



# Controlled Environment Agriculture Project

Community Enterprise CEA Business Planning  
Consultation Report



For **Social Farms & Gardens**

May 2022



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f3 is a co-operative of experts and practitioners delivering sustainable local food systems advice: [localfood.org.uk](http://localfood.org.uk)

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## The Project and the Brief

In April 2021 the Crop Cycle project was instigated by Social Farms & Gardens in conjunction with BIC Innovation, and supported by Welsh Government. The objective was to test Controlled Environment Agriculture (CEA) growing systems in community enterprise settings. CEA encompasses a system of hydroponics, growing micro-greens and salads in interior spaces, with artificial light and circulating nutrients. In principle this technology can produce significant quantities of nutritious fresh produce at a variety of scales, including at a local community level.

Four community enterprises in different parts of Wales were selected for a trial of CEA technology, each with slightly different objectives and business models. They were: Cultivate in Newtown; Welcome to our Woods in Treherbert; Greenmeadow Community Farm in Cwmbran; and Xplore! Science Discovery Centre in Wrexham.

The brief to f3 for this report from Social Farms & Gardens was as follows:

***‘Deliver business development support to four independent community food growing sites in Wales, who are part of a pilot project for the Community enterprises for inclusion of Controlled Environment Agriculture (CEA) growing systems in community settings to provide sustainable, hyper local, nutritional crops for the benefit of the population and to develop the infrastructure for the continued supply of secure foods.***

***Provide the groups and individuals involved with a clear and practical development road map which will describe the pros and cons of different options and enable them to reach decisions which have the best chance of achieving financial viability, and balancing that with other goals which are a priority for them.’***

The four community enterprises are now approximately one year into trialling the CEA installations. For most it has been a slow start and a steep learning curve. Levels of production and income to date have been significantly lower than initially projected in a best-case scenario as described in the initial Crop Cycle report.

Our report identifies the progress made and difficulties that have been experienced to date. With the benefit of hindsight, and our research into CEA systems with infrastructure suppliers and other enterprises in Wales and beyond, a more realistic expectation of production and income for each of the four enterprises has been generated.

The updated plans show the potential for growth for the pilot projects over a period of three years, indicating the potential financial benefits and the need for continued funding, as well as noting the non-financial social benefits and outcomes. Commercial opportunities, potential marketplaces and key approaches have been suggested for all four pilot projects based on meetings and conversations with them, with the manufacturers of the hydroponic equipment, and with enterprises operating similar projects in other parts of Wales.



## An introduction to CEA

In the context of this report, Controlled Environment Agriculture (CEA) involves a range of high-tech systems for crop production in which aspects of the growing environment are controlled in order to reduce the risk of pest infestation or disease, to increase production and efficiency, and create predictable levels of production. Temperature, humidity, light, carbon dioxide, nutrients and water are carefully controlled using sensor-driven technologies. The installations can be located in indoor and urban situations such as basements or – as is the case with the Welsh pilot projects – in specially adapted container units.

Typically, these technologies are used for growing short cycle crops to produce, for example, micro-greens and small salad crops. Depending on the type of system being used and the varieties of plants being grown, the cropping cycle from planting to harvest can be as short as two weeks.

Because crops are harvested young and cultivated under LED lighting, they can be grown on trays allowing stacking of production units - 'vertical farming' - to maximise use of space.

Several different technologies have been used in the CEA trials, including NFT (nutrient film technique) in which crops are grown in a medium containing liquid nutrients such as rockwool; flood and drain systems whereby nutrient rich water circulates through the tray in which plant roots are placed (hydroponics); and a system which sprays a mist of nutrient rich water at an exposed root system (aeroponics). Aquaponics uses aquaculture to produce fish in a tank whose wastes are recycled as nutrients in the water which is used to feed the roots of plants growing above

Alternative low-tech systems produce similar crops involving protected cropping on benches, using natural light and manual watering/fertilising in an enclosed environment such a poly tunnel,

Examples of the technologies used in the Welsh CEA trial are shown below:

### *Digital Farming's flood & drain system*





*LettusGrow aeroponics system*



*Farm Urban vertical NFT system*





## CEA trials with social enterprises in Wales

### 1. Greenmeadow Community Farm

#### The Community Farm and its objectives

Greenmeadow Community Farm is owned by Torfaen Borough Council and the staff are employed by the local authority. It is unusual in that it charges an entry fee, and pre Covid had between 60 - 70,000 visitors per annum including paying visitors and school groups (mainly young children); educational visits including work placements (workplace learning qualifications in animal care, although not currently linked to a college nor a registered deliverer); alternative education; and volunteering opportunities.

One regular group of visitors called Farm Friends comprises adults with learning difficulties, and another group called Green Wellies runs an allotment at the Farm.

The farm animals are the most popular attraction. There is a café on site, which uses some of the produce from the project and a gift shop.

Greenmeadow also undertakes outreach work, such as taking animals out to schools and public events.

Although there is some direct income to the Farm such as the entry fee, a subsidy is required to keep it viable. Greenmeadow runs at a cost to the council, an amount which varies and is not entirely dependable as it is a non-statutory service. Greenmeadow aims to be self-financing within two years, ideally creating a surplus to reinvest in the project.

#### The CEA project

Two years ago Greenmeadow was selected by Social Farms & Gardens to pilot a CEA project because of its relatively high visitor numbers.

The main CEA installation is in a modified shipping container containing a hydroponic system with NFT (nutrient film technique) racks provided by Digital Farming; a packing area; and some external and internal vertical growing walls. The container is powered partly by solar panels on the roof. The internal areas are not accessible to the public, although people can see what is happening inside via an interior webcam and a TV monitor. The CEA system and production capacity will be discussed in more detail later.

A second CEA installation at Greenmeadow is a vertical NFT system provided by Farm Urban and located in the café area. This unit is mostly geared to public visibility as a way of showing visitors the CEA approach to food growing.

There is also a demonstration aquaponics unit located within the café consisting of two tanks - the top tank for hydroponic growing of vegetables under lighting, whose roots drop down into a lower tank in which fish live and provide nutrients for the plant growing. This is a portable unit which is suitable for school demonstrations.



### Produce use and sales

Production so far has shown to be adequate in providing salads and micro greens to meet the needs of the café kitchen. An estimate of production value is shown below:

	kg	pw	price/kg	total pw	pa 50wks
Shop sales	0.15	4	£ 15.00	£ 9.00	£ 450.00
Café (inherent value)	0.25	5	£ 7.50	£ 9.38	£ 468.75

Demand in the Greenmeadow kitchen varies according to season and weather conditions, school holidays etc. This fluctuation can largely be anticipated on the basis of past experience.

### Funding and resourcing

Welsh government provided funding for capital costs of the CEA, but no ongoing revenue funding.

Torfaen BC agreed to Greenmeadow hosting a shipping container for the CEA project, on the basis that should it prove unviable on-site, it could be moved to another location.

There is no dedicated additional staff time or personnel to run the CEA installations, so it is resourced by existing staff members when time allows. The current shop assistant has experience with growing and has an interest in developing this work stream.

Additional funding during this financial year will allow the shop assistant to spend at least one day a week on the project. Some additional capital funding may also be available.

In financial terms, the CEA installation needs to be treated as a cost centre, so that the Farm is able to show that they can generate a net profit.

*The Greenmeadow CEA container showing the solar panels and external growing wall*



*Inside the Greenmeadow CEA container*



### Finance

We have aimed to create a model which provides a budgeting and cash flow tool for the enterprise, based on realistic projections for production levels– and associated sales figures, informed by our conversations with the hydroponic equipment manufacturers.

The financial elements are laid out in a spreadsheet which is structured with several tabs, as follows:





**Capital costs:** based on known costs to date, plus budgets for future years. Note that in the profit and loss tab, it is assumed that these capital costs are fully funded by Welsh Government or other grants.

