



Humber
Tech
Park

Greenhouse Benefits Report



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1. Brief

This report sets out the impact on the food chain of a greenhouse as part of the development of the Humber Tech Park.

The glasshouse is proposed, as in figure 1 below, to be developed to the east of the Data Centre, using heat from the district heating unit. The site will be landscaped and include multiple areas of enriched bio-diverse land uses including hedges, woodland areas and wildflower meadows, as well as new wetland habitats.

The total site is 200 acres (80 hectares) and currently used for arable production. The proposed glasshouse is 7 acres (~2.8 hectares), with this scale of development used to undertake the assessment of the impacts of the proposal on food production relative to its current use. However, there is potential to expand the glasshouse area if required with land and heat available to support a larger area of intensive crop production.

This report covers:

- The agricultural baseline of the site as it is currently used for arable production.
- The potential benefits of a 7 acre (~2.8 hectare) greenhouse.
- How the development aligns with policy related to agriculture and horticulture.

Figure 1 – Site Masterplan showing Glasshouse Position¹



¹ Source: Humber Tech Park Ltd.

2. The Agricultural Baseline of the Humber Tech Park Site

The agricultural baseline of the site has been assessed based on the Humber Tech Park development leading to the following changes:

- The development will use a 200 acre (circa 80 hectare) site currently in arable crop production to create a data centre, linked greenhouse and associated green infrastructure. This will convert all of this grade 3a arable land to a new use.
- This will mean that the current crop production on the site and the linked economic outputs (value of crop, supply chain spending and jobs) this creates will be lost.
- The development will also remove the negative externalities associated with arable crop production, including for example nutrient leaching.

This section of the report looks at each of these issues and estimates the impact ceasing agricultural production on the site will have on food production, the economy and the environment.

a. Best and Most Versatile (BMV) Land

The Best and Most Versatile land (BMV land) is defined as Grade 1 to 3a on the national agricultural land classification (ALC) framework².

The policy is designed to see BMV land as a national resource which should be protected in most cases due to its value to agriculture. However, as shown in this report the greenhouse should offset the losses to agriculture, both in terms of crop size and value, with substantially more jobs supported across the economy.

The land at the Humber Tech Park is a mix of grade 3a and grade 3b³:

- Grade 3a: 23.9 Ha
- Grade 3b: 52.2 Ha

Whilst grade 3a falls within the policy parameters of BMV land, grade 3a is not as versatile or productive as grades 1 and 2. Grade 3a is defined as:

- Subgrade 3a – good quality agricultural land - *Land capable of consistently producing moderate to high yields of a narrow range of arable crops, especially cereals, or moderate yields of crops including: cereals, grass, oilseed rape, potatoes, sugar beet, less demanding horticultural crops.*

² <https://www.gov.uk/government/publications/agricultural-land-assess-proposals-for-development/guide-to-assessing-development-proposals-on-agricultural-land>

³ Amet Property (2024), Agricultural Land Classification report: Humber Tech Park

Grade 3b is not covered by the BMV rules and is defined as:

- Subgrade 3b – moderate quality agricultural land - *land capable of producing moderate yields of a narrow range of crops, principally: cereals and grass; lower yields of a wider range of crops; high yields of grass which can be grazed or harvested over most of the year.*

Whereas grade 1 land supports intensive crops such as fruit, salads and ornamentals which can have output values 3-10 times (or more) the average for all crops:

- Grade 3a land in North Lincolnshire is typically used for a mixed arable rotation of cereals, oilseeds with occasional lower value field vegetables crops (e.g. some brassicas) or potatoes.
- Grade 3b land in North Lincolnshire is typically used for ‘broad acre’ cereal and oilseed crops or grassland.

From the maps reproduced in the detailed soil survey report (Amet Property 2024) it is clear that the land is predominantly grade 3b with pockets of grade 3a around the edges and in one small irregular shaped strip through the centre of the site.

Given this and the fact that modern farming will only grow one crop in a whole field, our conclusion is that the crop choice will be based on the majority land type, i.e. grade 3b, with a mix of cereals and combinable crops and potentially some grassland.

This means that the average value of output on the Humber Tech Park site is that typically associated with ‘broad acre’ arable crop rotations, which are dominated by cereals, pulses and oilseeds.

b. Baseline of Agricultural Production

Given the location and land type, the predominant crop will be feed wheat, which has been used below to illustrate the economics and food production potential if the land was to remain in arable production. Other crops in the rotation are likely to include barley, oilseeds, pulses and potentially occasional use for higher value crops such as potatoes or field vegetables.

