Rethinking perennial biomass crops implementation in farmed landscapes: designing opportunities for integration into the farming system

Deliverable 2: Report on support mechanisms for integrating PBC into farming systems

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1. Introduction

1.1 About this project

This project aimed to rethink how PBC - specifically Miscanthus and Short Rotation Coppice (SRC) willow - can be more effectively integrated into existing farming systems.

Objectives:

1. Identify opportunities for integrating PBC into farming systems at farm and landscape level
2. **Scope out the public and private sector mechanisms to support farmers and land managers in integrating PBC into their farming systems at farm and landscape level**
3. Co-design strategies and prototypes for PBC integration

A key focus of this project was on identifying strategies that were profitable, resilient and practicable both at a farm and landscape scale. This included identifying past and current support mechanisms and revenue streams as well as exploring experiences of PBC growers. This project synthesises previous data collected as part of the PBC4GGR project Phase 2[1], with new evidence collected as part of the Flexibility Fund project, as outlined below. The analysis largely relates to the English context.

This research was conducted with continuation funding as part of the UK's BBSRC funded project Perennial Biomass Crops 4 Greenhouse Gas Removal (https://pbc4ggr.org.uk/).

1.2 Report aims and outline

This report builds on Deliverable 1 (D1) Report on potential integration strategies. It aims to address **objective two** and explores public and private sector mechanisms (including markets) which are currently available to, or could potentially support, PBC integration on farm.

The findings are presented in two parts. **Part I** presents findings from a desk study of current and emerging public and private sector support mechanisms for integrating PBC.

[1] PBC4GGR Phase 2 aimed to capture wider non-grower (farmer) and stakeholder views in four regions in England and Wales: North-East, mid-Wales, Yorks and Humber and Midlands selected to represent different biophysical regions, farming systems and market opportunities, with 16-18 interviews in each region. This was followed by a participatory modelling workshop in each region. Stakeholders included representatives of the farming and agricultural community, biomass crops industry, renewables and carbon removal sector, forestry commission, conservation and catchment management agencies.

Part II presents findings from interviews that specifically addressed what support mechanisms participants used, were aware of, or might foresee in the future. Data has been interpreted under the following support categories:

1. Public policy support
2. Growing commercial markets
3. Nascent nature markets
4. Stacking and blended finance opportunities

The outputs within this report will be used to identify funding opportunities and synergies, such as stacking, diversification, and enhancing resilience, as well as identifying gaps in support, both financial and non-financial.

2. Methods

A qualitative approach was employed for this study with data captured via primary and secondary sources.

i) **Desk study** to map the existing and emergent public and private sector mechanisms available for farmers and other land managers to support implementation of PBC.

ii) **In-depth interviews** with 23 participants as outlined in Report D1. The purpose of this exercise was for participants to validate and build on desk study findings.

2.1 Interview materials

The questions in Box 1 taken from the interview script relate specifically to objective two. For the full interview script see appendix A in Report D1.

Box 1: In-depth interview questions relating specifically to objective two

6. What conditions / future mechanisms would need to be in place for this shift? / for you to make this shift?
   Prompts: such as new policy instruments (like SFI), natural capital markets
7. Where are there gaps in support?
8. What future opportunities have we missed? New markets? Community energy?
   Prompts: New policy instruments; ecosystem services; other natural capital revenue; other GGR options such as biochar

2.2 Analysis

i) The **desk study** drew on a structured review of publicly available online sources and relevant secondary materials. Key sources included government and industry websites, legislative and policy documents, and sector- specific publications. Secondary resources, such as peer-reviewed journal articles and prior evaluation reports, were also consulted to ensure accuracy, context, and triangulation of findings. All sources were assessed for credibility, relevance, and timeliness prior to inclusion. The analysis is presented in part I of section 3.

ii) Deductive **thematic analysis of the in-depth interviews** interpreted data in response to the questions above and in respect to what support mechanisms participants had used - or were aware of - in order to grow PBC. The interviews were transcribed and uploaded onto data analysis software tool, NVIVO. The data was then coded in NVIVO using semantic coding (e.g., “bank loans”) and latent coding (e.g., “mindset”). These codes were then reviewed and clustered (see Figure 1 in Report D1). The analysis is presented in part II of section 3.

3. Findings- Part I: Current support for farmers and landowners wanting to grow PBC

The desk study identified existing and emergent policy instruments, potential payments natural capital markets for co-benefits as well as markets for bioenergy feedstock, alternative products.

3.1 Public policy support

3.1.1 Agri-environmental schemes

The rules within agri-environmental schemes prevent payments where commercial crops are grown, as such there are no direct payments for PBC. In the Sustainable Farming Incentive (SFI)[2] 2023 offer (updated August 2025) PBC such as Miscanthus and SRC willow were recognised as *non-horticultural permanent crops*. Therefore, payments were available for SFI actions where PBC were grown, but not for the establishment and production of biomass itself, nor specifically for PBC co-benefits. Examples of the types of actions a PBC grower could have applied for are listed in Table 1, adapted from the Handbook for the SFI 2023 offer[3]. The annual payments listed reflect the latest rates, revised in 2024.

[2] The main scheme in Defra’s Environmental Land Management Schemes (ELMs) in England
[3] https://www.gov.uk/government/publications/sfi-handbook-for-the-sfi-2023-offer

Table 1: Example SFI actions available to PBC growers (2024)

Code	SFI action	Annual payment
SAM1 (P)	Assess soil, test soil organic matter and produce a plan	£6.00 per hectare and additional payment of £97 per agreement
IPM1 (P)	Assess integrated pest management and produce a plan	£1,129 per agreement
IPM2	Flower-rich grass margins or in-field strips	£798 per hectare
IPM4 (P)	No use of insecticide on arable crops and permanent crops	£45 per hectare
AHL1	Pollen & nectar flower mix	£739 per hectare
AHL2	Winter bird food on arable/horticultural land	£853 per hectare
NUM1 (P)	Assess nutrient management and produce a review report	£652 per agreement
Grass buffer strip/field wildlife actions	Various habitat measures	£450-£850 per hectare

Note: Codes with (P) against had also been implemented by interview participants (PBC growers)

However with the relaunch of SFI in June 2026[4] these options for PBC growers have been reduced. Previously available actions have been removed, including SAM1, NUM1, IPM1, as well as the management payment and hedge options such as HRW1 and HRW3. The CIPM4 'No use of insecticide on arable crops and permanent crops' now only applies to "permanent crops – horticultural and non-horticultural (not PBC). The, the only applicable option for PBC within SFI 2026, if it is mapped as a permanent crop, is CIPM2 – 'flower-rich grass margins or in-field strips,' amounting to £45/ha/year. This will limit growers' ability to access broader scheme support in the future.