**Production:** the productive capacity based on the existing installation. It does not include the external vertical growing walls which have been primarily used to date for demonstration purposes, but which may in future have limited capacity for commercial production. It makes assumptions about the weight of produce which can be produced by each growing point based on data from the manufacturers and allowing for a certain amount of loss. It also makes assumptions about the cycle length to maturity for a range of lettuces, mixed small-leaf salad and micro green crops, including time for cleaning. The estimates have been cross checked against figures provided by Agxio who provide advice on the Digital Farming unit, as well as from Farm Urban and Lettus Grow (with information gleaned from site visits) and from models provided by Tech Tyfu and other growers. It shows that a maximum capacity of 614kg of mixed salads and 312kg of microgreens could be produced.

**Income:** this page shows monthly estimates for produce sold over a three-year period. It also shows other plant items that might be sold, such as potted plants, and income from education activities such as working with local schools. The page includes a realistic estimate of the proportion of the full capacity of the salad and micro greens which will be productive, shown as 33% in year one; 55% in year two; and 100% in year three. Pricing is based on typical market values at retail prices. This assumes that all technical and skills issues would have been addressed by year three, allowing maximum production.

Income potential in year one is currently shown as just over £4,500, in year two just over £7,700, and in year three as just under £12,000. The income at full capacity will vary according to the proportions of different crops produced and how they are sold; wholesale sales commanding a lower price than retail. This section also includes projected income from other plant sales and education days.

**Fixed costs:** these overheads are costs that don't change much related to the scale of production. They include insurance, vehicle costs, contingency, accounting etc, assuming that these costs are not absorbed by the Greenmeadow project. The most significant of these fixed costs is staffing, which has been modelled on the basis of a 20% of a full-time role in year one; 25% in year two; and 30% in year three. Fixed costs in year one are projected to be just under £6,500; in year two just under £8,000; and in year three close to £9,500.

**The cost of sales:** this page calculates the variable costs related to the level of production. It includes for example, seeds, compost, packaging, water, electricity and cleaning (materials and time). It also estimates the cost of materials and delivery, for example for the educational visits and other retail items. The numbers are linked to the estimated levels of production in the Income tab. This project's cost of sales are estimated to be just over £1,100 in year one; £1,700 in year two; and just over £2,200 in year three.

**Profit and loss:** this final sheet brings together all the information from previous tabs into one monthly and annual estimated income calculated over three years. It indicates that, when including key variables such as employment costs, sales figures, and all other costs, the project will run at an overall loss until year 3. This loss is projected to amount to around £3,000 in year one, just under £2,000 in year two, and a small surplus in year three.



## Discussion

These figures and viability calculations are based on current knowledge. Some estimates may be ambitious, but in other areas may be underestimated. As the project progresses, more realistic production and sales figures will become evident and the spreadsheet can be updated to reflect this.

On a purely commercial basis, even with the support of other retail items and educational visits, and with the assumptions made about production and pricing, the calculations indicate that additional grant funding or related sources of income may need to be found in order for the Greenmeadow CEA operation to consistently turn a profit. Our calculations point to the CEA installation as being of vulnerable financial viability at its current size – although enlarging the operation may bring some economies of scale. However, there is no doubt that other benefits such as the educational activities, having a local supply of fresh nutritious food, and the augmentation of the community farm experience, all of which are harder to quantify, also need to be taken into account in determining the overall 'value' of the project.

## Routes to Market

The financial projections for Greenmeadow are based on a three-year programme of development. Selling what is produced at Greenmeadow will be a process of trial and error; some potential marketplaces will be easier to access, others will take an ongoing effort to develop customer relations, and some may have no interest in the type of product and/or scale of production

Based on the experience of other small food businesses in South Wales, we have created some target segments, and made informed assumptions about sales opportunities that may exist. The segments are as follows:

**Direct sales from Farm premises.** Salad bags, for example, could be sold from the Farm shop, particularly at weekends and during holidays. This would require use of an existing cooler or a purchase of a new cooling unit specifically for the purpose of fresh produce sales. Point-of-sale information in the form of posters and/or flyers will be very helpful in telling the story of the production process and the nutritional benefit of the produce.

There have been some produce sales direct to the public through the gift shop, although this is challenging in terms of judging demand and keeping produce looking fresh. There is also an opportunity to sell related items such as potted plants or vegetable plugs in the Greenmeadow shop. Educational visits to schools to demonstrate CEA may be another source of income.

**Direct sales to supporters.** Greenmeadow has a large number of contacts and supporters who may be interested in purchasing produce from the Farm. Ideally this would be set up on a subscription basis, encouraging people to buy a regular weekly or fortnightly supply of salad crops, perhaps augmented by other fresh produce from the Farm or from other local collaborating suppliers, using an online ordering system. This approach has been used successfully by other small- scale producers.

We recommend inviting customers to pick up from the Farm, rather than delivery, which for small quantities is inefficient and costly. Online orders can be managed through an existing



system such as Bucky Box, and it may be worth considering membership of the Big Barn marketplace as a way of generating sales to be picked up.

**Direct sales at fairs or markets.** Fairs and farmers markets are ideal opportunities to both sell produce and to inform people about other opportunities offered at the Farm. Whilst markets will charge an attendance fee, and the income generated has to take into account the staff time and travel costs, it is not unusual to be able to take several hundred pounds in sales in a day's trading. It is important to have a good display system and marketing materials, so this will require some investment.

There are several farmers markets in South Wales which could be tried out. Events at the Farm itself are a further opportunity to showcase products and capture people's contact detail, so that a promotional email with a link to an online ordering system can be sent.

**Supplying the Greenmeadow café.** This is already taking place to some extent, but there might be an additional opportunity to offer a regular seasonal salad dish as a standby element on the menu, thereby increasing demand. Whilst this will not generate cash flow for the project as such, the value to the café should be recorded by the project as if it were a wholesale income.

**Wholesale supply to restaurants and hotels.** Micro leaves in particular are currently very much in demand in the hospitality sector. Wholesale prices will be typically 50% less than direct retail prices but this could nevertheless be a useful source of income. One approach could be to establish links with larger buyers in the vicinity (such as the Celtic Manor), perhaps delivering fortnightly orders to them.

The income generated in this way needs to factor in the costs of delivery and staff time, hence it is best to avoid supplying a lot of establishments with small amounts. A good way to interest these kinds of buyers is to take some samples in for the chef to taste, coupled with clarity about the unique features about the produce on offer - local, fresh, pesticide free, supporting a community enterprise etc.

**Wholesale supply to other producers and box schemes.** Whilst this is the least effective route to market in terms of income generation, as it is two steps away from the consumer (meaning that one is probably selling at about 30% of retail value), it may be a useful way to establish collaborations with other suppliers, particularly if the project has a regular surplus after selling to other marketplaces. A local producer of micro greens 'Veggie Confetti' might be a potential collaborator or buyer of micro greens produced on site.

**Related products.** Explore opportunities for production of appropriate related products either using the CEA system or other growing areas available nearby. This could for example include production of plug plants, young salad crop pots, growing herbs for culinary purposes or for drying for herbal teas (one of the staff involved has some experience of using herbs).

## Pricing

Pricing can be set in three ways: first by covering all costs involved including overheads, then adding a profit margin; second by researching the competition, and either matching their prices, offering it slightly cheaper, or charging more (because of the 'unique offer'); thirdly, simply charging what it is felt that potential customers would pay.



We have based the financial viability calculations on a selling price of £2.50 for 150 g mixed salad bags or 75 g of micro greens, equating to £17 and £33 per kilogram respectively. This price allows for a slight profit by year 3.