Wheat is used as a proxy as it is will typically cover 40-50% of the land area on this land type and in this location, and whilst some crops are worth more (e.g. potatoes) they will normally only be grown at most 1 year in 6 or less (for rotational reasons to break crop pest and disease cycles), with lower value crops such as pulses or oilseed rape completing the rotation. The output from wheat is thus a good proxy for the average value of crop output, costs and labour requirements for a typical arable crop rotation. Developing the site so that arable cropping stops is projected to have the following impacts on agricultural output and margins:

Table 1 - Loss of Arable Cropping Potential

Parameter	Change in output or costs	Metric
Arable crop output reduction	80 hectares at average yield of 8.6 tonnes per hectare ⁴ Plus 80 hectares of straw in swath	688 tonnes fall in cereal production 200 tonnes of straw
Arable crop value reduction	Current prices as at March 2024 (Nix 2023) ⁵ , straw price as per Nix (2023)	£130,281 ⁶ fall in the value of crop grown
Input costs to support this level of production	80 hectares at £908/hectare (Nix 2023), for:	£73,000 less spent with suppliers
Fall in the margin generated by farming	Value of crop minus the costs of inputs	£57,281 reduction in farm gross margin

To put these figures into context:

- 688 tonnes of wheat is only circa 0.04% of the total wheat crop grown in Greater Lincolnshire/UK Food Valley in a typical year⁷, grown on 0.01% of the farmed area of Greater Lincolnshire which is 572,000 hectares (DEFRA 2023 data⁸).

⁴ John Nix, Farm Management Pocketbook 2023 (53rd edition)

⁵ Prices as at 20th March for 5th May 2024 delivery [Cereals and Oilseeds markets | AHDB](#)

⁶ Wheat 688 tonnes at £169/tonne and 80 hectares of straw at £173/hectare

⁷ Greater Lincolnshire and Rutland has over 205,000 hectares of wheat production – DEFRA BPS data 2023

⁸ DEFRA (2023), Crop areas in England sourced from the Basic Payment Scheme

- This level of farm output represents 0.005% of the value of total farm output in the Greater Lincolnshire/UK Food Valley, which is estimated at £2.5billion per annum.

This level of reduction in arable production will have only a negligible impact on the jobs supported in agriculture and the supply chain locally and regionally.

For most types of crops grown on grade 3 land the added value processing and supply chain multipliers are low. For example, wheat grown on grade 3 land is typically used in the UK (or exported) for animal feed, with added value being low as the crop is only lightly processed.

In a typical year the UK also has an export surplus of feed wheat and so this depresses UK market prices (which have to be set at 'export parity'). Small reductions in the output of these crops are thus not a strategic priority for UK food supply.

Table 2 sets out estimates for the jobs supported on farm and in the pre farmgate (input supply) and post farmgate (added value processing, transport and marketing) parts of the supply chain.

Table 2 – Loss of Jobs Associated with Land Use Change

Parameter	Change in jobs supported	Metric
Farm production	Based on a ratio of 1 FTE worker per 600 acres for a modern fully mechanised combinable crop arable farm	-0.35 jobs
Input suppliers	Based on the supply of seed, fertilisers, sprays worth £73,000 (table 1) plus fuel worth £5,200 (from work on the AHDB 2012 Cereals and Oilseeds Carbon Footprint calculator development ⁹)	-0.2 jobs
Added value processing and supply chain	Based on feed wheat for livestock, with minimal processing, storage and transport	-0.1 jobs
Total of jobs 'lost' by cessation of arable production		-0.65 jobs

Our assessment is therefore that the current land use, arable crop production on grade 3 land, supports 0.65 jobs in the local and regional economy.

The change in land use would thus lead to the elimination of this part time equivalent job role, but in a farming sector which in Greater Lincolnshire employs 14,407 employees¹⁰ and over 75,000 if including the whole food chain¹¹, the impact on jobs supported is negligible at the sector level.

⁹ [Development of a carbon footprint protocol for the UK cereals and oilseeds sector | AHDB](#)

¹⁰ Farm employment in Greater Lincolnshire 2021, from DEFRA June Census of Agriculture datasets

¹¹ UK Food Valley data

c. Environmental and Bio-diversity of Agricultural Production

Whilst the current use of the site is not devoid of biodiversity and eco-system services, intensive arable production means the delivery of eco-system services will be limited on this land.

The LandIS soilscape for the site (Table 3) shows the development to be located on a flat coastal plain with loamy and clayey soils which are subject to being wet and suitable for grassland, some cereal production and woodland.

Table 3 – Soilscape type for the Humber Tech Park (adapted from LandIS, the Land Information System)¹²

<p>Soilscape 18: Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils</p>
<p>Texture: Loamy and clayey</p> <p>Coverage: England: 19.9%, Wales: 2.4%, England & Wales:17.5%</p> <p>Drainage: Impeded drainage</p> <p>Fertility: Moderate</p> <p>Landcover: Grassland and arable, some woodland</p> <p>Habitats: Seasonally wet pastures and woodlands</p> <p>Carbon: Low</p> <p>Drains to: Stream network</p> <p>Water protection: Main risks are associated with overland flow from compacted or poached fields. Organic slurry, dirty water, fertiliser, pathogens and fine sediment can all move in suspension or solution with overland flow or drain water</p> <p>General cropping: Mostly suited to grass production for dairying or beef; some cereal production often for feed. Timeliness of stocking and fieldwork is important, and wet ground conditions should be avoided at the beginning and end of the growing season to avoid damage to soil structure. Land is tile drained and periodic moling or subsoiling will assist drainage</p>

Our expectation is that the landscaping proposed around the development will have substantially more biodiversity than the current arable use, which will be explored in summary in section 3 of this report, but here we assess the potential impacts on the environment from the current use of the site for arable production.

