Department for Environment Food and Rural Affairs

NATURAL ENVIRONMENT INVESTMENT READINESS FUND

Environment Agency

NATURAL ENGLAND

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This is one of a suite of case studies of NEIRF funded projects, to highlight efforts to protect and enhance the natural environment, while generating revenue from ecosystem services.

Pollybell Farm on Lowland Peat

LAPWING ESTATE

HIGH LEVEL SUMMARY OF PROJECT

GOVERNANCE

Lapwing Estate Ltd. will manage this project initially. It will have a project director from the estate and overall oversight from the estate's board. If the project is expanded a Special Purpose Vehicle (SPV) will oversee the project.

CREATION OF A SPECIAL PURPOSE VEHICLE (SPV)

Rewetting peatland and growing crops on it to sequester carbon. These crops will then go through pyrolysis, converting them to a stable carbon store called biochar. This process also generates sustainable energy which will be used to grow food in controlled environments.

SELLERS

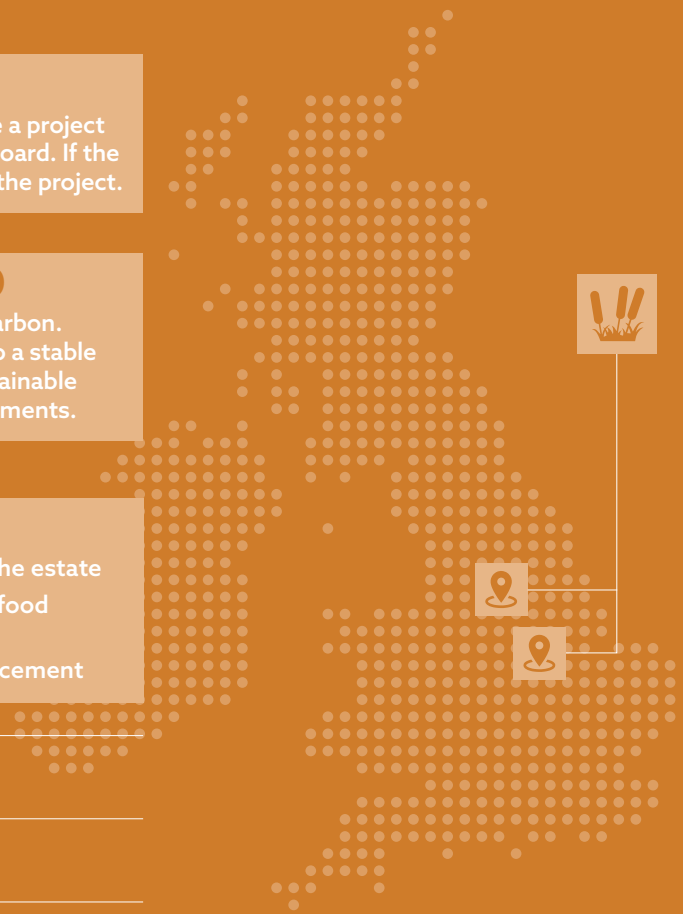
Lapwing Estate Ltd.

BUYERS

Food: supermarkets and food subsidiaries on the estate

Energy: used internally by estate (e.g. for food production); excess to National Grid

Biochar: industry users as a coking coal replacement



Habitats and geographical location

Peatland

Nottinghamshire and South Yorkshire

PROJECT OVERVIEW

The systematic drainage of lowland peat for agricultural practices accounts for 2-3% of total UK greenhouse gases. Peat is formed of partially decomposed plant remains, which have been waterlogged, trapping the carbon in the plants within the soil. When lowland peat is drained of water, it is exposed to oxygen, which allows soil microbes to break down the carbon stored in the peat and causes the peat to emit carbon dioxide (CO_2).

Another key environmental challenge of agricultural practices is food chain supply emissions, including emissions from growing food. Bioenergy is a novel source of renewable energy which can be generated through burning crops, however growing a material for sustainable energy often comes with lost opportunity for food production.

The government's 25 Year Environment Plan and Environmental Improvement Plan 2023 details the need to address some of these issues, including emissions from food supply chains and halting the degradation of lowland peat soils.

