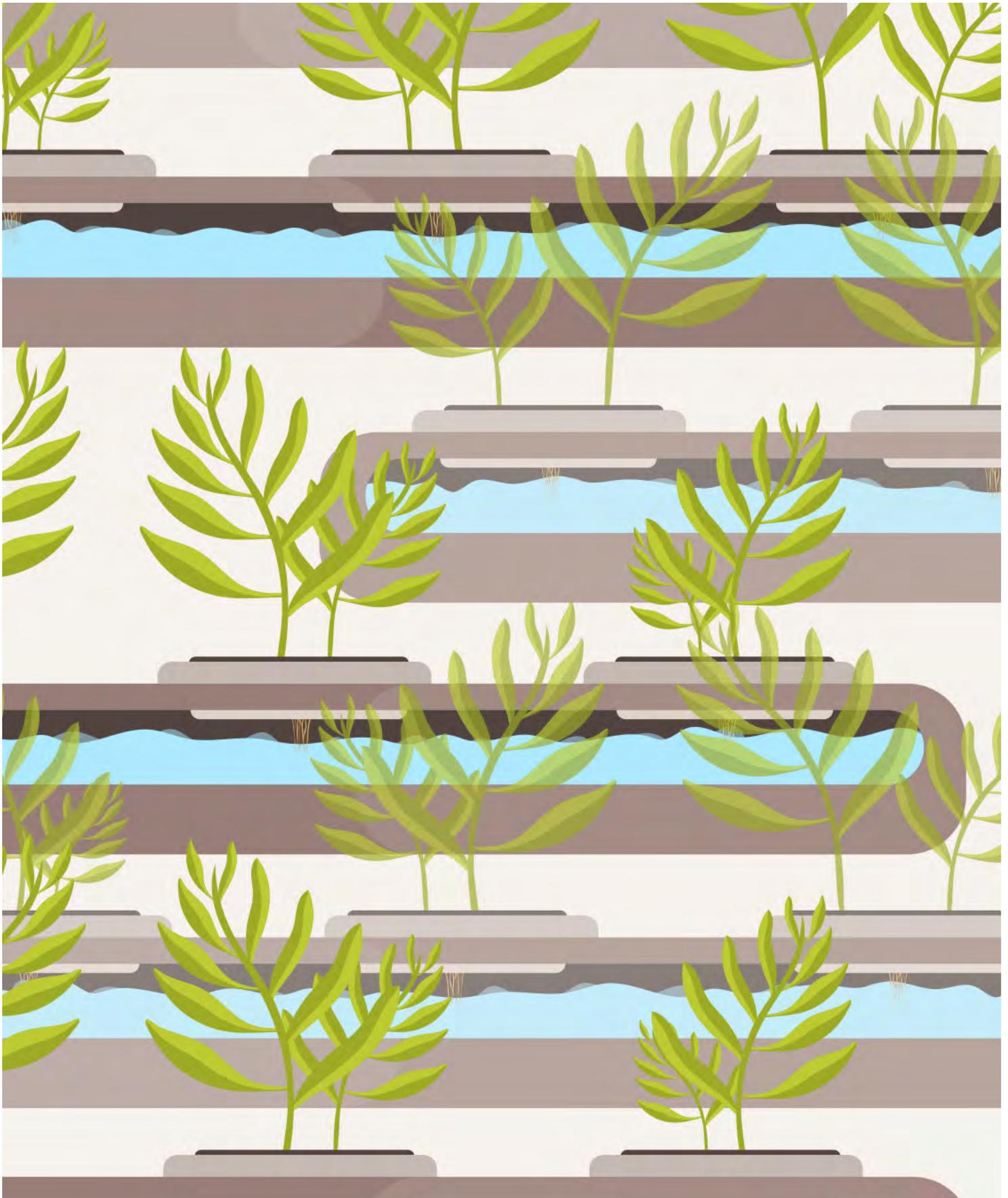


UK Rural - Autumn 2019

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SPOTLIGHT
Savills Research

Controlled Environment Agriculture



Technological innovation • Ways to invest • Food and water security

Demand for artificial growing

Technological innovation and climate change are driving the market for controlled environment agriculture (CEA)

Technology is enabling a new generation of growing systems to become commercially viable. Growing plants indoors is not exactly a novel concept, but technological innovation has achieved both dramatic and continuing incremental improvements in growing efficiency that make artificial growing systems increasingly attractive to growers and investors alike.