As with SFI, under Countryside Stewardship (CS), PBC were also eligible as *permanent crops* where environmental actions associated with that land area. However, as with SFI, CS does not offer payments for planting PBC. To illustrate, a farmer could have planted a flower-rich 6 metre margin on a PBC field edge (equating 2 ha over the whole PBC area) to access an income of £1,596 a year under a CS AB8 action.

3.1.2 Landscape scale support

There were also opportunities within the Landscape Recovery Networks, the landscape scale collaborative tier of ELMS. Farmers might combine SFI actions on contiguous

[4] Individual guidance for SFI 2026 has not been officially released yet

pieces of land such as buffer strips within catchments to improve water quality; or collaborate on natural capital markets.

Government supported projects such as Slow the Flow North West (STF NW) have used Local Levy funds and Defra Natural Flood Management funds to plant SRC willow to help reduce the risk of flooding to Communities at Risk.

3.1.3 Feedstock planting, productivity, research and innovation support schemes

There is currently no direct government support for farmers to grow PBC as biomass feedstock. The last dedicated government subsidy to incentivise bioenergy crops was Defra's Energy Crop Scheme which closed to new applicants in 2013.

A number of initiatives supporting productivity, research and innovation have been available through Innovate UK, and DESNZ but only offer indirect support to farmers to grow PBC through research and innovation funds.

ADOPT[5] could potentially support PBC development mainly by focusing on increasing efficiency, improving establishment methods, and developing new machinery. For example, an ADOPT recipient is trialling SRC willow as a high-carbon crop and testing compost mixes as a peat-free growing medium that could be adopted more widely across arable farms.

> *"We are looking at whether we can produce a willow-based compost or mulch for sale into the commercial horticulture sector. It's about using a methodology that is reproducible on a farm with normal farm equipment, with no special kit."* (Defra, 2025)

This farmer recognised the benefits of a perennial crop and not having to commit their land to a permanent land-use change, highlighting PBC's relative flexibility.

> *"I think in terms of looking at changing climate and how we respond to that, it's potentially quite a flexible option where that land could come back into food production. It's not forestry"* (Defra, 2025)

The Biomass Feedstocks Innovation Programme[6], a large programme aimed at increasing domestic biomass production, supports new technologies, processes and products from PBC. It does not directly support individual farmers. Another example is the Reverse Coal Project at the Lapwing Estate, is using pyrolysis to produce biochar and renewable energy from SRC willow (cited in the Whitehead Review 2025).

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[5] Accelerating Development of Practices and Technologies (ADOPT) Fund is a farmer-led innovation fund within the Farming Innovation Programme (Defra partnering with Innovate UK https://defrafarming.blog.gov.uk/2026/02/05/adopt-round-6-opens-today-hear-how-farmers-are-using-funding/

[6] Funded through DESNZ's Net Zero Innovation Portfolio (but often highlighted within the Innovate UK-supported ecosystem)

3.2 Growing commercial markets: conventional and alternative

3.2.1 Feedstock supply contracts with finance

Biomass feedstock supply contracts with integrated finance mechanisms are available to farmers establishing PBC. Terravesta, who specialise in Miscanthus, offer long-term, index-linked off-take agreements, typically lasting 10–20 years, which provide farmers with secure market access and a predictable income stream. These agreements can be used to support applications for establishment finance through specialist agricultural lenders, most notably Oxbury bank.

The finance packages often cover the upfront costs of planting, with interest-only repayment during the establishment period and full repayment beginning once the crop becomes commercially productive. In addition to facilitating access to finance, biomass supply companies also provide practical support such as planting material, agronomic advice, and harvesting and logistics coordination. This integrated approach helps lower both financial and operational barriers for farmers and has made contract-based supply models a more accessible route for supporting the expansion of PBC.

3.2.2 Supply chain intermediary support

Other supply chain entities within the sector, such as Eco Crops Ltd, do not currently appear to offer dedicated establishment finance schemes for SRC willow or Miscanthus. However, they do offer value to a farmer seeking market access and income opportunities, operating primarily as a biomass supply chain integrator and crop management provider. While this model helps reduce operational complexity and market uncertainty for farmers, it does not directly address the upfront capital costs associated with crop establishment. As a result, farmers need to secure establishment funding independently, for example through farm business finance.

3.2.3 Industrial biomass supply chain investment

Industrial end-users are increasingly investing upstream in order to secure long-term bioenergy feedstock supply, offering establishment finance, long-term purchase agreements, and structured supply chain partnerships to incentivise crop planting and secure reliable feedstock volumes. These arrangements aim to reduce upstream supply risk while supporting the scaling of PBC within farming systems.

There are examples of emerging industries which have developed long-term feedstock supply using other sources of biomass in the UK such as Velocys, a sustainable aviation fuel developer, and natural fibre and bio-based material companies like the HempFlax Group. The latter are investing in biomass supply chains to support the production low-carbon construction materials and are establishing direct sourcing relationships with growers and providing stable markets. These examples illustrate a broader shift toward biomass supply chains as part of the UK's transition to low-carbon energy and materials.

Government subsidy agreements between DESNZ and power plants like EP Lynemouth Ltd and Drax such as Contracts for Difference (CfD) are designed to support low-carbon electricity generation and provide stability in the sector. Although not supporting farmers and landowners directly, these do create stable, long-term demand for biomass feedstocks[7].