¹² [LandIS - Land Information System - Soilscales soil types viewer](#)

Potential environmental impacts associated with arable production include:

- Soil condition - as arable machinery has increased in size this has led to problems with soil compaction and soil erosion:
 - Our assessment is that on this site soil erosion will be low because rates of soil erosion are driven primarily by topography with slopes increasing erosion and 'lighter soils' such as sand, some light silts and peats being more prone to wind erosion. As a flat site with clayey and loamy soils the potential for erosion will be low.
 - However, as a clayey/loamy soil with a high water-table and seasonally wet land, the ground will be very susceptible to compaction in arable cropping. Compacted soil can lead to problems with drainage and has low air content, which in turn lowers soil bio-diversity and rooting depth.
- Crop protection – the use of crop protection products to control pests and diseases will mean lower bio-diversity than would be found in lower intensity land uses such as seasonal wildflower meadows.
- Energy use – the cultivation of arable crops will use 5,200 litres of diesel per year for crop production activities on the field (65litres/hectare on 80 hectares).
- Carbon emissions – there are four main sources of carbon emissions associated with wheat production, with work by the Agricultural and Horticultural Development Board (2011)¹³, showing that for cereals crops such as wheat, emissions were concentrated in:
 - Fossil fuel use for fertiliser production – 37%
 - Nitrification of fertilisers once applied – 36%
 - Field energy use (diesel) – 8%
 - Agrochemicals – 8%
 - Other (grain drying, transport of grain, crop residue management) – 11%
- Fertilisers – the analysis of carbon emissions shows that fertiliser use, both its production and breakdown in the field is the emissions hotspot in wheat production. However, the impacts of fertiliser also include its impact on water quality with work showing that:
 - Arable production results in nutrient loss from fertiliser and spray leaching, thus impacting water quality e.g. arable land typically has a surplus of 95kg/ha of nitrogen¹⁴, which is lost to the environment.

¹³ [Development of a carbon footprint protocol for the UK cereals and oilseeds sector | AHDB](#)

¹⁴ <https://www.gov.uk/government/statistics/uk-and-england-soil-nutrient-balances-2021/soil-nutrient-balances-uk-2021-statistics-notice>

3. Potential Impacts of the Greenhouse

a. Basis of Assessment

This section of the report reviews:

- The strategic case for greenhouse production
- Production potential of a greenhouse growing the UK's largest greenhouse crop, tomatoes
- The potential to produce other crops
- The potential to use other types of Controlled Environment Agriculture (CEA)
- The environmental and health benefits of greenhouse crops

b. The Case to Increase UK Greenhouse Production

The case for intensive crop production horticulture to expand is compelling when it is realised¹⁵ that:

- The value of UK horticulture has grown by 45% from 2012-'22 to £4.3billion.
- However, the total market size is now over £10.7bn after allowing for imports (£6.6bn in 2022 and up by 18% from 2012) and exports (£0.2bn in 2022 and down by 4% from 2012).
- Only 40% of UK domestic demand for horticultural products is met by UK suppliers by value. However, the 40% figure hides the fact that at individual category level, UK self-sufficiency is often a lot lower: only 10% for cut flowers; only 15% of fruit; and, 35% of salads.
- This creates a large opportunity for import substitution, which means any gains in output do not displace other UK production, but displace imports, and the economic benefits generated are thus a net benefit to the UK economy.

Moreover, UK agriculture (the NFU, as well as some UK supermarkets) has committed to a 2040 net zero target¹⁶. Protected horticulture, when compared to overseas protected cropping's reliance on natural gas¹⁷, higher transport emissions, and diminishing natural water resources¹⁸, can deliver potentially large CO2e and environmental benefits by reshoring protected cropping in the UK.

¹⁵ DEFRA (2023), Basic Horticultural Statistics [Latest horticulture statistics - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/statistics/latest-horticulture-statistics)

¹⁶ [NFU | Net Zero and Agriculture](#)

¹⁷ The Netherlands, the second largest supplier of horticultural fresh produce to the UK after Spain, used natural gas CHP to heat 2/3rds of their greenhouse sector, with cogeneration of electricity, producing 8% of the Dutch Grids electricity demand. [Nederhoff, E | Crophouse Ltd | 2022 | Energy Benchmarking in Covered Cropping](#)

¹⁸ [HortiDaily | 2022 | Spanish Greenhouse Construction Stopped Because of Water Shortage](#)

The CO₂e savings of UK production over imports in particular can be large, and as evidenced by Swinn (2017)¹⁹ can be as high as a 10 to 1 LCA CO₂e differential in favour of UK produced premium cut flower bouquets compared to imports from Africa.