Based on the income projections on the spreadsheets, we have allocated sales volumes (bags) to each of these target customer types as follows, over three years:

	Farm sales	Farm supporters	Markets	Cafe	Hospitality	Other wholesale
Year 1	225	100	100	320	310	100
Year 2	415	200	200	420	655	200
Year 3	725	300	300	420	1625	200

### Recommended Action Plan

The following action points are our recommended priorities for *Greenmeadow Community Farm* over the next three years:

- maximise productivity and efficiency of the CEA units, if necessary, asking for further advice from the manufacturers and using digital systems for the control of the growing environment;
- train a dedicated staff member to become skilled in micro-greens and micro salad production;
- keep good financial records and update the spreadsheet model on a regular basis so that it becomes clearer which assumptions need to be challenged and updated;
- develop packaging, branding and point of sales marketing information (see marketing documents in the Appendix for ideas about how to frame this);
- Include as much CEA-produced salad as possible in meals sold at the Greenmeadow café, and advertise this fact on the menu;
- trial sales of salad items at the Greenmeadow farm shop, probably requiring an investment in a chiller unit;
- if there is surplus production, make enquiries with local potential wholesale buyers of micro-greens and salads, taking sample produce to their premises;
- reach out to Greenmeadow ‘friends’ and supporters to gather the level of interest in regular salad bag pickups; if there is sufficient interest, set up an online ordering system such as Bucky Box;



- if there is sufficient surplus produce, invest in basic market stall set up equipment, such as display case and banner to be able to attend a local farmers market. partly to sell produce and partly to promote the online order system and farm visits;
- research further possibilities for delivering paid-for educational programmes to local schools; establish and prepare materials for school educational packages and promote use of produce pods (see notes on this in the final Summary section);
- maintain a dialogue with all customers, private and commercial, to maintain loyalty and to get useful feedback on products, pricing and packaging.



## 2. Welcome To Our Woods

The Welcome to our Woods (WTOW) CEA Crop Cycle project in Treherbert is one element of the Community Food Resilience strand of the Rhondda Skyline project, funded by the Welsh Government Challenge Fund and by the National Lottery Climate Action Fund.

In the future WTOW intends the Crop Cycle project to include community agroforestry demonstration sites and school engagement programmes around familiarity with the benefits of growing food locally, good nutrition and understanding food miles.

Two converted containers are located on a former garage forecourt on the main street through Treherbert (Bute Street). The site has been slowly developed by WTOW over a number of years and is an ideal location for the CEA project due to its high profile in the community. The way the site looks now is a transformation from the eyesore it had been, so there is already a positive public orientation to the project.

The WTOW CEA project is in its early stages, and there have been a number of teething troubles with some of the hydroponic equipment, as well as some very useful learning. An older and smaller container on the site is used mainly as a classroom, and also houses a Farm Urban 'growing wall' which has been tested and put into production, although it was not operational at the time of writing.

The Growing Wall will be used initially as an educational display for people visiting the site and may produce some saleable produce in the future. WTOW described the construction of the Growing Wall as 'hobbyist' rather than professionally engineered. Their feeling is that it may be relatively high maintenance and they are unsure about its potential productivity.

Some of the Farm Urban aquaponic 'Produce Pods' are also housed in the classroom container and have been used to deliver educational workshops to local school children. One of the pods is currently housed at a local school and is apparently operating well, with fish living in the bottom part and some salad greens growing on top. The children have shown a lot of interest in it, and at some point in the future it will be returned to WTOW and then re-loaned to another school. The intention is for other aquaponic pods to be on permanent display on site and also loaned to other schools/organisations at one time.

A newer CEA container has been installed at the other end of the site. WTOW expressed disappointment with the quality of the container conversion; they felt the wall materials are not of sufficient quality; the windows are only single glazed, which causes excessive condensation; and the floor, door and windows are not properly finished and sealed. This container holds a small hydroponic unit at one end, which has not yet been brought into production partly because of misgivings the team have about the level of time it will require to operate and maintain it. They plan to use it in the future to grow bedding plants for sale to local gardeners.

At the other end are a couple of germination areas and an aeroponics unit, which operates by spraying a mist of nutrients on the roots of the plants. It can be monitored remotely by local staff and support staff at LettUs Grow in Bristol.



WTOW have so far grown three trial 'harvests' on the aeroponics unit. They are impressed with the engineering of the unit and believe it can potentially produce yields which are of a sufficient scale to generate a small amount of income. The greens it produces could be sold to for example a local pub with a gourmet landlord, and to a 'Pay as you Feel' café nearby, as well as to local a local food hub that is being developed with the Open Food Network. WTOW also plan to run a pop-up market on the CEA site itself in the summer months. They believe there would be local demand for 'living lettuces' as well as bedding plants, herbs in pots and salad bags.

A polytunnel bought in the first round of Crop Cycle funding will be used to rear and grow on the CEA started plants for sale to local gardens and allotments. A second polytunnel on site will act as an additional education space (the aquaponic workshops), a pop-up retail/market space, and space for a weekend pop up 'pay as you feel' café.'

*WTOW Classroom unit*



*Aeroponics equipment*





## Financial viability

With our financial assessment for this project we have created a model on a spreadsheet which can provide a budgeting and cash flow tool for the enterprise. The spreadsheet is structured with several tabs, as follows:

**Capital costs:** costs known to date, plus additional funds approved for this year and budgets for future years have been inputted. Note that in the profit and loss tab, it is assumed that these costs are fully funded by Welsh Government or other grants.

**Production:** the productive capacity and income potential is calculated on this page. This is based on the current installation of the aeroponic systems and makes assumptions about the weight of produce from each growing point, based on data from the manufacturers, while allowing for a certain amount of loss. It also makes assumptions about the cycle length to maturity for a range of salad and micro green crops and includes time for cleaning. Pricing is based on typical market values at retail prices.

The estimates have been cross checked against some figures provided by Lettus Grow (who installed the aeroponics system) and Agxio (who provided advice on the Digital Farming unit) and other models created by hydroponics researchers Menter Mon. It shows that at maximum capacity annual income potential for salads and micro greens could be over £5,800.

**Income:** this gives a monthly estimate of numbers of salad bags sold over a three-year period. It also shows other items that might be marketed, such as potted plants and income from education activities for example with local schools. The page includes an estimate of the proportion of the full capacity of the aeroponic system which will be productive, which is being shown at 25% in year one; 40% in year two; and 100% in year three. This makes the assumption that all technical and skills issues would have been addressed, allowing maximum production by year three (which may be ambitious), and that both installations will be in operation (to date only the aeroponic system is being used). Income potential in year one is currently shown as just over £3,100; in year two just over £4,400; and in year three just over £8,000.

The income at full capacity will vary according to the proportions of different crops which are sold, and to whom; for example, wholesale will command lower sale price than retail. This also makes assumptions about the potential for WTOW to sell other types of produce, and educational visits paid for by schools or colleges.

**Fixed costs:** these allow for overheads, i.e. costs that don't change much related to the scale of production. It includes insurance; vehicle costs; contingency; accounting etc, assuming these costs are not absorbed by the wider enterprise. The most significant fixed cost is staffing, which has been modelled on the basis of a 20% commitment of a full-time role in year one; 25% in year two; and 30% in year three. Fixed costs in year one are projected to be just under £4,900; in year two just under £5,500; and in year three close to £6,500.





**The cost of sales:** this page calculates the variable costs related to the level of production. It includes, for example: seeds, compost, packaging, water, electricity and cleaning. It also estimates the cost of materials needed and delivery, for example, for the educational visits and for any other items which are sold. The numbers are linked to the estimated levels of production in the Income tab. This project's costs are projected to be just over £630 in year one; £860 in year two; and just over £1,400 in year three.

**Profit and loss:** this final sheet brings together all the information from previous tabs into one monthly and annual estimate calculated over three years. It indicates that when including key variables such as employment costs, sales figures, and all other costs, the project will run at an overall loss until year three. This loss is projected to amount to just under £2,000 in year one, just over £1,900 in year two, and breaking even in year three.

### Pricing:

Pricing can be set in three ways: first by covering all costs involved including overheads, then adding a profit margin; second by researching the competition, and either matching their prices, offering it slightly cheaper, or charging more (because of the 'unique offer'); thirdly, simply charging what it is felt that potential customers would pay.

We have based the financial viability calculations on a local selling price of £2.50 for 75 g of micro greens or £33 per kilogram (the price could be higher in some urban areas).