3.3 Nascent nature markets

Nature markets present new opportunities for PBC farmers to generate income by delivering ecosystem services such as carbon sequestration, biodiversity enhancement, water quality improvements, and flood mitigation. These markets operate by assigning financial value to ecosystem services, enabling private companies, investors, and other organisations to pay farmers and land managers for measurable environmental benefits. In the UK, nature markets are expanding rapidly in response to legally binding net zero targets and growing corporate demand for high-quality carbon removals and environmental offsets.

Table 2 is adapted from the Green Finance Institute HIVE toolkit[8] (an initiative to engage farmers and landowners with nature markets). The diagram is based on a framework presenting potential flow processes from respective natural capital 'stocks' to nature markets. For the purposes of this report, there is an additional focus on uses and co-benefits of PBC and how they can be packaged in a way that opens up nature markets to growers. In some cases[9], a farmer or landowner could receive payments for carbon sequestration and biodiversity net gain on the same land, as long as the services are not double counted.

[7] https://www.gov.uk/government/publications/lynemouth-power-station-agreement-between-desnz-and-ep-lynemouth-ltd/desnz-and-ep-lynemouth-ltd-heads-of-terms-summary
[8] https://hive.greenfinanceinstitute.com/gfihive/farming-toolkit/introduction-to-nature-markets/
[9] Scheme rules vary so farmers and landowners need to check eligibility criteria

Table 2: Flow from natural capital to nature markets with a focus on PBC

	Natural Capital		Ecosystem Services		(Nature) Markets
	The 'stocks' of nature and natural resources on farmland, also called 'ecosystems', e.g.,	>	The 'flows' of benefits to the wider economy and society that come from healthy natural capital, e.g.,	>	The 'packaged' way that ecosystem services can be valued and paid for by individual businesses and organisations, e.g.,
1) Biomass	Planting PBC on less productive land	>	Agricultural production Harvesting PBC for use on and off farm	>	Feedstock, fibre products As bioenergy feedstock for fuel and as biomass products such as animal bedding
2) Carbon	Planting PBC where it does not replace peatland or long-term grassland	>	Carbon sequestration/ and soil improvement	>	Carbon units can be turned into carbon credits
3) Nutrient Neutrality & Water Quality	Wetlands: Planting PBC alongside watercourses as riparian buffers	>	Nutrient run-off reduction and improved water quality	>	Nutrient units can be turned into nutrient mitigation credits
4) Natural Flood Management	Rivers: Planting PBC alongside watercourses as riparian buffers	>	Flood risk reduction	>	Reduction in flood disruptions and damages
5) Biodiversity Net Gain	Habitats (including above): Planting PBC as shelter corridors, or with species rich margins or undersowing	>	Biodiversity improvement	>	Biodiversity Net Gain Units

3.3.1 Biomass production

Biomass production is included within Table 2 as part of a farm's ecosystem services to exploit alongside other nature market income streams; its current funding mechanisms are outlined above in section 3.2.

3.3.2 Voluntary carbon markets

Voluntary carbon markets, where private companies purchase carbon credits to offset their own emissions, are emerging in the UK. Miscanthus and SRC willow capture carbon in both biomass and soil. It is argued that PBC are well suited to carbon finance due to its capacity for long-term carbon sequestration. An independent study[10] conducted for Terravesta reported Net Carbon Capture up to 2.35 tCO^2e per hectare per year in the

[10] This Net Carbon Capture calculation does not account for the carbon content of the harvested biomass, which is taken off farm for other uses

soil, in addition to displacing fossil fuel emissions when used as a bioenergy feedstock[11].

In the UK, several intermediaries facilitate carbon credit generation by supporting farmers with measurement, reporting, and verification processes and connecting them with corporate buyers[12]. These arrangements may include upfront planting finance, annual carbon payments, or long-term carbon contracts, typically lasting between 10 and 30 years. Carbon prices in UK nature markets currently vary widely depending on project type and verification standards but commonly fall within the range of £15-£95 per tonne of carbon[13]. However, farmers and landowners are generally advised to be aware of risks associated with carbon credits. In particularly they should consider any future net zero requirement from their processor or retailers since agribusinesses, are seeking opportunities to inset their carbon units, by working with farmers within their supply chains to decrease emissions and increase sequestration[14].

With respect to larger projects, there are European examples such as Dutch carbon credits where local certification bodies like ONCRA[15] and SNK[16] have certified Miscanthus cultivation and SRC willow plantations.

3.3.3 Nutrient neutrality and water quality

There is evidence that PBC can support both nutrient neutrality and can actively improve water quality[17]. There could therefore be potential income under the following related mechanisms.

3.3.3.1 Nutrient neutrality - compliance-driven demand

Property developers pay growers to reduce nitrogen and phosphate runoff to offset the environmental impacts of new developments, with reductions measured in nutrient credits (equivalent to 1 kg of nitrogen or phosphate). Payments can range from £1,800 - £4,000 per kilogram of nitrogen, and £14,000 - £100,000 per kilogram of phosphate[18]. Nutrient Neutrality requirements are enforced across 74 Local Planning Authorities, which determine the number of credits developers must purchase using methodologies provided by Natural England and adapted to local catchment conditions. Natural England is also delivering a national Nutrient Mitigation Scheme, initially launched in

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[11] https://terravesta.com/shared-files/3688/?Terravesta-Miscanthus-Carbon-Life-Cycle-Report.pdf
[12] https://farmcarbontoolkit.org.uk/wp-content/uploads/2025/10/Farm-Carbon-Toolkit-Voluntary-Carbon-Market-Report-October-2025.pdf
[13] https://hive.greenfinanceinstitute.com/gfihive/farming-toolkit/introduction-to-nature-markets/
[14] https://foodcouncil.uk/ukfoodsystem
[15] ONCRA: Open Natural Carbon Removal Accounting framework
[16] SNK: Stichting Nationale Koolstofmarkt is a Dutch initiative for certifying carbon reduction projects
[17] Cooney at al., 2023 doi.org/10.1007/s12155-022-10488-0; Livingstone et al., 2023 https://doi.org/10.1016/j.spc.2023.01.013
[18] https://hive.greenfinanceinstitute.com/gfihive/farming-toolkit/introduction-to-nature-markets/#introduction-more-info2

the Tees catchment and now expanding to other high-priority areas, working with farmers and landholders to increase the supply of nutrient credits.