More than £56 billion has been invested globally in agritech since 2012, but Savills is predicting that the 2020s is the decade when “agritech” will become mainstream.

Market evolution

There are a series of external factors that are combining to drive interest in CEA systems in the UK.

High labour costs are common in field work for delicate and perishable fresh horticulture, with this type of work coming under increasing pressure from labour shortages. Climatic disruption has recently highlighted how exposed UK fresh produce supply chains are to just-in-time imports, and high levels of waste are becoming an increasing policy and resource concern, as well as being a drag on productivity. Increasing focus on resource

efficiency in inputs and wastage creates greater demand for the ultimate precision growing systems. Technological innovation in CEA is the result.

Reliance on imports

Domestic production of fruit and vegetables has almost doubled in the UK since 2000. But national consumption has increased by 138% in the same period, meaning imports have been forced to compensate with a 164% increase. While exports have almost quadrupled, the UK only produces around a quarter of its fresh produce needs, meaning there is still an enormous trade imbalance to target. As recent events have indicated, heavy reliance on imports is an increasingly significant risk to UK supply chains.

On-shoring supply chains is one solution to help mitigate this risk. Supply chains source fresh produce from other countries to meet consumer demand for non-seasonal supply, while contributing a nutritional advantage in ensuring the year round availability of fruits, salads and vegetables.

However, increasing domestic production of such produce through CEA systems has the potential to mitigate some of the UK's

food security risk, while respecting the water security status of the exporting countries at the same time.

Controlling ambient conditions and often operating in sterilised environments results in yields being optimised and processing costs reduced. This level of control means that risks from climatic variation and the effects of freak events such as the 2018 heat wave, are minimised or even completely eliminated.

Improving domestic production also reduces the UK's exposure to trading risks. With the “expected time between disasters” reducing, corporates are increasingly looking to mitigate their exposure to supply chain disruption. By growing more food on a reduced land area through vertical farming, buyers can mitigate some of this risk. It also has the potential benefit for consumers of avoiding price fluctuations that occur from international events.

Pricing in the growing risk of non-supply and also factoring in the environmental damage caused by our fresh produce trading partners creates a clear advantage in on-shoring production. However, getting the right business case for investment in CEA systems remains crucial.