The Lapwing Estate in Nottinghamshire and South Yorkshire received NEIRF funding to explore a business model aiming to 'Rethink Farmed Peatlands'. It used the funding to develop a business model to use Short Rotation Coppice (SRC) willow on peat soils with a high water table (known as paludiculture). The willow will then be burnt without oxygen (pyrolysis) to create bioenergy as well as a stable form of carbon called biochar. The bioenergy will then be used for Controlled Environment Agriculture (CEA), a technology-based approach to create optimal growing conditions for food production to offset the farmland being used to grow crops for pyrolysis.

KEY TERMS

Paludiculture

Paludiculture, or farming on rewetted peat, is a system of agriculture for the profitable production of wetland crops under conditions that support the competitive advantage of these crops. It entails raising the water table to achieve wetter conditions. Paludiculture provides a profitable solution for maintaining lowland peatland whilst reducing the greenhouse gas emissions associated with their current (dryland) agricultural use.

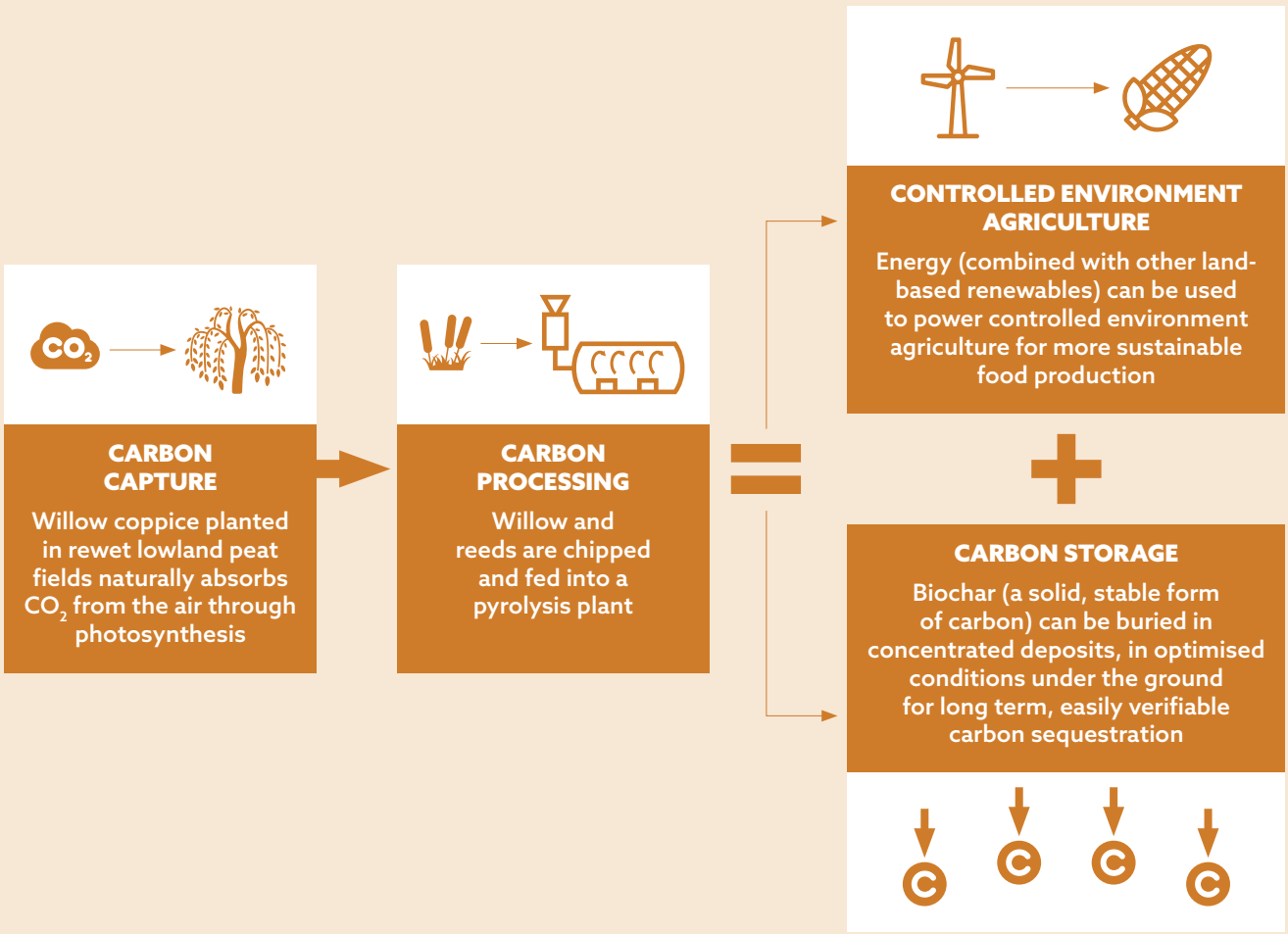
Pyrolysis

Pyrolysis is the thermal decomposition of biomass with the absence of oxygen. This creates a stable form of carbon, called biochar, that can either be permanently buried to sequester the carbon, used to improve soil quality or it is being explored as a potential sustainable alternative to coal in industry.