Suitable crops to grow the UK greenhouse sector are those which have a high import value and quantity, and where UK production can be shown to be more environmentally sustainable.

c. Greenhouse Production Potential

The greenhouse (or vertical farm) linked to the data centre could grow a wide range of intensive crops using (low carbon) waste heat, but to simplify the analysis and to give an overview of what might be possible one crop²⁰, tomatoes, has been used to illustrate the parameters for this crop. Tomatoes have been chosen as they are the largest UK greenhouse crop, have high levels of imports (table 4) and high value (table 5). This allows expansion in UK production without displacing economic activity elsewhere in the UK.

Table 5 also demonstrates that tomatoes have a net import demand throughout the year, with no month where the UK becomes a net exporter, or where the net import volume falls dramatically. This is in contrast to alternative crops, including berries and lettuces, which experience lower import volumes (including net export volumes for some sub-types e.g. strawberries) during the later summer months as UK outdoor supply is in season.

Tomatoes therefore provide a crop with year-round import substitution potential. This means that they are priced at ‘import parity’ (i.e. global market price plus transport), instead of ‘export parity’ (global market price minus transport), as is the case with a crop which is net exported. This improves UK commercial returns.

Table 4: UK Imports of Tomatoes (Fresh and Chilled) (2019-2023)²¹

Exporter	Imported quantity, Tons		
	2021	2022	2023
World, of which:	323,028	388,986	368,560
• Netherlands	122,038	124,167	129,418
• Morocco	110,846	144,316	125,622
• Spain	66,212	73,380	67,933
• Belgium	7,625	23,976	21,894

¹⁹ Swinn, R. (2017) “A Comparative LCA of the Carbon Footprint of Cut-Flowers: British, Dutch, and Kenyan”. MSc Thesis, Environment and Development, Lancaster University.

²⁰ In the full report in April 2024, a wider range of crops and production systems (e.g. venlo, higher greenhouses, vertical farm) will be modelled

²¹ [International Trade Centre | 2024 | List of supplying markets for a product imported by United Kingdom | Product: 0702 Tomatoes, fresh or chilled](#)

Table 5: Trade in Tomatoes, fresh or chilled (adapted February 2023-January 2024)²² - 0702
Tomatoes, fresh or chilled

Month	Net Imports		
	Tonnes	£million	£/kg
February 2023	25,045	£44.6	£1.78
March	33,252	£63.2	£1.90
April	30,164	£57.9	£1.92
May	34,999	£53.0	£1.52
June	35,830	£49.4	£1.38
July	32,462	£42.7	£1.32
August	29,813	£40.9	£1.37
September	26,559	£39.1	£1.47
October	29,175	£47.7	£1.63
November	30,529	£53.9	£1.76
December	29,017	£55.2	£1.90
January 2024	36,195	£64.7	£1.79
Total Feb '23-Jan '24	373,041 tonnes	£612.4million	£1.64

The basic parameters for a tomato crop in a high-tech greenhouse are set out below, assuming 7 acres (2.8hectares) of production.

Tomatoes output and jobs:

- Output – average of cherry (307tonnes /hectare) and large salad tomatoes (933tonnes /hectare)²³ tomatoes, suggests an output of 1,736 tonnes per year.
- Turnover and value of crop – 1,736 tonnes at an average at £2,000/tonne (some crops could be double this) gives a conservative crop output value of £3.47million (or c.£2.85 million at the average import price/kilo which is lower than average UK prices due to differences in the balance between cherry and salad tomato types).

²² [HMRC | 2024 | UK Trade Info | Custom Table | 0702 Tomatoes, fresh or chilled](#)

²³ KWIN (2019). Kwantitatieve Informatie voor de Glastuinbouw 2019. Raaphorst & Benninga. Raaport WPR-899. Wageningen University & Research, The Netherlands.

- Jobs – circa 28 FTE jobs (at 10 per hectare assuming 20% lower/hectare than the UK market leading grower due to creating a new build greenhouse with state-of-the-art production systems).
- Supply chain input costs – these would vary between crops, but typically could be expected to be £2.25m (65% of gross output value). This expenditure would support a further 5 FTE UK jobs (to provide seeds, packaging, energy etc, some of which are imported thus reducing UK jobs supported by this level of input spend).
- Added value food chain – in marketing, distribution and processing, is estimated at a further 5 FTE jobs (could be (much) higher for some crops depending on the degree of processing before final sale).