55%

Of UK trading partners have worse environmental impact

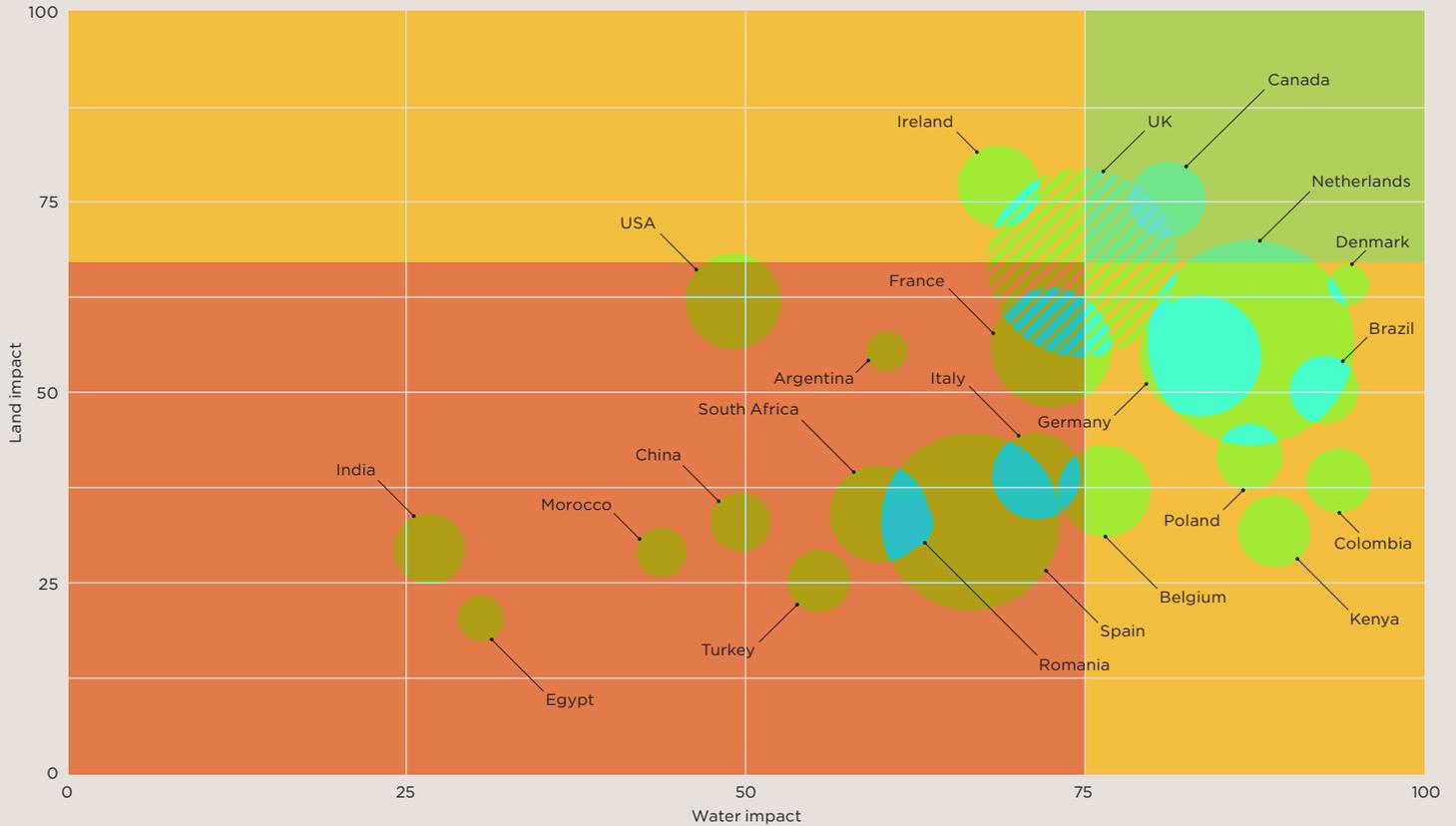
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Key UK trading partners in fruit and vegetables

£1.94bn

Value of vegetable imports from Spain

Environmental impact of fruit and vegetable imports into the UK



The size of the bubbles represents the value of imports coming into the UK from that nation. All nations included supply over £100 million worth of fruit and vegetables to the UK per year. The UK bubble is sized according to the value of domestic production. The bubbles are positioned according to land and water impact scores derived from the Economist’s Food Sustainability Index. A higher score indicates more sustainable practices in the corresponding area.

Source Savills Research, EIU, HMRC, Defra

Securing our food supply

The UK has a positive environment for sustainable agriculture but it is not being fully utilised

Savills Rural Research analysed a variety of datasets to better understand the environmental impact of food production in the UK compared to its main trading partners. The UK scores well for both land impact and water impact (see chart above). The score awarded to the UK for its environmental impact of agriculture on land is significantly better than average; 67 against an average of 40. Despite a higher global average score for water scarcity, the UK is still ahead; 75 against an average

of 69. However, only around a quarter of UK fruit and vegetable supply is derived domestically. The remainder is imported.

The majority of those imports (where value exceeds £100 million per year) are from just 28 nations. Such a poorly diversified supply network increases the risk posed by international events. Of the 22 nations where data is available, only Canada has water and land scores above that of the UK. Of our key trading partners, 55% are worse in both cases.

Given the UK possesses a relatively sustainable and robust agricultural system, on-shoring will be a key step in securing future food supply. But with around 70% of UK land area already dedicated to agriculture, this must be undertaken with diligence and intelligence. Complete self-reliance on food supply is not a realistic aspiration and is risky in itself, but in increasingly volatile circumstances, more could be done to develop UK food production.