Short rotation coppice (SRC)

Fast growing tree species are regularly harvested and cut back to a stump, but new stems emerge after each harvest. It has low labour requirements compared to arable crops and can often last 30 years before it needs replanting.

RETHINKING FARMED PEATLANDS



The specific site within the Lapwing Estate was chosen because it is:

- Close to a riverine Site of Special Scientific Interest (SSSI) that is in unfavourable condition. This maximises the benefits of the project as in drought it will help maintain the water levels of the site, and in flooding excess water can be moved to the paludiculture areas, to maintain the SSSI.
- Peatland which is more difficult to crop conventionally. These areas are typically fields which are waterlogged, compaction prone, suffering from blackgrass or sterile brome or other yield constraints.
- Furthest from farm buildings and traffic, to reduce disturbance to the SSSI. The selected site is also on deep peat and has the largest CO_2 emissions on the estate and thus the largest abatement potential.

The project is using a phased, scalable approach, piloting each stage, and has modelled three options:

1. 270ha to be rewetted and willow to be grown for the pyrolysis plant.
2. Expanding to 800ha, increasing the amount of energy that is generated so that excess energy can be sold to the National Grid.
3. Expanding to 35,000ha across the whole estate and potentially adjacent land.

The NEIRF funding was used to develop business models for each of these options, scoping out financing options and different income streams with different stakeholders, as shown below.

Income source	Income generation options scoped	Income stream status
Energy	Selling renewable energy generated through pyrolysis to the National Grid, as well use for CEA.	Confirmed, for use for CEA. Additional capital spends would be required to sell to the National Grid.
Food	Net-zero food grown in CEA, both internally (subsidiaries of the estate) and externally (supermarkets and other food suppliers).	Confirmed, research is ongoing with supermarkets, however no additional premium for net-zero food has been identified.
Biochar	Making biochar through pyrolysis, including a research project exploring whether it can be sold to industry with a Life Cycle Assessment and therefore generating UK Emissions Trading Scheme credits. Alternatives explored are the carbon units associated with it, and benefits to soil quality.	Research ongoing into industry uses for biochar. This option has the potential to support a larger scale expansion.
Tourism	Using renewable energy and food to enhance the estate's tourism offer, e.g. powering a tourist centre.	Confirmed.
Countryside stewardship	Various benefits are covered by countryside stewardship scheme including rewetting of peatland and fen creation.	Possible, but if chosen then the carbon cannot be sold again (e.g., through ETS units as biochar).
Biodiversity Net Gain	Habitat creation on the headlands and margins of the peatland to generate biodiversity units which can be sold to developers. The project has worked with Nottinghamshire Wildlife Trust who manage the nearby SSSI to support biodiversity improvements, potentially at a landscape scale.	Research ongoing with experts on generating biodiversity units.
Water quality	Monetising the improvement in water quality in the River Idle and Torne from rewetting of peatland. The project is working with the Environment Agency to collaboratively manage water.	Not currently – monetising water services is a developing market.
Flood alleviation	As above.	Not currently – monetising water services is a developing market.