Tomato production in a 7 acre (circa 2.8 hectare) greenhouse would thus be expected to support a total of:

- Circa 38 jobs across the supply chain (28 on site and 10 offsite).

Vehicle movements:

- Wheat:
 - Car movements to and from the field are negligible to grow a wheat crop (~10 occasions per year to check crop growth).
 - Tractor and sprayer movements to grow the crop are estimated at 15, plus 34 for harvest (688 tonnes/20). Total vehicle movements = circa 60/year or 0.16/day.
- Tomatoes:
 - Car movements assume, an average of 16 worker vehicles per day (from 28 FTEs employed on site, allowing for holidays, weekends, lift sharing), 7 days per week, x 2-way flow = circa 11,680 per year, or 32 per day, but most before 7am or 3-4pm (as the sector starts and finishes early due to supermarket delivery schedules).
 - Lorries would transport more than the 1,736 tonnes of crop output, as the crop needs inputs and packaging, so assuming 2,500 tonnes per year moved, this equates to 125x 20 tonnes per year. However, in practice a lorry per day is needed during harvest, so the total lorries per year is likely to be at least 300 x 2 (in and out of the site) or 1.65 movements per day.

d. Comparison of Tomatoes to Existing Arable Production

Table 6 (below) sets out a comparison of the relative tonnes and value of crops produced by 200 acres of wheat or 7 acres of tomatoes. It also shows how many jobs each crop would support and how many vehicle movements would be generated per day by different crop options.

Table 6 - Comparison of 7 acres of Tomatoes and 200 acres of Wheat Production

Parameter		Baseline wheat	Greenhouse tomatoes	Difference
Tonnes of food produced		688 tonnes wheat 200 tonnes straw	1,736 tonnes	X 2.5
Value of crop output		£130,000	£3,470,000	X 27
Jobs supported		0.65 FTE	38 FTE	X 58.5
Average vehicle movement per day	Cars	0.02 cars/day	32 cars/day	X 1,600
	HGVs	0.13 lorries/day	1.65 lorries/day	X 12

The table shows that compared to the baseline of a crop of wheat, the proposed greenhouse growing tomatoes would:

- Deliver 2.5 times as many tonnes of food per year, with production spread across the year;
- A crop output value over 27 times as large as a wheat crop;
- Support over 58 times as many jobs, on farm and in the linked supply chain.

This increased physical output and large increase in economic impact in terms of turnover in the local economy and jobs would lead to a large proportionate increase in vehicle movements, but starting from a very low base for arable production. The site’s location, adjacent to a major junction on the A160, means the average of 1.65 lorry movements and 32 car movements per day to support tomato production will have only a modest impact on access roads.

Furthermore, the daily cycle of working hours which is typical for greenhouses (staff tend to start early and finish early to avoid daytime peak temperatures and to fit with supermarket delivery schedules) means most car journeys are expected to fall outside peak travel times in both the morning and afternoon. The modest level of journeys and most falling outside peak periods means this is not expected to result in any capacity constraints on road infrastructure.

e. Potential for Other Crops to be Grown

In addition to tomatoes, other food crops which are typically produced in the UK in greenhouses or CEA, and which have large annual import volumes and values include:

- Cucumbers;
- Sweet peppers (capsicum);
- Lettuce (and chicory);
- Raspberries, strawberries and other berries (e.g. blackberries, loganberries, etc).

Of these alternative crops, cucumbers and sweet peppers, like tomatoes, have a net import requirement every month of the year (table 7). These two crops could therefore be considered as direct alternatives to tomato production, and if the greenhouse/CEA production area was expanded, these crops could be incorporated into a business model to provide diversification of any crop specific market risks.

Table 7: Trade in Cucumber and Sweet Peppers, fresh or chilled (February 2023-January 2024)²⁴

Month	07096010 Fresh or chilled sweet peppers			07070005 Cucumbers, fresh or chilled		
	Net Import Value (£ million)	Net Import Mass (tonnes)	Average Price of Imports (£/Kg)	Net Import Value (£ million)	Net Import Mass (tonnes)	Average Price of Imports (£/Kg)
February '23	£31.6	16,123	£1.96	£23.2	13,382	£1.74
March	£45.2	20,185	£2.24	£25.8	15,052	£1.72
April	£41.1	16,512	£2.49	£16.6	12,977	£1.28
May	£42.8	19,094	£2.24	£19.5	15,436	£1.26
June	£37.3	17,619	£2.12	£20.0	16,548	£1.21
July	£31.1	15,954	£1.95	£18.2	14,043	£1.30
August	£30.9	15,091	£2.05	£16.7	12,638	£1.32
September	£33.4	16,185	£2.07	£18.1	14,559	£1.24
October	£32.7	16,816	£1.94	£20.2	16,401	£1.23
November	£34.1	18,278	£1.86	£25.7	16,421	£1.57
December	£30.2	16,479	£1.83	£20.1	14,353	£1.40
January '24	£43.1	22,341	£1.93	£26.7	18,435	£1.45
Total Feb '23 – Jan '24	£433.5	210,677	£2.06	£250.7	180,246	£1.39

As can be seen above, the total combined net import volume of fresh or chilled sweet peppers and cucumbers from February 2023 to January 2024, was similar to the net import volume of tomatoes over the same period. Sweet peppers in particular can be seen to have a high average price of imported crop, being £2.06/kilo throughout the year, with a minimum price of £1.83 in December 2023, coupled to year-round UK net import demand.