👉 Given the UK possesses a relatively sustainable and robust agricultural system, on-shoring will be a key step in securing our future food supply 👈

“Spain exports nearly £2 billion worth of produce to the UK. However, CEA increasingly offers opportunities for the same produce to be grown in the UK”

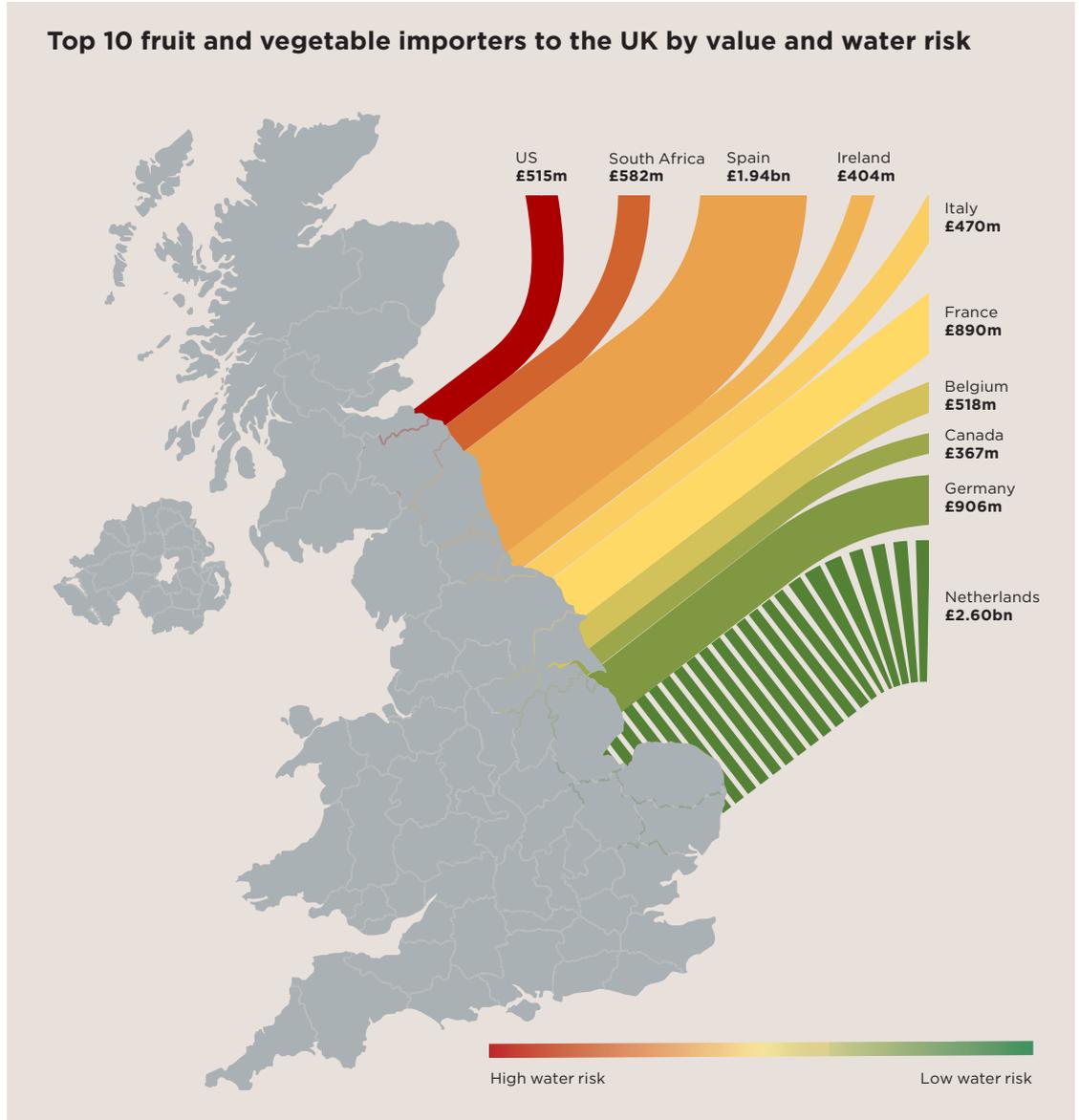
HOW TRADE FLOWS CAN BE DISRUPTED

Qatar imports around 90% of its food, something it became very aware of when its neighbours accounting for 33% of its food imports cut diplomatic ties. The blockade by Egypt, Bahrain, Saudi Arabia and the UAE cut off land and sea trading routes. While something of an extreme example, Qatar’s \$1.2 billion agricultural trade deficit is significantly less than the near \$6.3 billion deficit shown by the UK. Recent political events also show that those trade flows are not entirely invulnerable to disruption.

INVESTING IN SECURITY

Singapore only dedicates 1% of its 724 square kilometres to agriculture, meaning it only produces 10% of its total food requirements. The small island nation hopes to increase that to 30% by 2030 by investing over £120 million in research and technology. Thirty vertical farms already contribute to the near 12,000 tonnes of leafy vegetables grown each year. That will have to increase to over 30,000 tonnes to hit the target; an undertaking that will inevitably require further investments in agritech.

£14bn
Value of imported fruit and vegetables into the UK in 2018



Source Savills Research, HMRC, EIU

Exporting responsibility

Over half of the UK’s fruit and vegetables come from more water insecure nations than the UK itself

In 2018, the UK imported £14 billion worth of fruit and vegetables. The map above shows the top 10 nations of origin for those imports, which accounted for almost two-thirds of imports in 2018 (by value). Over half of that value comes from areas where water is scarcer than in the UK. Spain, where climate change and poor water infrastructure is hampering agriculture’s efforts to produce food, exports nearly £2 billion worth of produce to the UK. However, CEA increasingly offers opportunities for the same produce to be grown in the UK. Our data highlights another traceability concern with international