3.3.3.2 Water quality - voluntary-driven demand

Water companies are active in catchment management schemes that actively collaborate with farmers to reduce nutrient and sediment runoff at source. These schemes typically provide financial incentives, advisory support, and funding for on-farm interventions that improve water quality while also enhancing farm efficiency and profitability. This approach is recognised as a cost-effective alternative for water companies and plays an important role in delivering regulatory water quality objectives.

To illustrate, Affinity Water runs payment schemes for farmers often using the EnTrade platform for reverse auction. Their Soil Innovation Fund funds farm project and works alongside farmers to prevent run-off and other water-related issues associated with poor soils[19].

3.3.4 Natural flood management - voluntary-driven demand

PBC are flood tolerant crops and can offer flood mitigation benefits if planted strategically in the landscape (as demonstrated by Slow the Flow projects). Organisations, including businesses and public bodies, pay farmers and landowners to install measures or manage land to slow water flow across catchments to reduce flood damage and disruption. Private finance for Natural Flood Management (NFM) in the UK is currently limited, but interest is growing as flood risk increases in England. To illustrate, a partnership between RSA Insurance and Gloucestershire Wildlife Trust, launched in 2023, aims to deliver an extensive Natural Flood Management (NFM) programme to reduce flood risk in Cheltenham and Gloucester, high-risk areas. They support and work with farmers and landowners. This might also be characterised as blended finance.

3.3.5 Biodiversity Net Gain – compliance-driven demand

There is evidence of PBC biodiversity co-benefits, where the ecological value depends on location, species, and biomass crop[20]. Biodiversity Net Gain (BNG) was set up to compensate for the environmental impacts of development. Property developers pay farmers to create or restore habitats that deliver biodiversity uplift, enabling them to meet the statutory requirement to achieve at least 10%. BNG is measured in biodiversity units using the statutory metric developed by Natural England, which determines the number of units developers must deliver. As of February 2026, BNG unit

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[19] https://www.fwi.co.uk/business/water-company-schemes-to-consider-for-your-farming-business
[20] https://ecocrops.co.uk/biodiversity-net-gain/#:~:text=Flora%20%E2%80%93%20Encouraging%20biodiversity%20by%20allowing,invertebrates%20that%20control%20pest%20species.

pricing ranged from £17,000 to £250,000+, driven by ecological distinctness and supply scarcity[21].

3.4 Combinations of support - stacking and blended finance

3.4.1 Stacking

Stacking occurs when farmers generate income from multiple income streams, agricultural production, agri-environment schemes, supply chain incentives, and natural capital markets from one parcel of land.

3.4.2 Blended finance mechanisms

Farmers can combine public grants (e.g., ELMs, Landscape Recovery) with private investment for initiatives like habitat creation, carbon sequestration, and private loans. These models are particularly relevant for larger land owners or groups of farmers looking to make long-term improvements in sustainability. Examples include:

- Combining ELMS funding with private capital to finance large-scale habitat restoration, woodland creation, and river restoration.
- Carbon and Biodiversity Credits: Farmers can use private finance to fund projects that generate income through selling Biodiversity Net Gain (BNG) units or carbon credits, which are then used to repay investors
- Supply Chain Partnerships: Collaboration with food companies (e.g., Tesco, Co-op) and banks (e.g., Lloyds) provides insetting funds to help farmers implement greener, more resilient practices.

In summary, there is currently no dedicated government support specifically for growing PBC as feedstock. SFI has provided payments for environmental actions on land where PBC are grown however future options are limited. With respect to conventional markets, in the absence of any planting grants, private finance integrated into feedstock supply contracts plays an important role. Newly emerging markets for biomass products as part of the transition to low-carbon energy and materials, as well as nature markets herald future revenue opportunities for growers.

4. Findings - Part II: Participants' views and experiences

The following section details findings from thematic analysis of the in-depth interview transcripts. Key observations from the interview data include:

- Participants felt that public policy currently disincentivises PBC through lack of support in, or competition with, ELMs

[21] https://earthtrade.co.uk/latest-news/the-real-price-of-bng-units-in-2026/

- Uncertainty surrounding government support continues to present a barrier to planting long-term crops like PBC and, in some cases, has driven PBC removal
- Some PBC growers did have SFI agreements. Several felt that adjusting SFI/ELMs actions to get PBC "on the radar" could be key to incentivising planting, particularly if the focus is placed on its co-benefits, rather than solely on its role as an energy crop
- Participants discussed their experience with emerging new markets, noting how more value is being placed on these compared to feedstock, and this may potentially drive more planting
- However, they also recognised farmers require stronger business acumen, risk tolerance, and market development skills. Outcomes vary based on their mindset and entrepreneurial capacity
- Nature markets (based on PBC co-benefits) are viewed as promising but are immature. Participants discussed regulatory uncertainty and their own lack of understanding as limiting uptake
- Many participants also saw the potential for stacking multiple incomes based on co-benefits
- Blended finance remains largely underdeveloped and experimental

4.1 Categories of support

As with part one, findings were grouped under four main categories of support:

1. Public policy support
2. Growing commercial markets
3. Nascent nature markets
4. Stacking and Blended finance opportunities

For each of these, sub-categories 'existing', 'emerging' and 'future-gazing' were identified. Table 3 summarises participants understanding of workable support (or market) mechanisms under these subcategories. A deeper exploration under each group follows.