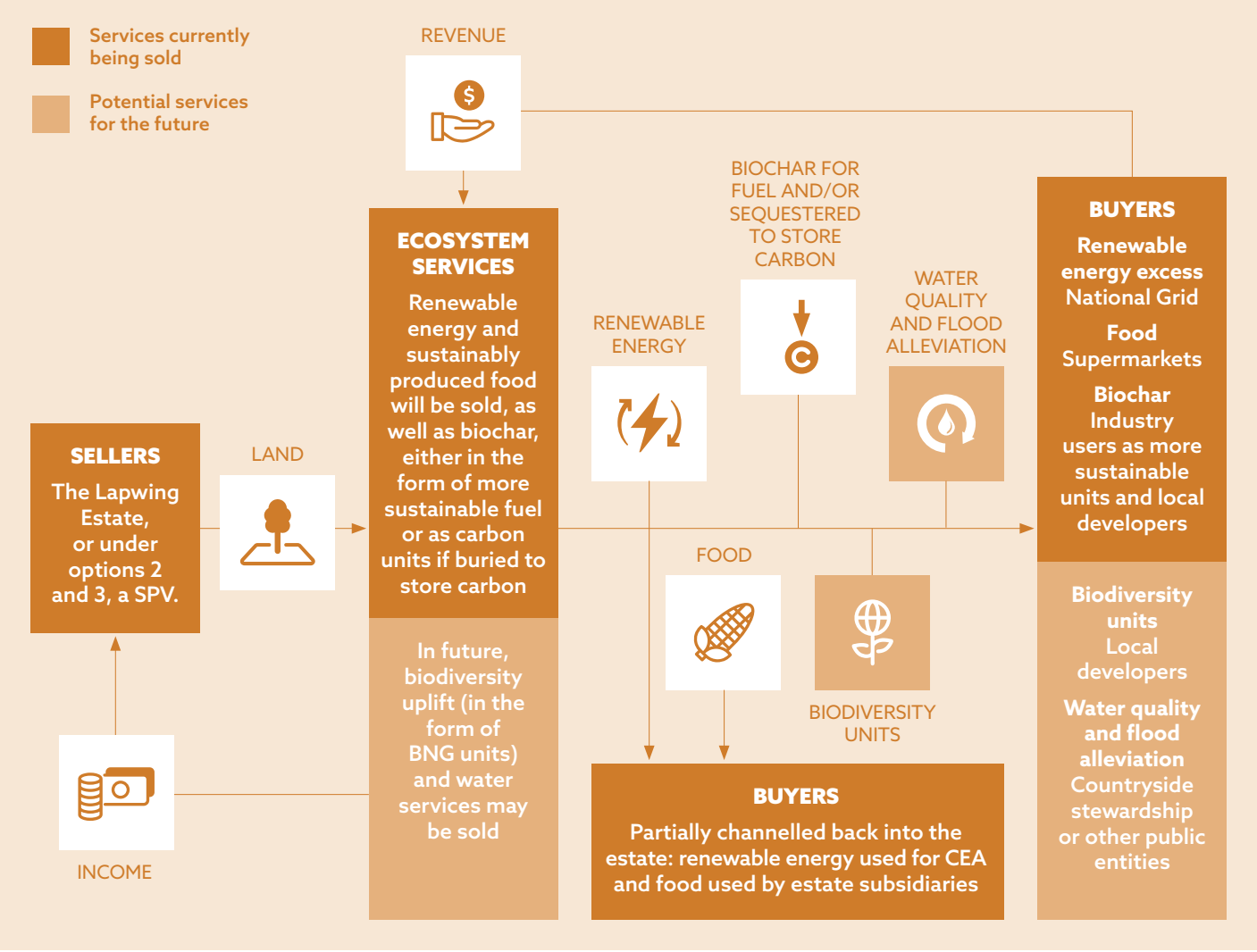
The project's next steps will be to start running the pyrolysis plant and set up the CEA, followed by the phased roll out of paludiculture. The project is continuing to research how to monetise the above benefits that do not currently generate income.

GOVERNMENT ENVIRONMENTAL GOALS

Clean air	Lowland peat contributes to 2-3% of total UK greenhouse gases. **Through rewetting peatland CO_2 emissions will be abated**, and further CO_2 sequestered through planting of crops and pyrolysis that stabilises carbon.
Clean and plentiful water	By rewetting the site's peatland, the project could meet 25% of the catchment's abstraction target for the Idle and Torne rivers, **reducing the impact of drought and flooding** on the whole catchment.
Thriving plants and wildlife	The headlands and margins of the paludiculture area will act as a **continuous habitat for wildlife** from the nearby SSSI.
Reducing the risks of harm from environmental hazards	Storing water in paludiculture acts as **natural flood management** and reduces the impact of drought and flooding on the whole Idle and Torne catchment.
Enhancing beauty, heritage, and engagement with the natural environment	Peatlands are an iconic feature of the British countryside. Creating a tourism centre will encourage people to engage with nature, **benefiting their health and wellbeing**.
Mitigating and adapting to climate change	Pyrolysis produces renewable energy which will then be used to **produce net zero sustainable food** in controlled environments that will not be susceptible to changing climate and thus improve food security. Biochar is a more sustainable alternative to coal, acting to **replace fossil fuels in industry** and helping with the transition to net zero. It can also be used to enrich soil.