### Discussion

These figures and viability calculations are based on current knowledge. Some estimates may be ambitious, but in other areas may be underestimated. As the project progresses, more realistic production and sales figures will become evident and the spreadsheet can be updated to reflect this. Our calculations point to this CEA installation as being of questionable financial viability at its current size – although enlarging the operation could bring some economies of scale. Purely on a commercial basis, even with the support of other retail items and educational visits, these calculations indicate that additional grant funding or related sources of income will need to be found for two years before the CEA operation can break even, assuming production is at the maximum capacity and prices are at full retail levels.

However, there is no doubt that other benefits such as the educational activities, having a local supply of fresh nutritious food, and the augmentation of the community farm experience, all of which are harder to quantify, also need to be taken into account in determining the overall 'value' of the project.

### Routes to Market

Our financial projections for WTOW are based on a three-year programme of development. Selling what is produced at WTOW will be a process of trial and error; some potential marketplaces will be easier to access, others will take an ongoing effort to develop customer relations, and some may have no interest in the type of product and/or scale of production based on the experience of other small food businesses in South Wales, we have created some target segments, and made informed assumptions about sales opportunities that may exist. The segments are as follows:



**Direct sales from WTOW premises.** This is a very feasible option, due to the high profile of the WTOW premises on the main road. Salad bags, for example, as well as related items such as potted plants or vegetable plugs could be sold from the WTOW site. This would require purchase of a new cooling unit specifically for the purpose of fresh produce sales. Point-of-sale information in the form of posters and/or flyers will be very helpful in telling the story of the production process and the nutritional benefit of the produce.

**Direct sales to supporters.** WTOW has a large number of contacts and supporters who may be interested in purchasing produce. Ideally this would be set up on a subscription basis, encouraging people to buy a regular weekly or fortnightly supply of salad crops, perhaps augmented by collaborating with other local suppliers, using an online ordering system. This approach has been used successfully by other small-scale producers.

We recommend inviting customers to pick up from the site, rather than delivery, which for small quantities is inefficient and costly. Online orders can be managed through an existing system such as Bucky Box, and it may be worth considering membership of the Big Barn marketplace as a way of generating sales.

**Wholesale supply to restaurants and hotels.** Micro leaves in particular are currently very much in demand in the hospitality sector. Wholesale prices will be typically 50% less than direct retail prices but this could nevertheless be a useful source of income. One approach could be to establish links with larger buyers in the vicinity perhaps delivering fortnightly orders to them.

The income generated in this way needs to factor in the costs of delivery and staff time, hence it is best to avoid supplying a lot of establishments with small amounts. A good way to interest these kinds of buyers is to take some samples in for the chef to taste, coupled with clarity about the unique features about the produce on offer - local, fresh, pesticide free, supporting a community enterprise etc.

**Wholesale supply to other producers and box schemes.** Whilst this is the least effective route to market in terms of income generation, as it is two steps away from the consumer (meaning that one is probably selling at about 30% of retail value), it may be a useful way to establish collaborations with other suppliers, particularly if the project has a regular surplus after selling to other marketplaces.

### Recommended Action plan

The following action points are our recommended priorities for *Welcome To Our Woods* over the next three years:

- maximise productivity and efficiency of the CEA units and bring them all into production, if necessary, ask for advice from the manufacturers and employ digital systems for the control of the growing environment;
- train a staff member to become skilled in micro-greens and micro salad production;
- keep good financial records and update the spreadsheet model on a regular basis so that it becomes clearer which assumptions need to be challenged and updated;
- develop packaging, branding and point of sales marketing information (see attached Marketing documents for ideas about how to frame this);



- trial sales of salad items at the WTOW site, probably requiring an investment in a chiller unit;
- Boost sales of CEA produce by raising the profile of the project in the local and adjacent communities;
- if there is surplus production, make enquiries with local potential wholesale buyers of micro-greens and salads, taking sample produce to their premises;
- reach out to WTOW 'friends' and supporters to gather the level of interest in regular salad bag pickups; if there is sufficient interest, set up an online ordering system such as Bucky Box;
- set up polytunnels on site and establish a small nursery business at which local people can purchase starter plants and other items started in the CEA system and for which there is local demand;
- research possibilities for delivering paid-for educational programmes to local schools; establish and prepare materials for school educational packages and promote use of produce pods (see notes on this in the final Summary section);
- maintain a dialogue with all customers, private and commercial, to maintain loyalty and to get useful feedback on products, pricing and packaging.



### 3. Cultivate

The CEA Project at Cultivate is housed in three adjacent and interconnected shipping containers. Cultivate also oversee the operation of a Farm Urban vertical growing unit which is located in the nearby college and is incorporated into their horticulture courses. Because this unit is only used for educational purposes, rather than potential income generation, it is outside the scope of this report.

A plastic 'growing wall' is situated in a glass sided container which acts like a greenhouse. This grow wall is 'low tech'; in theory water is poured at the top soil-containing 'pots' and drains down to the bottom pots. However, for this to function the top pots have to be saturated, and the bottom pots tend to be dry; so in practice the growing pots are watered individually. Cultivate plan to use this unit for growing edible flowers such as viola and nasturtium as high value items which can be added to salads to make them more appealing.

In one adjoining container there are shelving and sink units, and an enclosed germination area. Seeds are planted in recycled carpet material which is used as a neutral growing medium to line the plastic trays. The main disadvantage of the carpet material is that it can't be composted and goes into general waste. The preference would be to use Koya mats, but these are expensive and hard to find. One problem in the germination area has been mould on the sunflower seeds in the unit, possibly because of the high level of humidity.

From planting in trays, the seeds spend 10 days in the germination unit before being relocated to the hydroponic and/or aeroponic growing system in another container, both of which were supplied by Lettus Grow. In the view of the project manager, although the hydroponics unit is relatively simple in operation, it requires high maintenance, and the harvesting process is relatively labour-intensive and physically difficult. In addition, she found the top shelves hard to reach, and that it takes a long time to clean the troughs after a harvest to maintain the required high levels of hygiene. In addition, even when the digital read-out showed that there was the correct mix of nutrients in the water, the plants being grown showed signs of being nutrient deficient, with yellow leaves and weak bendy stems. She was also disappointed by the yields from the hydroponic unit, partly because she had to remove every other growing plug from the troughs due to overcrowding of the plants

Four types of micro salads are being grown in aeroponics unit, namely peas, red cabbage, radish, and sunflower. Gem lettuce plants are also grown for transplanting into the hydroponics unit where their leaves can be harvested when they achieve maturity. Microgreens can be harvested after the seedlings have been growing in the aeroponics unit for around ten days. The aeroponics system is more complex in operation – and has malfunctioned sometimes - for example not draining properly or a fault light coming on for no apparent reason - but it can be conveniently controlled by an app on the manager's phone.

Cultivate have found that different types of microgreens have different levels of productivity in the aeroponics unit. For example, peas tend to produce around 800 grams per tray; red cabbage 200 grams, radishes 250 grams Sunflowers don't grow well and only produce 100 to 200 grams of product on average. These may be given up in the future. Red cabbage is useful for making salad bags look more attractive. Radishes take longer to germinate.



There are 24 trays in the aeroponics unit; on average 4 trays of mixed microgreens produce 1.2 kilos of microgreens per harvest. With good rotation 4 trays of the unit can be harvested twice a week, so produces 2.5 kilos of microgreens each week in total. Of this harvest 1.6 kilos per week go to a local restaurant ("Health Loaded") each week. They pay £4 for 4x 100g boxes, i.e. £16 for the total 1.6kg. In addition, 400g per week (i.e. 2 x 200g harvests) are used by the on-site kitchen which supplies a local deli. The remainder (for example 380 grammes from a recent harvest) is distributed to a local food surplus project.

In terms of labour input for the microgreen production: seeding the trays for the germination unit takes about 30 minutes; and each harvesting of the microgreens takes about one hour. Cleaning the trays for the aeroponics is time consuming, especially because of the pea roots. It takes approximately 10 minutes to wash each tray, sometimes longer depending on what was grown within the tray.

#### *Aeroponics unit at Cultivate*





*CEA Containers at Cultivate*



*Hydroponics unit (currently unused)*





## Financial viability

Our financial assessment for this project is modelled on a spreadsheet which provides a budgeting and cash flow tool for the enterprise.