imports. Figures for the Netherlands as a producing country are good, but the “Rotterdam effect” misleads the true sustainability of imports coming from there. The port of Rotterdam serviced around 13.7 million containers in 2017, making it one of the busiest ports in the world. Despite the Netherlands appearing as both the largest and most secure importer, it is likely that an amount of that produce does not originate in the Netherlands. Instead, produce reaches the EU via Rotterdam and is then distributed from there. The security of these imports is therefore even more uncertain.

£56bn+ **87%**

Amount invested globally in agritech since 2012

Of people would buy a product with an environmental benefit

10

Nations provide two-thirds of UK's vegetable imports



Three ways to invest in vertical farming

1 Home-growing systems

Vertical farming is very flexible thanks to advances in modular set-ups, from kitchen based systems to window boxes and hydroponic loop garden greenhouses. Such modules are designed to be easily incorporated into a home, shop, restaurant or even the workplace. Installation now, when the market is still young, will have an undeniable novelty.

Vegetables picked fresh by customers from a futuristic indoor farm would make an ideal Instagram post for the experience-focused millennial crowd. The key to a good business here is ease of use for multi-taskers and the reliability of the crop, so subscription services for maintenance and new plants are key, as well as the smart use of sensors to help the system look after itself. Completely fresh produce that looks beautiful with guaranteed provenance will always be a winner.

2 Niche crops

Wasabi. Micro-herbs. Medicinal-grade cannabis under licence. These high value crops can now be grown in the temperate UK climate using CEA. Capital expenditure in infrastructure and growing systems will be higher due to the demands of the crop and the commercial scale of the market, so the key is finding the right location. Co-locating with sites generating surplus carbon dioxide and heat minimises costs, so this is of particular interest to anaerobic digester (AD) operators. Generally, converting older buildings is less satisfactory than building bespoke CEA greenhouses due to the need for biosecurity and well-designed automation and processing facilities. Institutional investment is available for certain crop markets.

Other niche crops that have been proven to flourish with hydroponic systems include a whole range of mint leaves, sorrell and baby leaf salads. These enterprises depend on proximity to market to preserve freshness, and so can be labour intensive in servicing customers. However, there can be demand from local caterers looking for unique flavours that have provenance and are grown by novel, sustainable methods.