²⁴ [HMRC | 2024 | UK Trade Info | Custom Table | 0702 Tomatoes, fresh or chilled](#)

Sweet peppers (capsicum) are thus an addressable market and data from Raaphorst and Benninga (2019)²⁵ can be used to estimate the likely crop output from a greenhouse growing this crop. This report provides for a CHP fuelled greenhouse (19°C), operating 50 weeks of the year, yields of between 207 tonnes/hectare for red pointed capsicum; to 356 tonnes/hectare for green capsicum; 309 tonnes/hectare for red or orange; and 321 tonnes/hectare for yellow capsicum. This gives a mean average yield of these capsicum varieties of 298 tonnes/hectare per year, which across 2.8 hectares would be equivalent to 835 tonnes of food output (1.2 times the weight of wheat lost).

At an average import price of £2.06/Kg for the 2023-2024 year (table 7), this would be £1.72 million of turnover (13.2 times the value of lost wheat production).

Similar calculations for cucumber show:

- An average of 860 tonnes per hectare per year, or a potential for 2,408 tonnes on 7 acres (2.8 hectares), worth £1.195million.
- The yield is thus higher than tomatoes and peppers although the value is lower. However, the value of crop production is still nearly 9 times as high as wheat and the yield is 3.5 times as high as wheat.

In addition to these two high potential crops, lettuces and various varieties of berries (chiefly strawberries) can also be considered as potential viable food crops, with a range of CEA systems already in use to produce these crops in the UK.

However, these crops experience reduced net imports (and sometimes net exports) over the summer months, as these crops can be commercially produced outside in the UK over the summer season. This depresses their values over the summer months when berry and lettuce consumption typically peaks. Despite this, these crops show a large market for imports into the UK which could be replaced with more UK production (table 8).

Table 8 – Imports of Other Crops into the UK February 2023-January 2024

Crop	Net import volume (tonnes)	Net import value (£million)
Fresh strawberries	57,076	235
Fresh raspberries	25,688	189
Fresh blackberries, mulberries and loganberries	2,934	21
Lettuce and chicory	122,787	180

²⁵ KWIN (2019). Kwantitatieve Informatie voor de Glastuinbouw 2019. Raaphorst & Benninga. Raaport WPR-899. Wageningen University & Research, The Netherlands.

Strawberries are already grown in the UK in Venlo type greenhouses with table top or hanging gutter systems. Dyson Farming produce c.1,250 tonnes of strawberries per annum across 26 acres²⁶ (c.10.5 Ha) of modern Venlo in Lincolnshire (at Carrington near Boston), utilising a hanging gutter system to maximise crop density and yield. This new production unit has been successful and will be expanded from summer 2024.

Dyson's current 1,250-tonne production is equivalent to a yield of c.119 tonnes/hectare. If applied to the proposed 2.8 Ha greenhouse, this would be output of 332 tonnes per annum, which at a value of £4.14 per kilo, would be £1.38 million of turnover.

Lettuce crops can be grown via a range of systems. The output of lettuce within 'traditional' systems using growbags, and lit hydroponic systems in modern Venlo glasshouses in the Netherlands is provided by Raaphorst and Benninga (2019) as yielding between 317-532 tonnes per hectare per year. At an average value of £1.47 per kilo a lettuce crop could be expected to yield between £1.33 million of turnover in 'traditional' systems, and £2.19 million for lit hydroponic systems.

The other crops shown above, are not typically grown in a fully controlled environment in the UK, with protected cropping of berry crops such as blackberries or raspberries primarily²⁷ being in polytunnels. There is also a small area under glass which is heated to extend the season.

This analysis shows that there is a range of other crops which could be grown, in addition to or instead of tomatoes, where there is the potential to replace imports and produce a commercial return.

f. Other Types of Controlled Environment Agriculture (CEA)

As well as greenhouses, recent years have seen the development of 'vertical farms', or what some call Total Controlled Environment Agriculture (TCEA). In a vertical farm, crops are grown typically in a warehouse/ cold store type white walled building, in which the environment is completely man made, with all the heat, light, water, atmosphere and nutrient supply monitored and supplied by the operator. The premise is that this allows all crop inputs to be controlled precisely to deliver optimum crop growth conditions.