REVENUE MODEL

The revenue model is similar across the three options with variations in scale. The project plans to sell multiple benefits to spread the risks that could affect revenue streams. As some of these markets are in their infancy (carbon, water management services) the business model will be kept flexible until there is sufficient certainty to justify land use change on a larger scale.



Short Rotation Willow Coppice on rewet peat

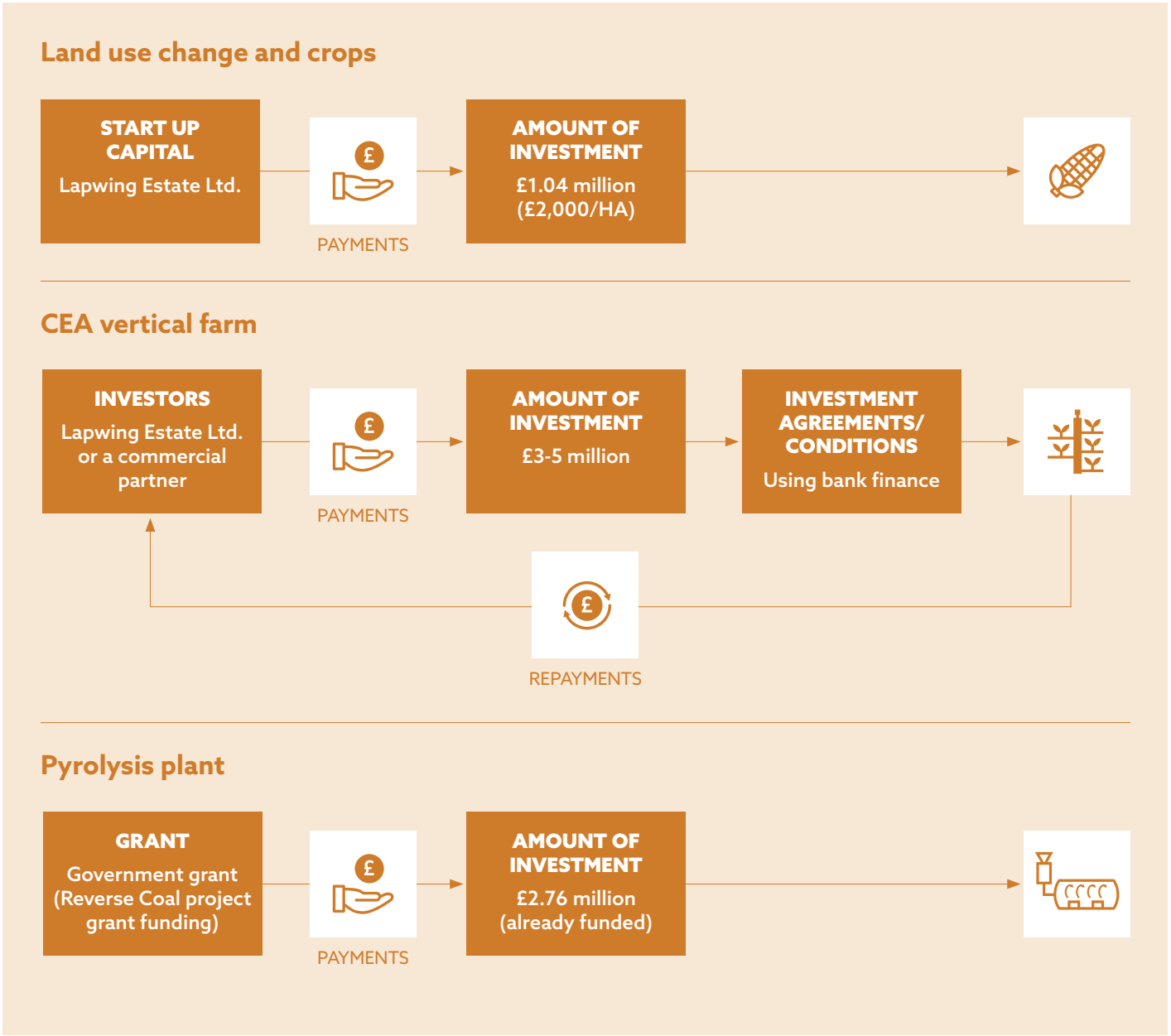
INVESTMENT MODEL

Option 1 (also the first stage of Options 2 and 3)