The spreadsheet is structured with several tabs, as follows:

**Capital costs:** costs to date plus budgets for future years have been inputted. Note that in the profit and loss tab, it is assumed that these costs are fully funded by Welsh Government or other grants.

**Production:** in this page the productive capacity and income potential is calculated, based on the current installation of the aeroponic/hydroponic systems. It makes assumptions about the weight of produce from each growing point, based on data from the manufacturers, while allowing for a certain amount of loss. It also makes assumptions about the cycle length to maturity for a range of salad and micro green crops, including time needed for cleaning. Pricing for the items produced is based on typical market values at retail prices. The estimates have been cross checked against some figures provided by Lettus Grow (hydroponics manufacturers) and Agxio (who provide advice on the Digital Farming unit) alongside models provided by hydroponics researchers Menter Mon. We calculate that a maximum capacity of 260kg of mixed salads and 347kg of microgreens could be produced, meaning that at maximum capacity annual income potential for salads and micro greens from the two installations could be close to £10,800.

**Income:** this gives a monthly estimate of numbers of salad bags sold, over a three-year period. It also shows other items that might be grown and sold, such as potted plants, as well as income from education activities such as time spent working with local schools. The page includes an estimate of the proportion of the full capacity of the salad and micro greens which will be productive, which is being shown as being 25% in year one, 40% in year two, 100% in year three. This assumes that all technical and skills issues would have been addressed allowing maximum production by year three - which may be ambitious - and that both installations are in operation (to date only the aeroponic system is being used). Income potential in year one is currently shown as just over £4,300; in year two just over £9,000; and in year three just over £13,000. The income at full capacity varies according to the proportions of different crops which are grown and the routes to market. For example, wholesale will command lower sale price than retail. We also make assumptions about the potential to sell other retail items, and educational visits paid for by schools or colleges.

**Fixed costs:** these allow for overheads; costs that don't change much related to the scale of production. It includes insurance, vehicle costs, contingency, accounting etc, and assume that these costs are not absorbed by the enterprise generally. The most significant fixed cost is staffing, which has been modelled on the basis of a 20% commitment of a full-time role in year one, 25% in year two, 30% in year three. Fixed costs in year one are projected to be just under £5,500, in year two just under £6,800, and in year three close to £8,000.

**The cost of sales:** this page calculates the variable costs related to the level of production. It includes seeds, compost, packaging, water, electricity and cleaning. It also estimates the cost of materials and delivery, for example, for the educational visits and other items which are produced and sold. The numbers are linked to the estimated levels of production in the Income tab, and results in projected costs of just over £940 in year one, £1,800 in year two, and just over £2,500 in year three.



**Profit and loss:** this final sheet brings together all the information from previous tabs into one monthly and annual estimate calculated over three years. It indicates that, when including key variables such as employment costs, sales figures, and all other costs, the project will run at an overall loss. This is projected to amount to just over £2,000 in year one, profit of nearly £600 in year two, and £2,500 in year three.

### Pricing

Pricing can be set in three ways: first by covering all costs involved including overheads, then adding a profit margin; second by researching the competition, and either matching their prices, offering it slightly cheaper, or charging more (because of the 'unique offer'); thirdly, simply charging what it is felt that potential customers would pay

We have based the financial viability calculations on a selling price of £2 for 150 g mixed salad bags or 75 g of micro greens, equating to £13 and £27 per kilogram respectively. It should be noted that Cultivate are currently selling micro greens at £10 per kg, which is much lower than the average retail price, but reflects the lower wholesale pricing margin.

### Discussion

These figures and viability calculations are based on current knowledge. Some estimates may be ambitious, but in other areas may be underestimated. As the project progresses, more realistic production and sales figures will become evident and the spreadsheet can be updated to reflect this.

Our calculations point to this CEA installation as being of moderate financial viability at its current size – although enlarging the operation could bring some economies of scale. However, there is no doubt that other benefits such as the educational activities, having a local supply of fresh nutritious food, and the augmentation of the community farm experience, all of which are harder to quantify, also need to be taken into account in determining the overall 'value' of the project.

On a purely commercial basis, even with the support of other retail items and educational visits, these calculations indicate that the Cultivate hydroponics operation can break even, if production is near the maximum capacity.

### Routes to Market

Our financial projections for Cultivate are based on a three-year programme of development. Selling what is produced at Cultivate will be a process of trial and error; some potential marketplaces will be easier to access, others will take an ongoing effort to develop customer relations, and some may have no interest in the type of product and/or scale of production based on the experience of other small food businesses in South Wales, we have created some target segments, and made informed assumptions about sales opportunities that may exist. The segments are as follows:

**Direct sales from Cultivate premises.** Salad bags, for example, as well as related items such as potted plants or vegetable plugs could be sold from the Cultivate site. This would require purchase of a new cooling unit specifically for the purpose of fresh produce sales. Point-of-sale information in the form of posters and/or flyers will be very helpful in telling the story of the production process and the nutritional benefit of the produce.





**Direct sales to supporters.** Cultivate has a large number of contacts and supporters who may be interested in purchasing produce. Ideally this would be set up on a subscription basis, encouraging people to buy a regular weekly or fortnightly supply of salad crops, perhaps augmented by collaborating with other local suppliers, using an online ordering system. This approach has been used successfully by other small-scale producers.

We recommend inviting customers to pick up from the site, rather than delivery, which for small quantities is inefficient and costly. Online orders can be managed through an existing system such as Bucky Box, and it may be worth considering membership of the Big Barn marketplace as a way of generating sales.

**Wholesale supply to restaurants and hotels.** Micro leaves in particular are currently very much in demand in the hospitality sector. Wholesale prices will be typically 50% less than direct retail prices but this could nevertheless be a useful source of income. One approach could be to establish links with larger buyers in the vicinity perhaps delivering fortnightly orders to them – and this has already been established by selling to a local deli and using CEA produce in the Cultivate kitchen

The income generated in this way needs to factor in the costs of delivery and staff time, hence it is best to avoid supplying a lot of establishments with small amounts. A good way to interest these kinds of buyers is to take some samples in for the chef to taste, coupled with clarity about the unique features about the produce on offer - local, fresh, pesticide free, supporting a community enterprise etc.

**Wholesale supply to other producers and box schemes.** Whilst this is the least effective route to market in terms of income generation, as it is two steps away from the consumer (meaning that one is probably selling at about 30% of retail value), it may be a useful way to establish collaborations with other suppliers, particularly if the project has a regular surplus after selling to other marketplaces.

### Recommended Action plan

The following action points are our recommended priorities for *Cultivate* over the next three years:

- maximise the productivity and efficiency of the CEA units and bring them all into production, if necessary, asking for advice from the manufacturers and employing digital systems for the control of the growing environment
- continue to support and train a dedicated staff member to become skilled in micro-greens and micro salad production
- keep good financial records and update the spreadsheet model on a regular basis so that it becomes clearer which assumptions need to be challenged and updated
- develop packaging, branding and point of sales marketing information (see Appendix for ideas about how to frame this)
- if there is surplus production, make enquiries with local potential wholesale buyers of micro-greens and salads, taking sample produce to their premises



- reach out to Cultivate ‘friends’ and supporters to gather the level of interest in regular salad bag pickups; if there is sufficient interest, set up an online ordering system such as Bucky Box
- continue to sell CEA produce to the local café and deli – encourage them to purchase more, and boost sales by raising the profile of the CEA project in the local community.
- research possibilities for delivering paid-for educational programmes to local schools; establish and prepare materials for school educational packages and promote use of produce pods (see notes on this in the final Summary section);
- maintain a dialogue with all customers, private and commercial, to maintain loyalty and to get useful feedback on products, pricing and packaging.



## 4. Xplore!

Xplore! is located in a converted department store in the centre of Wrexham. It was initially affiliated with Techniquist in Cardiff before they got funding to relocate and to rebrand in 2019. They have a shop and café that is open to the public seven days a week. The exhibition/display area is open to school groups on four days a week, and to the public on three days. The schools are charged for children to use the exhibition displays and activities.