TCEA has been shown to deliver substantial savings on water use compared to outdoor crops, although the savings compared to modern greenhouses are modest. TCEA can also achieve more output per unit of land area, as crops are stacked in multiple layers. However, in most circumstances, as shown above, a modest size greenhouse produces much higher yields per hectare than traditional farming systems and land supply is thus not the key constraint.

²⁶ [Dyson Farming | 2024 | Strawberries](#)

²⁷ [Swain, J. & Hardy, E. | 2017 | Understanding energy influences for UK soft fruit production | AHDB](#)

The real problem for TCEA is that, except for a few specialist crops, most vertical farms are failing to reach commerciality because of very high energy costs, notably for lighting. TCEA means no natural light is used, with the system relying on LED lighting for 100% of crop lighting needs. In most cases after energy costs rose in 2022, the cost of power needed was equal to the value of crop output rendering the sector unviable and leading to even some of the largest TCEA units in the world failing commercially. Conversely being in a sealed, insulated container means TCEA does not require access to much heat input.

TCEA is thus different to greenhouses in that it relies on a large supply of electricity to run its lights and HVAC systems, whereas a greenhouse has much lower power needs but requires heat input during the winter and at night in spring and autumn. For this reason, our assessment is that a greenhouse is a better synergistic fit with the Humber Tech Park which will have 'waste heat' available from cooling the data centre.

Despite these challenges, a vertical farm of the same size could produce more output, although as a new technology there is significant divergence in vertical farming systems in terms of yield, investment (capital cost), level of control and energy use.

Lettuce and chicory are well-developed crops for vertical farming in the UK and overseas, including for example Shockingly Fresh operating a 1 hectare fully enclosed polytunnel unit at Offenham²⁸ producing lettuce using hydroponic growing towers.

In Thailand Vana.Farm²⁹ claimed (2022) that their container vertical farm system had the capacity to produce a lettuce yield of over 1,300 tonnes per hectare per year. Jin et al (2021)³⁰ reported that if light conditions are optimised, they could theoretically produce 7,000 tonnes per hectare per year³¹. If replicated across the proposed 2.8 hectare facility at Humber Tech Park, at a price of £1.47 per kilo. This would generate £28.8 million of turnover per annum.

These examples show that vertical farms or TCEA which stack multiple layers of crops on the same land can increase the value of crop output substantially, but as noted above whether this is economic is largely dependent on the cost of power.

In practice adopting some of the principles of vertical farms may be able to increase cropping density in a (tall) greenhouse whilst still using natural light for most of the crop lighting needs. This principle is being investigated by South Lincolnshire salad producer JEPCO for their new 10 hectare greenhouse unit in Holbeach.

²⁸ [Shockingly Fresh | Our Sites | Offenham Vertical Farm](#)

²⁹ [Vertical Farm Daily | 2022 | Vana Farm | One container can get a yield of 324 kg of lettuce on the first round](#)

³⁰ [Jin, W. Formiga Lopez, D. Heuvelink, E. & Marcelis, L. F. M. | 2021 | Light use efficiency of lettuce cultivation in vertical farms compared with greenhouse and field | Horticulture and Product Physiology, Department of Plant Sciences | Wageningen University and Research](#)

³¹ Although in practice problems such as 'tip burn' which occur in lettuce when they grow too fast would suggest a lower target yield is preferable

g. Environmental Impact of Greenhouses and CEA

The environmental calculations for greenhouses are complex and depend on crops grown, production system and many other factors which makes direct comparisons difficult. At this stage, before the final crops and production systems are chosen it is impossible to put precise figures on the comparative environmental footprint of greenhouse production, but some key parameters which may change compared to arable production are:

- Carbon emissions:
 - Whilst the greenhouse may have higher carbon emissions than the current arable production per hectare it will, as shown above, replace imports which have an even higher carbon footprint, whilst at the same time producing more food than the current arable system. The net result is thus likely to be a fall in the carbon of food consumed in the UK.
 - Using 'waste heat' from the data centre will create a lower carbon footprint than alternative sources of greenhouse heating, e.g. the majority of alternative sources of tomato supply, e.g. the Netherlands or the Lea Valley (UK), depend on natural gas for heating. Using recycled heat from the data centre will deliver lower carbon food.
- Water:
 - A modern greenhouse in which crops are grown in 'gutters' or other forms of hydroponic system means that all crop nutrients and crop protection chemicals are contained and recycled, thus meaning they will not create the diffuse pollution associated with arable crops. The impact on groundwater and watercourse quality will therefore be reduced. The development of areas of trees and wildflower meadows will also act as natural features which further reduce water quality impacts in the area.
 - A greenhouse with a rain water capture/storage system and controlled irrigation will only need a very small external water supply on a net basis, as the rain water harvesting will meet at least 90% of crop demand. The production is thus better environmentally than imported crops grown in outdoor or less controlled environments.
- Bio-diversity – a greenhouse can, as noted in the quote from Sir David Attenborough³² explored more fully below (section 4c), '*produce much more food on much less land*', which means that other land can be set aside to provide habitats for bio-diversity to thrive. At the Humber Tech Park this includes trees, wildflower meadows and wetland/open water areas. These new environmental features will provide a much richer and wider range of habitats than the current arable rotation.