The pyrolysis plant is already funded by the estate and a government grant and will soon be constructed. The project scoped several crop choices and found SRC willow to be the most viable. The pilot phase will transform crops purchased externally, and this will demonstrate the financial viability of growing SRC willow on rewetted peatland and using the energy for CEA. Assuming these are both feasible, land preparation and conversion will begin, followed by planting. The SRC has a three-year cycle, so each year 90 hectares will be planted (a total of 270 hectares) which will provide the pyrolysis plant with a continuous supply for three years. The first crops will not be ready for use until around four years after planting, so crops will be purchased externally until this point.

Energy for CEA, sustainable food and biochar production will be possible once the pyrolysis plant is operational, however the other income streams such as countryside steward funding will only be possible once land is converted to paludiculture.

In Option 1 the Lapwing Estate will manage all activity thus mitigating risks of third party delivery.

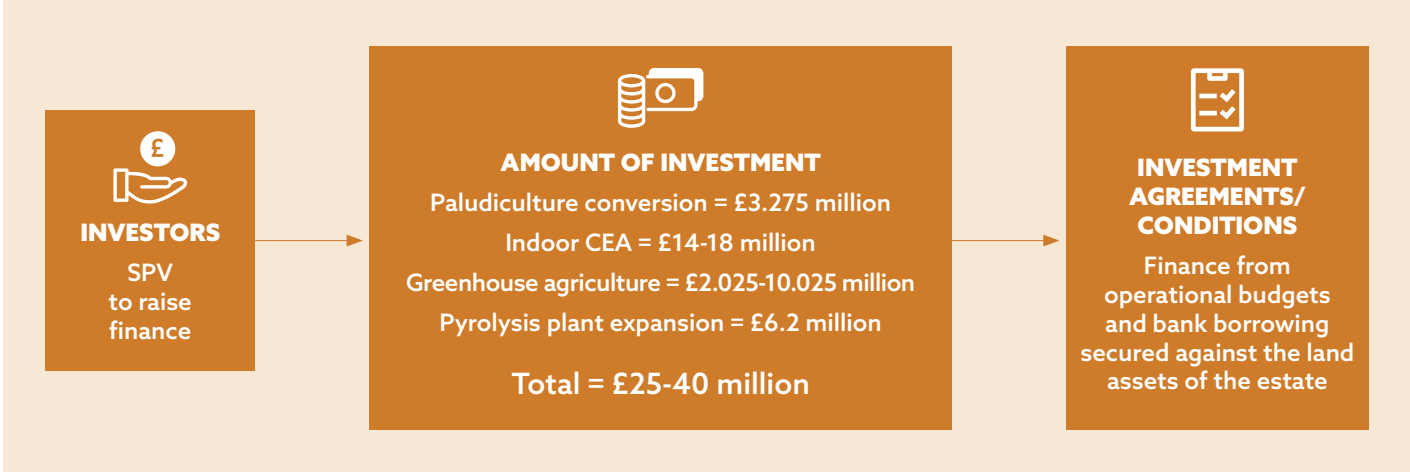


INVESTMENT MODEL CONTINUED

Option 2

This involves the expansion of the crop area to 800ha. This will be done incrementally, increasing the area by 200ha each year. It will also include an expansion of the pyrolysis kilns, upgrading of power transmission lines to enable sale of excess energy to the National Grid, and expansion of the CEA area.