Table 3: Support mechanisms suggested by participants under category and under subcategories of 'existing', 'emerging' and 'future-gazing'

Category 1	**Public policy support**
Existing	– Some farmers described using PBC to improve soil health and manage nutrient levels, they had **SFI actions** agreement with actions such as SAM and NUM: *"Our agreement is a soil management plan, integrated pest management plan and nutrient management plan"* (P22)
Emerging	– Participants looked to the next SFI funding round in 2026 with the hope that it contains more actions directly relating to PBC
Future-gazing	– The hope was that ELMS could explicitly include payments for growing PBC as bioenergy feedstock or to support nature restoration such as riparian buffers – They envisaged regional/ local government incentives to develop nature-based solutions to mitigate flooding incidents – They envisaged Defra fund carbon audit/ baselines across England (to enable entry into private markets)
Category 2	**Growing commercial markets**
Existing	– Long term (10yr +) contracts in PBC supply chain or directly with power stations to provide bioenergy feedstock; helps with establishment costs with some contracts being index-linked – [Oxbury] Bank loan with farm as guarantee – Commercial income selling cropped and processed PBC to alternative markets, such as animal bedding, compost, decorative bark to privately sourced customers (trade and end user)
Emerging	– New market opportunities, such as from the biorefinery sector
Future-gazing	– Housebuilders exploring miscrete blocks[22] (P4)
Category 3	**Nascent nature markets**
Existing	– Nature market experience is limited and anecdotal and some participants noted carbon markets specifically as akin to the "wild west" with confusion with regard to what and how carbon can be measured in respect to PBC, specifically in backdating already established crops (P22)
Emerging	– Nutrient neutrality was mentioned a few times as an opportunity for PBC *"Biodiversity Net Gain, I haven't really got my head around that yet. I think that maybe the ecologists that are doing that for companies aren't even aware of the benefits that these crops can provide, I think maybe with Miscanthus being an exotic monoculture, there's there'll be less opportunities, but with willow, I mean the... biodiversity credentials are better, but I think I don't think there's an obvious on the table offering for BNG for these crops"* (P9)
Future-gazing	– An incentive akin to the Woodland Creation Scheme that has carbon trading built into it but for PBC (to start absorbing CO_2 and feed potential BECCS plants) – Payment mechanism to growers from water companies to improve water quality – Work with insurance companies to develop bespoke risk mitigation strategies

[22] Miscrete Ltd- eco-friendly composite construction material in development https://icast.org.uk/developing-eco-friendly-composite-materials-for-the-construction-industry-our-work-with-miscrete/

	– Carbon royalty payments for storing more than a certain amount of carbon through the process (P15)
Category 4	**Combinations of the above Stacking/Blended finance opportunities**
Emerging	**Stacking** (farmers can generate multiple incomes from one parcel of land *"What we're looking at now is adding on nutrient neutrality on top of that [feedstock]. So what we can end up with is this bull rush field, which can work really well on wetland that's producing a product for fibre, it's removing carbon, it's producing a habitat and it's removing nutrients within a nutrient neutrality area. Now if you stack all those four payments on top of each other that suddenly becomes really quite profitable for a farmer"* (P2). **Blended finance** (farmers can combine public grants and private investment) – Working with Trusts, such as Wildlife, Woodland and Canal and River Trusts, and in partnership with other entities such as water and insurance companies within catchment areas to develop nature-based solutions

4.1.1 Public policy support

As previously highlighted, there is currently no explicit public policy mechanism to support growing PBC. Within this category, participants spoke briefly about the previous ECS they had engaged with, a lack of support from other policy mechanisms such as Countryside Stewardship (CS) and Sustainable Farming Initiatives (SFI), and thoughts as to how this could be addressed.

A few of the participants had received funds towards the establishment of PBC under the previous ECS (ceased in 2013 for new applicants), with one noting that without such an opportunity, planting PBC did not make business sense.

> *"… when we planted our crop the energy crop scheme was available, which essentially paid for the majority of the upfront cost. That is no longer there, and without it, purely from a business point of view, it just looks like a very poor option to lay out probably £2,500 per hectare. Taking all the risk that goes with the establishment and getting no return at all for three years effectively, it just doesn't make any business sense"* (P7, PBC grower and farmer)

In response to asking if they were aware of any other policy mechanisms, participants regarded CS and SFI more as a competitor for PBC than an incentive. One participant spoke about a conversation they had had with a potato farmer.

> *"He said, look, I have fields which simply don't work. My father has been farming them. My brother has been farming them. I'm farming them. There's no way to make money from that. I'd loved to plant Miscanthus, but there is the SFI. The government pays me more for not farming"* (P1, Miscanthus supply chain)

Instead some PBC growers are finding themselves pulling out PBC and planting alternative ‘competing’ crops because they will get paid for those actions.

> *“… you're obviously competing with all these SFIs. So for example, my farm, we've got willow on it, but some like poorer quality fields I've actually put wild bird mix in this year where I should, I mean, I should be planting willow. I can do it for a lot cheaper than most other people, but it's more cost effective for me to put wild bird mix in and get claim £900 a hectare a year for that than it is to put willow in. So what does that say?”* (P14, SRC willow supply chain)

> *“when the SFI was still going and there were quite big payments for bird feed mixes and those sort of SFI options that were related to £850 per hectare per year, just guaranteed income we were directly seeing these crops pulled out, so sort of the you need to have some kind of zealot type willow or Miscanthus enthusiast to keep going with some of these things because they they're really not being rewarded and Defra putting other things on the table for green, rewarding green values that aren't this crop that we're seeing directly leading to these crops being grubbed out”* (P9, PBC grower and researcher)

However there was also little confidence in the future of agri-environmental schemes given the recent uncertainties with SFI funding. Comments such as “pulled the SFI without any notice” (P15, Miscanthus supply chain), “fed up with government pulling the rug” (P13, bioenergy plant operator), and “we've got this crazy freeze in the SFI, farms are pulling their hair out” (P9) illustrates the frustrations felt. Some in the industry see this as an opportunity for a more reliable PBC crop and income, along with market and weather volatility.

Participants also wondered where PBC would fit going forward, as there appears to be no source of incentive for energy crops or otherwise.