3 Build a brand

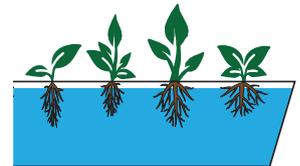
While the economics of fresh produce are still tipped in favour of outdoor and imported production, the other way to gain market position is to build a brand. There are existing operators in the market who are able both to sell the infrastructure and franchise the marketing opportunity to UK investors. This approach enables rapid access to mainstream supply chains in supermarkets and retailers. Building a brand from scratch takes time, consideration and energy, but promoting the benefits of CEA is likely to achieve a loyal following if done correctly.

Key environmental messages around the system will resonate with consumers, such as no pesticides, reduced food miles and efficient water usage. According to a 2017 Cone Communications study, 87% of consumers would buy a product with a social and environmental benefit if given the opportunity and 88% would be more loyal to the company. Two-thirds of millennials are already buying products with these things in mind. However, increasingly consumers are rejecting notions of “factory farming”, so it is vital that your brand of CEA growing system communicates on a human scale even if the technology is advanced.

DIFFERENT GROWING SYSTEMS

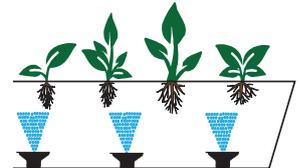
Vertical farming:

A form of controlled environment agriculture distinct due to its use of vertically stacked layers, each capable of producing crops.



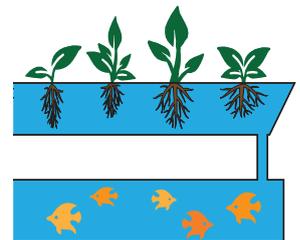
Hydroponics:

Plants are grown in the absence of soil by using a nutrient solution. Roots may be suspended within the solution or supported by pebbles, sand or other materials. Various forms exist including ebb-and-flow, deep water and continuous flow.



Aeroponics:

Plants are still grown in the absence of soil by using a nutrient solution. The nutrient solution is delivered as a fine mist to the roots that hang in suspension.



Aquaponics:

A form of hydroponics where nutrients are provided through the waste products of aquatic creatures. Plant growth purifies the water in turn.

95%

Amount by which hydroponics can reduce water usage

“Utilising waste resources reduces input costs, but also enhances the positive image of associated brands”

Keeping an eye on costs

With the margins on offer and the ability to optimise growing conditions, even small improvements can produce major advantages in productivity returns. These are the key issues to consider in planning a CEA investment

1 Energy
Controlling growing conditions is energy intensive. Lighting, heating and water pumping costs are required to maintain optimum growing conditions, and these have to offer a return over and above the use of natural light and outdoor irrigation or rain-fed systems. Creating the optimal micro-climate through cooling, dehumidification and carbon dioxide control uses energy but enhances yields, and the smartest CEA systems automatically adjust internal conditions in response to external changes in sunlight levels and temperature.

Research shows that in the worst case scenario, energy costs can account for two-

thirds of variable costs, but there are ways of offsetting this. Investing in efficient LEDs reduces both lighting costs and cooling costs as less waste heat should be produced by more efficient systems. Co-locating with any industrial system producing waste heat and carbon dioxide, such as an AD plant, internet server or a boiler room in a commercial property is advantageous. Utilising waste resources reduces input costs and enhances the positive image of associated brands.

2 Labour
CEA offers a number of labour advantages over field systems. Firstly, automation offers an increasingly attractive solution to

labour-market challenges, as outdoor work in variable conditions becomes less desirable for the migrant workers who have been relied on. Field conditions can be very tough on robots, and although high humidity glasshouses are also not ideal, conditions are at least consistent.

Secondly, growing and processing equipment in CEA systems can account for around 45% of establishment costs, so designing this to get the most from your labour or automation system is crucial and a major opportunity to be more efficient than field systems. Treating the CEA facility as a manufacturing process can create an efficient layout and the opportunity to standardise workflows to maximise output.