Funding for the CEA project was originally provided by Farm Urban – who felt Xplore! would be a suitable location for them to show their vertical growing technology. The Xplore! CEA project initially launched in 2019, but because of Covid shutdowns and restrictions and inconsistent staffing levels, there has not been continuity for the project until recently.

There are two Farm Urban vertical growing units at Xplore!, one located in the front café/entrance area which is open to the public, and one in the exhibition/activity area. Maintenance of the vertical growing units is currently mostly being fitted in by the project manager, and she has nominally allocated about 1.5 hours per week to the task.

The vertical growing unit in the entrance has been planted with herbs, but at the time of writing is not functioning properly. The other unit in the activity space is growing lettuces. When they are ready to pick, a 'harvesting' session is held, and the children watch them being cut. These lettuces are then offered to children and/or parents free of charge or in return for a small donation. Any surplus is taken home by Xplore! staff.

The plants for both units are grown from seed in specially designed trays on a shelving unit in the activity area. At present, all the lettuces in the growing unit are at the same stage of development, but the plan is to transplant them sequentially so that they can be more regularly harvested and the children can see them at different stages of growth.

There is currently no commercial potential for what is being grown in the vertical units. The level of production is relatively low, and the Xplore café is unable to sell or make use of any produce because they have no water plumbed in so are unable to wash the leaves prior to serving. There is also the possibility of giving away any spare produce to local cafes.

Capital investment in plumbing to a catering/preparation area in the café area with a sink for salads with sandwiches would make it feasible to sell some of the produce in the café and generate a small financial return. The project manager would also like to have more advanced ways of conveying the CEA growing process to visitors, for example using touch-sensitive screens and suitable seating.

In the meantime, the main output from the CEA installation at Xplore is educational. The children visiting with school groups are shown in detail how the vertical growing units operate. Other children and parents see plants growing vertically with the hope that this will arouse their interest and curiosity in this alternative way of growing food in an urban environment.

Xplore also have a number of 'Produce Pods' provided by Farm Urban which they will use to demonstrate the basic principles of hydroponics to visiting schoolchildren. Although the Produce Pods can incorporate fish in their operation, Xplore! have no plans to do this at present. Going forward, their aim is to work with more schools who will receive fully funded sessions as part of the CEA project. They also feel that there is the potential to work with adult community learning groups to get them involved in the operation and maintenance of the vertical growing units.



*Xplore! exhibit area*



*Vertical Growing display*





## Finances - overview

The CEA installation at Xplore! is primarily for educational purposes and to augment the visitor experience. Commercialisation of the production capacity is therefore not relevant in this case.

There may be an opportunity to use some of the produce in the Xplore! café at a later stage, but this would be of limited monetary value.

The most significant opportunity at Xplore! for income generation linked to the CEA installation is through educational visits to schools or other establishments. The income tab in our financial spreadsheet indicates there could be up to 11 visits a year creating a possible income stream of £2,200.

There will be fixed costs or overheads associated with operating and maintaining the CEA installation, which we have estimated at just over £1,600 a year, the majority of which is allowing for staff input of 5% of the full-time equivalent role.

There will be other costs relating to the provision of the educational visits, to allow for staff time and travel, which we estimate at £50 per visit, combining to an annual cost of about £400.

Overall, the projected costs slightly outweigh the income benefits for two years, resulting in an annual projected loss of around £720 then £570, which would either need to be made up from additional funding or considered as part of the cost of providing the additional educational benefit. The operation could break even in year three, on the basis of all current assumptions.

## Recommended Action plan

The following action points are our recommended priorities for *Xplore!* over the next three years:

- maximise productivity and efficiency of the CEA units, asking for advice from the manufacturers on how to make the grow walls as productive as possible;
- Install plumbing so that CEA produce can be washed on site, enabling it to be served as part of meals at the Xplore! Café and given or sold to children/parents visiting;
- keep good records and update the financial spreadsheet model on a regular basis so that it becomes clearer which assumptions need to be challenged and updated;
- develop packaging, branding and point of sales marketing information;
- research further possibilities for delivering paid-for educational programmes to local schools; establish and prepare materials for school educational packages and promote use of produce pods (see notes on this in the final Summary section).



## Summary and recommendations

### Financial feasibility of CEA in a community enterprise context

CEA systems offer the opportunity for intensive production of microgreen and other salads in a small space, including internal spaces. The manufacturers of the equipment and the information systems which run it, are currently developing their experience and evidence base.

What is evident from the research we've done, including visits with leading UK CEA manufacturers, is that this is an industry which is not yet mature. Whilst there are models and some examples of commercially profitable enterprises making use of these systems, there still seems to be a lot of uncertainty and many variables in maximising the productive capacity. Fine tuning the technology and developing precise production skills is clearly required, and this is a process in which the Welsh CEA projects can play a useful role.

Community enterprises exhibit a huge diversity in infrastructure, skills, and objectives. Most, in our experience, as evidenced by the four enterprises we researched for this study, would not describe themselves as either highly technically skilled or able to commit the labour inputs which seem to be required to maximise the productivity of the CEA equipment. In this sense there are some significant barriers or community enterprises to overcome in order to have a natural fit with these kinds of technologies. Additionally, the micro green and micro salads which the CEA units are designed to produce are a speciality, high-end product which may not be a natural fit with other outputs of the community enterprises or with their constituencies, particularly where new marketplaces need to be developed.

But by identifying realistic levels of production and showing additional income streams from related products and educational services, our study shows that each of these four enterprises can break even or generate a small profit after three years of committed development activity.

There are also other non-financial benefits particularly around education and providing nutritious fresh food to local communities, which has been identified in a parallel report and is not explored in detail here.

However, it's important to note that this is because these four community enterprises have had considerable capital investment in the form of grants, without which it is difficult to see how the CEA systems would be justifiable financially as a cost centre.

### Market development, maximising value, and 'USP'

Community enterprises are intrinsically complex, with the need to balance financial viability with social objectives. The word 'profit' can feel uncomfortable in this environment and yet without surplus generated by the enterprise as a whole it is destined to be reliant on grant funding. If a financial surplus is required there needs to be a dispassionate analysis of opportunities for income generation, both for the enterprise as a whole and for cost centres within it. The financial models for the CEA systems and related income streams contained in this report will hopefully provide individual enterprises with a working model to understand



the potential profitability of this cost centre, at the same time as contributing to a wider shared understanding of opportunities for CEA within community enterprise.

With any new product or service, whether commercial or socially orientated in terms of outcomes, a development plan is required. This requires an understanding of the marketplace for what is on offer, whether that comprises 'customers' or 'beneficiaries'. It is not the objective of this report to go into detail in describing possible approaches to market development. However, some common themes which will be critical to any of the CEA - related initiatives have been explored.

The first step in any marketing plan is to understand the potential customer's needs and desires. It is best not to make assumptions about what people will buy or use, and the most useful form of market research is to start trialling sales, with the objective of understanding the customer's actual spending choices. In order to sell successfully (even if the sale is discounted or free) one needs to understand the opportunity provided by a product or service from the customer's point of view. With regard to micro-greens and salad crops, each enterprise will need to be clear about their own target customers' preferences when it comes to form of presentation, packaging, weight and price, where it will be picked up or delivered to and how, likely frequency and volume of sales, and how to maintain loyalty and repeat purchase. And the best way to find this out is to trial various approaches, learning of from others' and their own experiences, seeing the results in terms of sales and asking for customer feedback.

It will also be critical to define the unique selling proposition (USP) of each product. For micro greens and fresh salads this will almost certainly build on the nutritional value, freshness, localness, seasonality, taste, and keeping qualities, alongside the feeling of doing the right thing in supporting local community business.

The advantage that a community enterprise will have in this regard in comparison with a mainstream commercial shop of business is the probability of a fairly high level of public support for, and interest in the project which may mean that purchasing decisions will be shaped by larger considerations than simply price and product – although these will always be important. Customers will also be more likely to provide helpful feedback, including ideas for improvement.