> *“I've just come out of that meeting with Defra a few days ago and there is absolutely no support, any shape or form for any type of growing willow, whether it's for biomass, where it's for carbon capture and storage, whether it's for flood resilience, any of it, there's just nothing. So we're having to compete with other crops that are getting a lot of financial support and we just can't, we're about to go up business basically… we can't compete with government funded schemes”* (P14)

A few participants spoke of how they were implementing SFI actions on the basis of PBC co-benefits of nutrient neutrality and improving soil health; Table 1 highlights which SFI actions participants have implemented, e.g., SAM1: Assess soil, test soil organic matter and produce a plan. One however noted that an additional SFI action that was suitable for PBC had since been removed due to additionality and the assumption that PBC do not require insecticides.

> *"It used to be the case that with the SFI you could claim for not using pesticides for your miscanthus fields, but on the last version, they even pulled that from miscanthus because they said it's there anyway and you don't use miscanthus- pesticides on miscanthus so you can't even claim for that now"* (P15)

Building on above, some participants felt that with respect to SFI and CS, even the smallest of actions to get PBC "on the radar", give them "more visibility" (P17, bioenergy researcher) and "ease people into the point of production" (P22, farm business consultant and PBC grower), could be the key to incentivise growing the crops, especially if the focus was the co-benefits of PBC, not just on feedstock.

> *"even just getting it recognised as a way to meet some sort of, like making it explicit could be just the smallest thing we could do to start recognising it... because there are there are obviously obvious climate benefits from these crops, you know, that's quite clear. And there are other studies that were done at Rothamsted as well that looks at the biodiversity benefits... like a farm scheme... that's one way for them to meet some objective... Just feel like these tiny levers are quite, you know, just it just gets it on the radar. Small but powerful in a way"* (P17)

A minority of participants challenged farmers reliance on policy mechanisms such as SFI, suggesting that they are "continuously hooked" to payments, and should be considering seeking alternative business models: "*I think farmers need to get to that sort of space where it's not expected that there has to be payments"* (P12, PBC grower and farm manager)

4.1.2 Growing commercial markets: conventional and alternative

Many participants shared examples of where either themselves or contacts had moved into alternative markets. One suggested a reason behind this was due to a lack of government support for PBC; "*... the sort of the challenge around less public support, pushing people more into the direction of private support*" (P16, catchment adviser). Others saw more value placed on PBC by commercial markets driving the need for more planting (p4, researcher and farmer), not just for bioenergy feedstocks but for other uses. Participant examples given included large-scale investment with PBC products being used in construction, to serving smaller, local markets such as providing animal bedding, feed or compost.

> *"Somebody like a big sort of house builder was going to use the miscrete blocks to insulate the house, instead of using oil-based stuff, you know, and there's a million and a half houses need to be built in the next year according to the government. You know, there's a huge amount of places you can store carbon in a house to make it more efficient. And if farmers can grow it, and they knew there was a big market like Redrow or somebody, and that's a company driving it"* (P4)

Participants were very open with respect to the conditions of their markets. One shared that they were in a long-term contract directly with a biomass plant with a loan to purchase and establish the crop. A participant from a biomass plant corroborated this approach, adding how they had had to source PBC growers for feedstock but that this was a "finite" funding option. They went on to share that many "*growers aren't in that world of commercial reality*" (P13, bioenergy plant operator), highlighting the need for more education when it comes to fulfilling contracts, specifically in respect of product specifications.

> *"He said, you only took the bales, you know, from in the main body of the stack. You wouldn't take all the top layers… I was left with 50 or 60 bales and… those bales worth £100 each and I was left with them, and I said, well, why do you leave your stack outside in the rain? I said if I was a furniture retailer… would I put all my settees and wooden tables and chairs out on the street outside in the rain, trying to sell them? I said no, you put them under a roof, wouldn't you? Or you put a tarpaulin over them or something? I said, I said. You again, you signed a contract with the fuel spec. Why did you leave it in the outside? You know, well, I thought it'd be alright. You're only going to burn it anyway. Yeah, I know. I want to burn dry fuel, not wet, soggy straw"* (P13)

Another PBC grower questioned long-term contracts as being not in "*the farmer's favour*" (P22, farm business consultant and PBC grower) and instead has sought to sell PBC products on the open market with multiple end uses, and ergo income streams, as bioenergy feedstock, animal bedding and compost. When asked how these new markets opportunities were found, the participant responded, "*just luck and through contacts and what have you*", admitting that they are "*very dog and stick farmers in a way we haven't got a website. We haven't got any form of marketing ourselves*" (P22). Another wanted to break the "*chicken and egg*" cycle they perceived and took a risk to grow PBC irrespective of an end market.

> *"I will plant biomass a little bit geographically distant from where there is a market hoping to encourage neighbours to look at it, to say, Oh well, somebody's doing it well, there is an opportunity here and it's that sort of thing"* (P6, PBC grower)

Risk was perceived differently. As illustrated above, some participants wanted to limit risk by locking into a long-term contract supplying PBC as bioenergy feedstock, while others felt that there was risk in being tied-in, or in case companies go "bust"; a fear based on previous experience.

> *"What went wrong with Miscanthus as I sort of remember in the early 2000s, twenty plus years ago, 25 years ago, was the contract went bang and went bust*

and peat farmers were left with miscanthus in the ground with no end user" (P5, PBC grower)

Some participants consider alternative markets as a less constrained option compared to receiving public funds and associated administrative requirements.

> *"Obviously, inspections are there for a reason, but anything where they can grow something where they've not got somebody necessarily kind of breathing down their neck and you've got to fill this box in and you've got to submit this for God knows what else I think will be of benefit"* (P10, agricultural adviser)

> *"I think a lot of people were persuaded by the argument because the, the other thing is with an incentive comes a pair of shackles as well. So once, once you've taken the King's shilling, you are basically constrained by what you can do, whereas if you don't do it but you do everything proper, you can get what you want very, very quickly and probably in the long term save much more money than you would do by just taking the incentive, but unfortunately, lots of farmers are wedded to the incentive view"* (P3, SRC willow supply chain)

The overarching observation from above is that these markets are exposing for growers in potentially good and bad ways. Opportunities are noted but also risks and much of this is dependent on the individual's mindset and appetite for risk as well as business acumen and growers' ability to find new markets beyond the farm gate.

