who is it targeted at	Is it stand alone	How easy is it to do	Commercialisation potential	Can we be sure of the validity of information? i.e. how certain are we of the science that backs up the calculator?
	safeguarding of the plantation mixtures of varieties need to be used. A simple choice graphic could be developed based on location , variety suitability and mixture compatibility.					not certain - i.e. some species die in higher temperatures than would be expected and it is to do with the cycles of cold, warm, wet periods during winters.
Zero discharge system sizer	Enabling would be house builders to work out the size of plot required to treat sewage created by a new build.	House builders, eco house developers	Yes	Relatively easy	Potential for paid for content targeting aspirational new builders and developers	Yes, we have this capability based on paper information, Chris's input and Zak Simmonds

Potential calculator	What will it involve	Who is it targeted at	Is it stand alone	How easy is it to do	Commercialisation potential	Can we be sure of the validity of information? i.e. how certain are we of the science that backs up the calculator?
Pollination services - pollen and nectar provision	Estimation of the amount of nectar and pollen that could potentially be produced by different willow varieties	Permaculture enthusiasts, bee keepers, orchard owners	Yes	Relatively easy	None, although could be part of academic project	We have some information and could extrapolate from various references. It might need some further monitoring.
Biodiversity Net Gain	Biodiversity net gain (BNG) is a way of creating and improving natural habitats. BNG makes sure development has a measurably positive impact ('net gain') on biodiversity, compared to what was there before development. This can be applied to biomass	Developers, local planning authorities and land managers wanting to sell in the BNG market	Yes	Relatively easy	Potential for paid content for developers, who are legally required to consider BNG. Also for land managers who want to sell into the market.	Research framework is already set out for other crops, hedgerows, woodland etc

Potential calculator	What will it involve	Who is it targeted at	Is it stand alone	How easy is it to do	Commercialisation potential	Can we be sure of the validity of information? i.e. how certain are we of the science that backs up the calculator?
	crops and how they can improve the landscape of a farm.					
SRC Harvesting cost predictor and GHG	There are only a few SRC harvesting systems in the country at the moment. This tool would use mapping software to calculate distances and provide an indication of the cost in monetary terms and GHG outputs of transport from the base to where the interested grower is located.	Growers, would be growers of SRC, carbon calculators	Yes	Easy	None	Yes, simple information based on standard vehicles, MPG, distances

Potential calculator	What will it involve	Who is it targeted at	Is it stand alone	How easy is it to do	Commercialisation potential	Can we be sure of the validity of information? i.e. how certain are we of the science that backs up the calculator?
Siting guide based on landscape character	Based on your location, the field will be in a specific Landscape Area and there are various dos and don'ts based on this. This would involve the outputs for SRC and miscanthus being made available depending on where on a map the user clicks.	Growers, statutory bodies, local authorities	Yes	Relatively easy	None, but could be another way of appealing to DEFRA	Based on work from the 00s by Natural England so only available in England.
Livestock methane reduction calculator	Based on the amount of willow fodder introduced into an animals diet and indication of methane	Livestock farmers, carbon calculators, academics, carbon traders	Yes, although integration with other fodder	Relatively easy	Mostly, the potential to piggyback on future research efforts. A calculator (with necessary caveats)	Yes , as long as it is integrated with research projects and caveats are mentioned to say that this is an emerging area,

Potential calculator	What will it involve	Who is it targeted at	Is it stand alone	How easy is it to do	Commercialisation potential	Can we be sure of the validity of information? i.e. how certain are we of the science that backs up the calculator?
	reduction and live weight gain		calculator would be beneficial		would be an excellent way for knowledge transfer of the science as results emerge.	and we don't have all the answers.

Final Report

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