50%

Of total cost for a vertical farm is spent on utilities

17

The UK's largest vertical farm is 17 storeys high

£6.50

Price per sq ft for warehouse space in the "Golden Triangle"

In all situations, progressive employers need a clear strategy to attract and retain reliable, capable workers with the correct skills and knowledge. Vertical farming is a new industry so this can be more difficult than it seems.

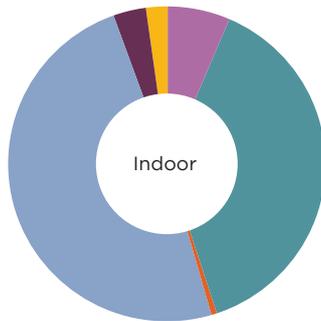
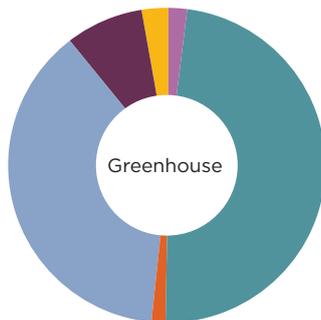
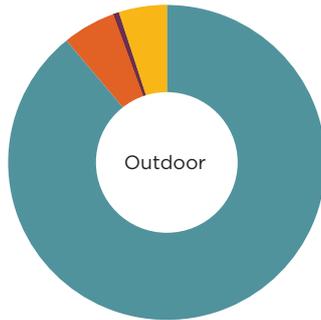
3 Technology
Technology is the modern solution to any problem. However, technological solutions must be applied with due consideration. Automation, for example, could replace the need for pickers and graders for produce. But it is only part of the solution and most systems will still require a bespoke solution at substantial capital outlay, as well as the need to have technicians to operate and maintain the system.

The scale required to justify the investment may need several growers to come together to fund the innovation. For most CEA systems, marginal improvements in productivity will be justified due to the exclusion of normally uncontrollable climatic variables. Sensors and software to automate the growing environment according to the needs of the crop can therefore present a beneficial return on investment, whereas in field systems these investments are questionable.

To succeed over conventional production, vertical and urban farming rely on maximising technology. Do not shy away from spending where the benefits are proven, such as more efficient LEDs or CO2 enrichment.

4 Rent
Rental levels for warehouse space vary dramatically across the country. Savills research shows that inner London areas such as Park Royal would command rents of at least £15.50 per sq ft, whereas areas around the Midlands would achieve £6.50 per sq ft. The Midlands is the UK supply chain's "Golden Triangle" where many of the major grocers locate their national distribution centres, so building next to one makes much more sense. Similarly, a rural location benefiting from an AD plant could potentially offset energy costs, but most barns are not suitable for conversion to high-grade CEA systems. That being said, including a vertical farm in an existing urban location can be worthwhile. Given the flexible nature of the technology, a modular unit can be set up on a rooftop, in a basement or somewhere in between. This way the building enhances its use of space and excess heat can be used to further offset energy costs and meet corporate social responsibility obligations.

Growing costs
Farming types compared



- Capital and infrastructure
 - Labour
 - Seeds
 - Utilities
 - Nutrients
 - Manufacture
- Source Deloitte

Costs associated with CEA are significantly different from broadacre cropping. Utilities become a significant outgoing. While costs are higher, yields can be optimised through CEA systems.



OUTLOOK FOR VERTICAL FARMING

Vertical farming is still a fledgling industry. Investors should be cautious of unnecessary capital investment and flawed business models. However, the industry is already worth around £1.5 billion globally and is predicted to grow to around £8 billion by 2025. The majority of investment has been in improving technology as opposed to setting up operational and well established businesses. A focus on climate adaption, food security and resource efficiency is likely to drive more demand for CEA systems over outdoor cultivation,

producing some clear winners and losers in business models and service providers. Early adopters need to keep a clear eye on markets and returns on investment in considering diversifying into CEA, whereas landlords looking to partner with a CEA tenant need to ensure that the business has a good understanding of costs and supply chains. Either way, a robust and well considered venture is the ultimate key to success.

£1.5bn

The current value of the vertical farming industry globally, predicted to grow to £8 billion by 2025



Savills Research

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