4.1.3 Nascent nature markets

Another opportunity discussed by many of the participants was potential income from natural capital markets. This is a relatively nascent sector (see above). Participants spoke mostly about voluntary carbon markets, although a few referred to biodiversity net gain (BNG) and nutrient neutrality.

In the main, participants were unsure about the support they could get from selling credits to voluntary carbon markets, while also acknowledging that opportunities were there (P22, farm business consultant and PBC grower).

> *"Is there a financial benefit out of the carbon sequestration piece, as well as just being a good for the environment, is it good for the commercials?... It hasn't manifested itself in hard cash yet and nobody's quite sure how it, where it will"* (P1, Miscanthus supply chain)

Some felt carbon markets to be comparable to the "wild west" (P9, PBC grower and researcher) insomuch as they fear it lacks proper regulation and the risk of being exposed to uncertain conditions.

> *"And it's so unclear. It's again, it's the wild. It's a bit wild westy at the moment and if people are making £20-30,000 investments in their land for a 20-year period,*

> *they want certainty and there just isn't any certainty. I mean are you clear about what carbon markets are and how much you can get for it and who's buying it and what what's gonna happen in the next 20 years 'cause I'm not"* (P14, SRC willow supply chain)

> *"I also think that the way people measure it and the way people manage land accordingly, I'm not sure I'd want to stand up and defend that in law in a court if someone said, well, hang on a minute, you haven't done what we said we're going to do and yeah, the payment we've given you to someone to offset so they can fly around the world a few more times. I just think it's bonkers"* (P22)

Participants shared suggestions with regards to what to do – or not – to prepare for carbon markets. One participant with more experience within nature markets suggested that the government drive and fund carbon baselines as a way to open nature markets up to farmers.

> *"We would like Defra to be paying for baselines because once we've got the baselines, that's the barrier to entry removed for farmers and then private, sort of, corporations will then quite happily buy carbon offsets from these farms… their budgets are considerably greater than Defra's"* (P2, natural capital market consultant)

Some participants suggested that growers might hold back planting or remove existing PBC in order to begin again (to enable comparable carbon measurement).

> *"I think I think this holds people back because I think it feels like it's touching distance and the worry I think a lot of people have is if they plant and they haven't got baselining right for, say, soil carbon or the markets aren't mature, that by being an early adopter, they actually miss out"* (P9, PBC grower and researcher)

Participants reported that PBC had yet to be included in nature markets and are not covered by any standards, like the woodland and peat codes. Compared to woodland, for example.

> *"I look at the woodland creation scheme. What's it called? England woodland creation offer is it? That has got a carbon trading bit built into that for new adopters of woodland. And they've got huge amounts of help to establish, plant, manage and maintain newly created woodlands. And there's just no parity for willow, or Miscanthus that have got similar outputs"* (P9)

Further to which some participants felt that at this stage selling a "*few carbon credits or some BNG units isn't enough to warrant a landscape change or a land use change*" (P22); suggesting that income from carbon or nature credits alone would not be able to support integrating PBC into farming systems.

Another ecosystem service participants spoke about frequently was PBC ability to reduce flood risk and the potential to work with insurance companies to develop risk mitigation strategies.

> *"... spoken to a few insurance companies in Cumbria a few years ago. Don't know if you saw, they were paying, I think it's one and a quarter billion they paid out damages from floods. So our idea not just ours, but the industry's idea really was to plant willow alongside the rivers, because when they were flooding the rubbish was back, was hitting the bridges and then back filling the water over into the fields, taking quite a lot of rubbish with them and so at least the willow should stop that quite a lot of that entering the land"* (P18, SRC willow supply chain)

However, they go on to highlight communication issues between the two sectors, agriculture and insurance: *"we're talking a different language to a different industry. And yeah, we're struggling to be over that"* (P18)

Another illustrated challenges they have experienced in seeking funding from a water company.

> *"We spoke to Anglian Water a couple of years ago and they were talking about, you know, water runoff and, you know, stuff going into the waterways and whatever. And they said, you know, they've got loads of farmers that land just runs off into the rivers and whatever. And we said, you know, you could put a strip of Miscanthus 8 metres wide along the edge of those fields and you wouldn't even necessarily have to harvest it, you could just leave it there, but it would help slow that stuff down and soak up some of the stuff. But again, they don't come back to us and go right, you know, let's do half and half for those growers to make sure that we're doing the right thing and they're doing the right thing and whatever"* (P15, Miscanthus supply chain)

One went on to suggest an engagement strategy based on appealing to the potential economic savings water companies could make from innovative nature-based solutions using PBC.

> *"So I think individual approaches with a story of what it [PBC] can do for them and that's kind of what we see I've seen with a lot of the successful kind of nature-based solution pitches for private finance right now that you do have to kind of tell the story, tell the solution that's going to solve a problem for the company, and it might be more of a theoretical problem. It might not necessarily be that we've proven it yet, but they pay such high fines and money in that compliance space that I think they're very interested"* (P23, natural capital adviser)

The breadth of suggestions given by participants suggests an interest to pursue nature markets. However, the data also illustrates participants' experience that, in the main, the nature market has yet to fully incorporate and value the co-benefits of PBC.

4.1.4 Stacking and blended finance opportunities

Stacking was identified as an opportunity to combine income streams (see Table 3). Although it represents an appealing scenario for many, few examples were given of current practice.

Many saw the potential that co-benefits of PBC, such as nutrient neutrality and carbon sequestration, could be realised as multiple incomes for farmers if they were able to be stacked. However, how this could be achieved presently was put into question.

> *"if you can stack and bundle the benefits, and stack and bundle the income, then farmers will do this at pace and at scale and you'll see, you'll see the dial move significantly in the ecosystem services that are that are unlocked and unleashed as a result of this type of land management… the trouble is because of the way the rules currently sit with neutral neutrality and BNG and carbon, they don't allow you to stack and /or bundle all of those things together, but actually that's nonsense"* (P2, natural capital market consultant)

Blended finance was suggested as a funding route by a few participants as a response to asking about collaborations to support integrating PBC into farming systems. Some tentatively discussed working in partnership with trusts, such as Wildlife, Woodland and Canal and River Trusts, and with other entities such as water and insurance companies to access both public and private funding respectively.