There are some excellent guides to marketing and financial management for community enterprise included at the end of the weblinks section links in the appendices. We have also attached several useful guides to developing a marketing strategy for microgreens and fresh local produce of various kinds.

## Notes on marketing educational activities to Schools

Drawing on information received from Farm Urban, and from participating Welsh CEA partners who already work in schools, it would seem that there is an existing demand from schools for workshops at which the basic principles of hydroponics and/or aquaponics can be demonstrated to pupils, and that these can be charged for at a rate which would enable a financial surplus to be generated. A typical rate might be £200 - £300 for a day or part of a day. This has been reflected in the spreadsheets for each project attached to this report.



Our belief is that this interest from schools could be developed by all CEA projects over time, resulting in an increased income generation and a healthier surplus for the projects during the financial year.





## Appendices

**1. Financial analyses for each CEA Social enterprise in this report – attached xls files**

**2. Documents describing marketing advice for fresh local produce - attached PDF's**

**3. Information from CEA equipment suppliers and relevant CEA projects in Wales**

**a. LETTUS GROW.** Notes from S. Garrett visit: April 19<sup>th</sup>, 2022

Lettus Grow sell converted containers fully fitted with their aeroponics systems. They sold twelve such containers in the last financial year and are aiming for twenty in the coming year. They also undertake research on methods of generating the maximum yields from their systems, including which plants are best suited and which combination of nutrients and light will generate maximum yields. Lettus Grow have provided the aeroponics and some of the hydroponics equipment installed in the Welsh CEA trial projects.

Key points gleaned from a visit: to their base in Bristol:

- It's hard to project yields and/or income from a particular hydroponics crop because of all the variables involved. Many CEA projects are generating additional income from educational activities – e.g. charging for schools visits
- Their aeroponics system can only really grow microgreens and herbs. Growing e.g. lettuce in their equipment is not cost-effective as they take up too much growing space relative to levels of productions.
- They estimate 20-25 hours per week to run one aeroponics system. There are definite economies of scale, if it involves automation and greater efficiencies
- It's not really sensible to grow other plants e.g. peppers in the system, because the leaves are not eaten, so a lot of growing energy is wasted. Also, larger plants put roots in water, so benefit less from the aeroponic approach. However it might make sense to start plants in their system and then transplant them.
- The sides of the growing trays limit air flow, so growth around the edges is poor, so they are experimenting with smaller trays, and cutting down the sides.
- In terms of demand, Lettus Grow are optimistic: young people are now more interested in eating healthy and sustainability, and we will all have a really different kind of diet in the future?
- Increased electricity costs will have a big effect on the cost-effectiveness of aeroponics. It's most cost effective to use renewables, and to ensure that plants 'sleep' when electricity is expensive.



Spreadsheets from Lettus Grow showing possible yields and income, together with estimated costs, can be found here:

<https://docs.google.com/spreadsheets/d/12tdauPiEPomk8cGviPtcXfPla7tZkr2G3ihRw- js79I/edit?usp=sharing>

#### **b. FARM URBAN** – Notes from S. Garrett visit May 5<sup>th</sup>, 2022

Farm Urban is a private company located in the basement of the Liverpool School for Life Sciences. The founders Jens Thomas and Paul Myers met at the school and began their work on setting up Farm Urban there. They are able to use the cellar of the School premises for production and research and are paid by the School to offer workshops and research opportunities to students.

Farm Urban generate income by: designing and selling vertical growing equipment to private, third sector and educational organisations; selling 'living lettuce's in specially constructed boxes on subscription to local households and selling vertical growing equipment and/or wholesale produce to local restaurants and other businesses.

Farm Urban use various models of delivery to restaurants, including: installing and replenishing vertical grow walls which they've installed; installing vertical grow walls and letting the customer plant and harvest themselves; delivering harvested lettuce

They combine selling equipment and produce with carrying out continuous R&D and educational programmes. Farm Urban believe that although their lettuces are relatively expensive, they do contribute to nutrition and sustainability because they are grown very local to the point of production, and the land that is freed up from production can be used to sequester carbon. However they agree that their growing methods would not be at all sustainable if the electricity used was generated using fossil fuels

Farm Urban provided us with realistic production targets for their vertical growing equipment which have been circulated to the Wales CEA projects as achievable targets for them to aim for and have also been incorporated into our financial projections for each project. They've found that Some lettuce varieties grow better horizontally

Farm Urban are always looking for ways to optimise the growing/harvest/packaging cycle. They're also researching ways of measuring the nutritional content of the lettuces grown hydroponically under lights to compare that with similar lettuces grown more conventionally. They plan to expand their growing area to other sites because they believe there are important economies of scale to their production methods.

<https://www.greensforgood.co.uk/shop> is the internet 'shop window' for Farm Urban's vertically grown produce

#### **c. TECH TYFU**. Vertical Farming Research and Pilot Enterprises in North Wales

<https://techtifu.com/>

The information below is condensed from notes sent by Luke Tyler on April 27<sup>th</sup>, 2022

Tech Tyfu run a pilot hydroponic growing project, in North Wales, undertake a range of research and training activities, and provide advice and support to several CEA and



hydroponic enterprises in the area. We found them to be an excellent source of information about hydroponics technologies and growing/cropping methods.

They provided us with four modelling tools they have used/developed and refined as data from their projects have been collected. However, they also emphasised the following points:

- these models should not be used to support funding applications or justify business plans. Organisations looking to do this should develop their own models based on their own circumstances
- A cost model could show theoretical yield from vertical farms but make so many assumptions that for those purposes the data is essentially meaningless.
- The models depend on supply chains being established for the crops in question, continuity in the supply chain as well as disregarding externalities, the impact of which is larger in smaller projects.
- Vertical farming involves high start-up costs, limited return on investment and high potential for obsolescence.
- To make it economically successful, organisations that use the new technology will scale up gradually, carrying out R&D to inform investment.
- Having a small number of individuals responsible for the design, growing, cultivation, harvesting, product design, marketing, sales and distribution will create weaknesses and become a high point of failure for a project.
- Successful projects will make good use of existing skills, infrastructure and networks, prioritising the time and skills of project participants.

Tech Tyfu themselves grow microgreens, watercress and pea shoots in various modular racks using flood and drain hydroponics. Some of these systems they have built themselves and some they have commissioned.

Clay balls are used as a growing medium in watercress crops and also in their aquaponics/vine crop systems. Tech Tyfu believe they have many advantages: they provide a good cation exchange surface and offer good root anchorage; they also absorb heat during the day and seem to help maintain root temperature during the night; they are easy to clean and are indefinitely reusable.

They pointed us to successful small businesses who have started with a small amount of equipment and have developed into profitable business through a combination of determination, training, specialist support and business advice.

Links to successful hydroponic enterprises supported by Tech Tyfu:

[Hooton's Homegrown](#)

[Tyfu'r Tyddyn](#)

[Ysgol Holyhead](#)



[Ysgol Llangedfni](#)

[Tyfu Eryri](#)

[Snowdon Valley Farms](#)

Table of crop production targets from Tech Tyfu:

Tech Tyfu Modelling Tool							
Based on V-Farm 31x47' tray size							
Microgreen	Ideal Weight of Seeds (grams)	Ideal Volume of Seeds (tbsp)	Germination time	Avg. Days to Harvest	Difficulty	Weight (g)	Price
Alfalfa			1-2 days	3-5 days	Hard	100	£4.95
Amaranth	116.6	11.7	2-3 days	10 days	Hard	100	£11.49
Arugula (Rocket)	116.6	11.7	2-3 days	8-12 days	Easy	100	£11.69
Basil	174.8	17.5	3-4 days	10 days	Easy	100	£8.49
Beet	218.6	43.7	3-4 days	8-12 days	Intermediate	100	£8.49
Broccoli Sprouts	218.6	21.9	2-3 days	8-12 days	Easy	100	£1.99
Butterhead Lettuce			3-5 days	10-12 days	Easy	100	£0.99
Cabbage	218.6	21.9	1-2 days	8-12 days	Easy	100	£0.80
Chard			2-5 days	8-12 days	Hard	100	£8.49
Chives			7-14 days	21 days	Hard	100	£10.50
Cilantro (Coriander)	276.8	54.3	7-14 days	21-28 days	Hard	100	£8.49
Fennel	218.6	21.9	3-4 days	12 days+	Hard	100	£1.42
Kale	218.6	21.9	2-3 days	8-12 days	Easy	100	£4.19
Leek Microgreen	276.8	33.5	3-4 days	8-12 days	Easy	100	£12.00
Mint			4-5 days	10-15 days	Easy	100	£7.49
Mustard	218.6	21.9	1-2 days	8-12 days	Easy	100	£7.99
Parsley			6-7 days	14 days+	Hard	100	£7.49
Pea Shoots	1,457	121.7	2-3 days	8-12 days	Easy	100	£5.50
Radish	291.4	29.1	1-2 days	5-12 days	Easy	100	£8.49
Red Leaf Lettuce			3-5 days	10-12 days	Easy	100	£0.99
Romaine Lettuce			3-5 days	10-12 days	Easy	100	£0.99
Sorrel	218.6	21.9	1-2 days	10-12 days	Hard	100	£12.49
Spinach			2-3 days	8-12 days	Easy	100	£1.39
Sunflower Sprouts	728.5	109.3	2-3 days	8-12 days	Intermediate	100	£0.99
Watercress	218.6	21.9	3-4 days	8-12 days	Easy	100	£5.50
Wheatgrass			2 days	8-10 days	Easy	100	£1.95

**d. HERBS FROM WALES** - email dialogue with owner Phil Mansfield on April 6th, 2022  
<https://herbsfromwales.co.uk/hydroponics/>

Herbs from Wales are a small and financially viable horticultural enterprise in North Wales growing a variety of herbs, salad crops and other vegetables in the field, and hydroponically and aquaponically in polytunnels. We gleaned the following information from them:

- Their most successful hydroponic crops are: lettuce, tomatoes, courgettes and dwarf French beans.



- move the salads to match the changing temperature. In the tunnel
- Lettuce is grown all year round so depending on the type of lettuce the time from planting (seed) to crop can vary from 35 days in the summer to 90 days in the winter.
- Tomatoes get planted into the hydroponics in late March to crop from late June to October. Courgettes successively planted and harvested from April to November. Beans much the same as courgettes.
- All their polytunnels and greenhouses have to pay for themselves in terms of electricity for pumps and aerators, seeds, nutrients and replacements. However thus doesn't take labour cost into account
- There is little doubt that two dedicated people, with access to machinery and training on a 5 acres smallholding could make a very good living just marketing in the locality. If you add in eggs, honey and herbal remedies then it would do very well.
- Hydroponic units are always controlled by outside elements whether that be nature, economics or politics. The current elevated electricity price is going to impact hydroponic growing, unless it is run by solar power alone and this will profit margins rather tightly.
- To make a living from hydroponics would involve a large investment in equipment and training.

## 4. Website links

### Companies/Organisations Linked To CEA Project

Lettus Grow: Based in Bristol – provide Aeroponic systems and containers.

<https://www.lettusgrow.com/about-us>

A summary of the Welsh CEA Project from them

<https://www.lettusgrow.com/blog/vertical-farming-social-impact-project>

UK-Based; provide complete growing systems, variety of scales -no production figures

<https://growstack.co.uk/>

<https://growstack.co.uk/our-solutions.html>

Make grow-walls and aquaponic pods, based in Liverpool, run training, and have own underground urban farm.

<https://farmurban.co.uk/>

Based in Bridgend – a small new company, mainly project management.

<https://www.digitalfarming.io/>



Manufacture lighting for the CEA Projects

<https://www.gecurrent.com/inspiration/current-supports-welsh-community-with-arize-horticulture-lighting>

### **Small-Scale Hydroponic Producers In Wales** (also see links on p.31)

Small-Scale microgreens in Brecon Beacons sell direct and to restaurants

[http://growninwales.co.uk/giw\\_grower/dragon-microgreens/](http://growninwales.co.uk/giw_grower/dragon-microgreens/)

<https://foodinnovation.wales/directory-entry/dragon-microgreens-ltd/>

Microgreens production in Cardiff using rinse and return glass jars for direct customer sales

<https://urban-vertical.org.uk/markets>

Small scale commercial microgreen production in Newport

<http://veggie-confetti.co.uk/>

<https://www.microacreswales.co.uk/>

### **Larger-Scale Hydroponic Producers, Consultants/Manufacturers**

Grow-Up farms, large scale producers

<https://www.growupfarms.co.uk/>

Large scale equipment manufacturer

<https://cambridgehok.co.uk/news/how-much-does-vertical-farming-cost>

Interesting overview ideas

<https://startups.co.uk/business-ideas/urban-farming/>

Description of large-scale underground hydroponics in London

<https://ww3.rics.org/uk/en/journals/land-journal/inside-the-underground-hydroponics-farm-in-london.html>

Based in Coventry – produce a range of hydroponic systems;

<https://v-farm.co.uk/>

Research, networking funding mostly larger scale, based in Cambridge UK

<https://www.agri-tech-e.co.uk/our-impact/agri-tech-innovation-ecosystem/controlled-environment-agriculture-from-glasshouse-to-vertical-farm/>

Article about commercial hydroponics in the UK

<https://www.fwi.co.uk/arable/crop-management/why-vertical-farming-is-growing-in-the-uk>

These make hydroponic systems of various sizes

<https://www.londongrow.com/pages/commercial-farming-and-vertical-farming-design-services>



U.S. Company dealing in all types of hydroponics – including containers

<https://cultivatd.com/services/brokering/container-farming/>

Vertical grow walls used on a commercial scale

<https://www.tendercare.co.uk/photo-albums/4/living-walls-vertical-gardens>

### **Horticulture Policies, Advice and Support In Wales**

About Business Wales 'clusters', including 'Nutri-Wales' which Supports hydroponics

<https://businesswales.gov.wales/foodanddrink/growing-your-business/clusters>

Future Foods based at Aberystwyth University

<https://www.futurefoods.wales/>

Business advice – based in Anglesey and Bridgend

<https://www.bic-innovation.com/what-we-do-for-businesses/funded-programmes/>

Article about large scale hydroponic strawberry growing in South Wales

<https://www.hortweek.com/s-a-produce-takes-south-wales-glasshouses-strawberry-production/fresh-produce/article/1171400>

Support for commercial horticulture in Wales

<https://www.tyfucymru.co.uk/knowledge-hub/>

Support for Food Businesses in Wales

<https://menterabusnes.cymru/cywain/en/home/>

Hydroponics industry association

<https://vertical-farming.net/>

### **Marketing ideas and Advice**

Four strategies for marketing local food

<https://www.cspdailynews.com/general-merchandise/four-strategies-marketing-local-foods>

Trading for Success, Plunkett Foundation, Michaels & McCartney

[https://plunkett.co.uk/wp-content/uploads/Trading\\_for\\_Success.pdf](https://plunkett.co.uk/wp-content/uploads/Trading_for_Success.pdf)

Marketing strategies for fresh fruit and vegetables

<https://smallbusiness.chron.com/marketing-strategies-fresh-fruits-vegetables-66635.html>

Strategies for marketing fresh local produce

<https://www.thepacker.com/opinion/try-these-strategies-promote-local-summer-produce>

Selling produce at a farmers' market

<https://www.fwi.co.uk/business/diversification/so-you-want-to-sell-produce-at-a-farmers-market>



Small-scale farming overview

<https://www.fwi.co.uk/careers/micro-farming-little-farms-with-big-profits>

Small-scale microgreen producers in Wales – marketing ideas

<https://www.facebook.com/tyfur.tyddyn>

<https://www.facebook.com/hashtag/verticalfarming>

<https://www.facebook.com/hashtag/microgreenswales>

<https://www.facebook.com/hashtag/microgreensgwynedd>

<https://www.facebook.com/hashtag/microgreens>