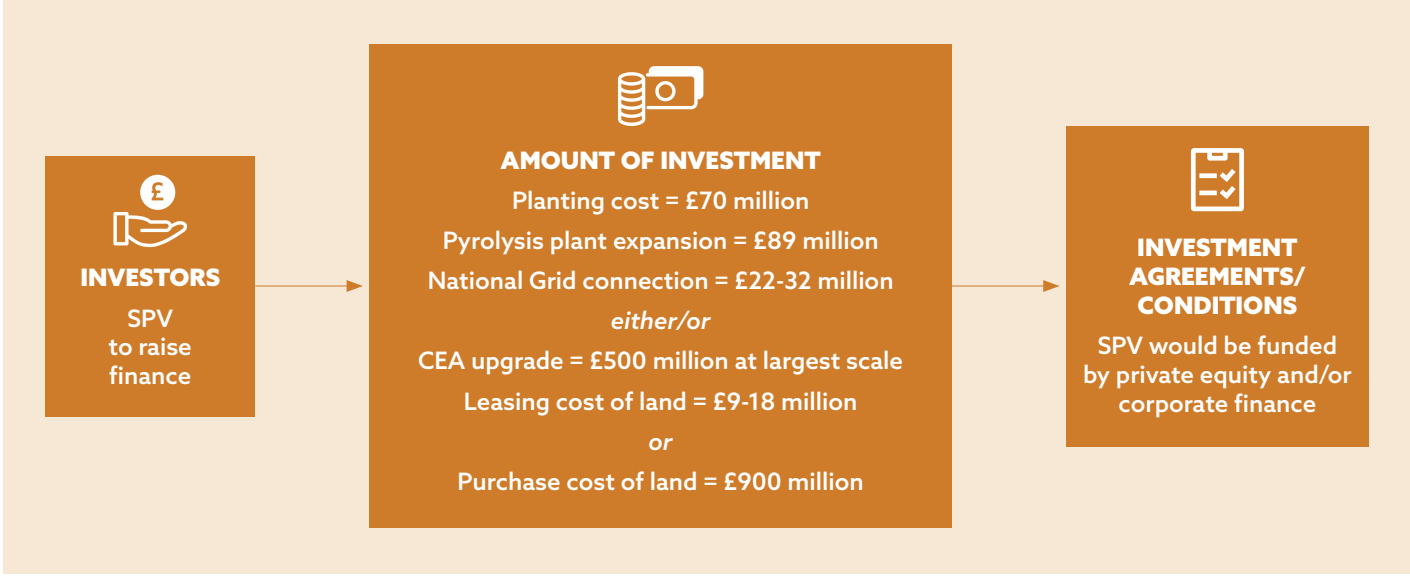
The higher costs of this expansion would require a SPV to be developed to raise equity while protecting the freehold on the estate. A financial partner would be needed to implement this, and some scoping of this partnership has been completed as part of the NEIRF project. The potential for green bonds to be issued was also investigated and may be explored further as the market develops.



Option 3

The project will expand across the whole estate (2,000ha) or across a landscape scale on multiple farms (35,000ha). This would require a significant expansion of the CEA facility and securing an additional 33,000ha of land. The land could either be leased or purchased.

The costs of this could exceed £1 billion, so as in Option 2 a SPV would be created.



INNOVATION

This project has developed a complex and novel business model to generate sustainable energy, food, and rewet peatland. It has the potential to generate income through several other streams, balancing the risk of market infancies and regulatory/policy changes. In addition, the expansion to landscape scale land use change will be one of the first of its kind in the UK. The cost of this could be up to £1 billion. This will require novel sources of investment which the project will continue to explore under a changing economic landscape.

SCALABILITY AND REPLICABILITY

The project has three options to scale up this project, including to a landscape scale at 35,000 hectares. This model could be replicated in other areas, to provide sustainable food using sustainable energy generated onsite. If it is found that industry can use biochar as a coal alternative, this will likely increase the profitability of this and similar projects.

LEARNING POINTS

- **Do not under-estimate the challenges of emerging policies; especially in relation to how multiple policies interact.** For example, there are lots of incentives but some policies are developing meaning uncertainties remain. In the meantime, the project will remain flexible in its business model so that it can adapt to any changes.
- **Keep the project scope manageable and be prepared to change its focus.** For example, after the project discovered that supermarkets no longer considered net-zero products as 'premium', the project changed its business-as-usual scenario to reflect that supermarkets are expected to make net-zero food a standard in the future. Funding options and business plans can change rapidly in the context of economic change. High inflation in the UK and the subsequent raising of the rate of interest has meant the cost of the project has increased in a very short time. The project has kept an open mind for their planned finance model for the expansion phase to account for changing rates.

WOULD YOU LIKE TO KNOW MORE?

If you would like to learn more about the Rethinking Farmed Peatlands project, please get in touch with James Brown, Project Lead at **james.brown@pollybell.co.uk** or Jamie Smith, Project Administrator at **jamie.smith@pollybell.co.uk**. For questions regarding NEIRF, please contact **NEIRF@environment-agency.gov.uk**.

This case study was produced by Ecorys.