The few examples within the data were based on initiatives known to participants as opposed to their own working practices, as well as examples of nature-based solutions using other crops and imagining the potential of PBC being included alongside.

Participants described knowing farmers who were funded by water companies.

> *"I think you can easily find your local supplier. Essentially, they're the one that supplies your water… Thames Water for example, but I know the guy that's doing it… The Wildlife Trust basically came up with the project, knew they were engaged, and then approached the water company I believe"* (P23)

Another spoke of Defra's Landscape Recovery funding, suggesting that a group of farmers within a catchment area could work together with private and public actors that serve the area.

> *"if there's 8 or 9 farmers in an area, they've got a similar sort of mindset on, you know, helping a river or putting a natural forest back in. And there's a landscape area approach to restoring nature and whether there's a parallel in there for*

cooperation on cropping that could be looked into, I don't know" (P4, researcher and farmer)

4.2 Gaps in support

There was a general consensus that gaps in PBC support remained, whether as energy crops or as offering co-benefits.

> *"So it does make a difference, but it's unfortunately anecdotal, it's never been paid for, unfortunately, once a flood event like that happens, it's down to the grower themselves to go into the crop and remove any debris themselves without payment. So it's a sort of thing that if, if, if anything is more likely to make a farmer think, Why am I doing this? Because that's- I can't harvest it when it's got a railway sleeper stuck in the middle of it, and I've got to get into it to get a railway sleeper out. So it's doing a public good, but it's. But farmers aren't being paid for it, unfortunately"* (P3, SRC willow supply chain)

A few participants spoke of how PBC falls between government departments highlighting a gap in ownership with no one team having full responsibility for PBC at policy level.

> *"We deal with the tree people in Defra and they said we're not touching Miscanthus because that's not our responsibility, so I have no idea where Miscanthus has gone [in Defra]. It might have gone into like, like arable crops or something. So I think it, you know, I don't want to, but I just. I don't know where it is and who owns it"* (P17, bioenergy researcher)

Participants also referred to knowledge gaps in respect of new markets; both from a farmer and a sector perspective. For example, many participants described how they needed more information of how nature markets work; the few that did understand them acknowledged that as a sector it is still evolving, especially in respect of stacking and bundling guidance (P2, natural capital market consultant).

> *"My... bit of a lack of understanding is the carbon sequestration of it that everybody's telling me about. I think that's something I need to see, learn a little bit more about how much it actually does sequestrate because I think it's- I don't know you and you do your carbon audits and we're all still, you know, still producing too many greenhouse gases and I don't think- is this still- is there a true figure yet on how much soil sequestrates and trees you know is it? Is it there yet? But yeah, I'd like to probably learn a bit more about the carbon sequestration of willow that could be a bigger game change I suppose"* (P12, PBC grower and farm manager)

Another knowledge gap concerned the need for the wider nature market sector to understand co-benefits of PBC. A specific example highlighted that this knowledge is needed in order to be able to carbon trade PBC.

> *"So whenever we approach people who have been looking to do carbon trading like a greener and firms like that, Miscanthus falls between two categories, so it's not a tree, but it's not also an annual crop rotation, so they would need to come up with something specific for Miscanthus in order to trade it."* (P15, Miscanthus supply chain)

Participants also highlighted skills gaps in relation to PBC market opportunities in terms of education and networking (P10, agricultural adviser), further compounded by the aforementioned different sector 'languages' and working practices, such as between insurance and agriculture. Some described an ongoing gap in respect of farmers needing to develop greater business acumen and contract management capabilities (P13, bioenergy plant operator) with a focus past the farm gate.

> *"And you know, the post farm gate wasn't really addressed in the Biomass Connect project and it- But that was a big, you know you're not going to get anybody to grow it unless they know what they're going to do with it and where the market is, what it's going to cost to get it off the farm, really. And that is to a large extent still not there in this market really"* (P4, researcher and farmer)

Many saw the potential that co-benefits of PBC, such as nutrient neutrality and carbon sequestration, could be realised as multiple incomes for farmers if they were able to be stacked. However, how this could be achieved presently was put into question.

> *"if you can stack and bundle the benefits, and stack and bundle the income, then farmers will do this at pace and at scale and you'll see, you'll see the dial move significantly in the ecosystem services that are that are unlocked and unleashed as a result of this type of land management… the trouble is because of the way the rules currently sit with neutral neutrality and BNG and carbon, they don't allow you to stack and /or bundle all of those things together, but actually that's nonsense"* (P2, natural capital market consultant)

5. Conclusion

This report aimed to scope out and examine public and private sector mechanisms to support farmers and land managers in integrating PBC into their farming systems at farm and landscape level.

Findings from a desk study and analysis of interviews with 23 stakeholders were structured around four support categories:

1. Public policy support

5. Growing commercial markets
6. Nascent nature markets
7. Stacking and blended finance opportunities

There is currently no dedicated government support specifically for growing PBC (for feedstock or for co-benefits)., PBC co-benefits are not directly recognised or rewarded in ELMs (or SFS), despite lobbying from PBC advocates. The relaunch of SFI has removed payment for actions previously used by PBC growers. Indeed, participants tend to regard SFI and CS more as a competitor for PBC than an incentive.

With respect to conventional markets, in the absence of any planting grants, private finance integrated into feedstock supply contracts plays the main role in financial support. Opportunities within emerging alternative markets for biomass products and materials were identified, although these are influenced by farmer attitude to risk, entrepreneurial skills and locality. Nature markets are also promising, potentially offering income for a range of PBC co-benefits, however farmers are currently cautious and waiting for these markets to be regulated. Interest in stacking is tempered by questions about eligibility and uncertainty, highlighting the fact that these options are as yet untested and involve high transaction costs.