³² Sir David Attenborough (2020), A Life on Our Planet: My Witness Statement and a Vision for the Future

4. Policy Alignment

a. Sustainably Growing UK Production of Greenhouse Crops

Expanding intensive, horticultural crops, of the type grown in a greenhouse or vertical farm, is well aligned with regional and national government policy, as well as being supported by many industry bodies. The rationale which underpins this focus on growing more horticultural crops, including salads, vegetables, fruit and ornamental crops, is:

- The UK is a big net importer of fresh produce crops, with the value of imports continuing to grow faster than UK production (see section 3b above) as demand rises. Sourcing more fresh produce in the UK, when it can be produced competitively, would deliver economic benefits and shorten supply chains leading to longer shelf life and improved nutrition.
- Regionally, Greater Lincolnshire is at the heart of the UK fresh produce industry, with 30% of England's vegetable production, 20% of the ornamentals and a rapidly growing fruit sector. It is also the processing and distribution centre of the UK fresh produce industry. It has set out a clear focus on growing the fresh produce and the controlled environment agriculture sector to build on its existing cluster strength and market opportunity.
- In many cases UK production is more sustainable, as the UK climate is more benign and the UK is not as impacted by water stress as many areas of the World from which the country currently imports fresh produce. Compared to for example Spain, a lettuce grown in Lincolnshire only uses circa 25% of the irrigation needed in Spain³³. Greenhouses and CEA substantially improve further on this, in some cases by reducing water demand by more than 90%, meaning they are very efficient in converting water into saleable production.
- A similar argument can be applied to carbon footprints, with multiple reports showing that after accounting for supply chain emissions (e.g. transport and storage), UK production normally has a lower carbon footprint per kilo of fresh produce than imports. A 2022 review in Nature Food³⁴ said: *'Global freight transport associated with vegetable and fruit consumption contributes 36% of food-miles emissions—almost twice the amount of greenhouse gases released during their production. To mitigate the environmental impact of food, a shift towards plant-based foods must be coupled with more locally produced items, mainly in affluent countries'*.
- Fresh produce is a key component of a healthy diet, with increased consumption supported by health policy, notably the 5-a-day campaign and the Eat Well Plate. Expanding the production of these crops in the UK will help to improve access to healthy food choices.

³³ [HESS - The green, blue and grey water footprint of crops and derived crop products \(copernicus.org\)](#)

³⁴ [Global food-miles account for nearly 20% of total food-systems emissions | Nature Food](#)

Key government policies focused on increasing the UK production of intensive crops include:

- The Devolution Deal for Greater Lincolnshire (2023)³⁵ – notes that:
 - *‘the region produces one eighth of England’s food and has nationally significant clusters in food production, food processing, fresh produce and seafood processing’.*
 - It also makes commitments to grow food production in the UK Food Valley, including through: *‘supporting commercial investment in the industry to increase production volumes and modernisation’; ‘supporting food chain investment with modern infrastructure including access to sustainable energy’.*
- The UK Food Valley produced a prospectus in 2021 (updated 2022)³⁶ on the potential to grow the fresh produce and controlled environment agriculture sector as one of three growth priorities for the Food Valley. This argued that: *‘Covid-19 and the UK’s EU-exit have reinforced the case for investment in UK-based advanced food production – highlighting the need for shorter, more resilient supply chains, and for investment in automation to reduce dependence on manual labour. With the UK producing just 56% of the vegetables and 16% of the fruit it consumes, significant potential exists for fresh produce import substitution’.*
- The Food White Paper for the Midlands published on 27th February 2024³⁷ – promotes the potential for growth across the food industry stating that: *‘Food system transformation offers potential for multiple benefits. These include carbon and sustainability savings from shorter domestic food chains, and healthier foods achieved via reformulation and growing the supply of naturally healthy foods e.g. fresh produce’.*
- The Government Food Strategy³⁸ (2022) said that:
 - *‘we will seek to: broadly maintain the current level of food we produce domestically, including sustainably boosting production in sectors where there are post-Brexit opportunities including horticulture and seafood’.* Under levelling up the food system by maximising growth, the food strategy also said: *‘Commercial horticulture uses a new generation of sustainable and efficient greenhouses and provides new opportunities to make UK producers more competitive. Growth in this sector would: boost home-grown fruit and vegetable production, help to future-proof the sector in a warming climate, and create new skilled job opportunities across the country..... with the right tools, vibrant, growing sectors like these can expand significantly’.*

³⁵ Greater Lincolnshire Devolution Deal, Department for Levelling Up, Housing and Communities

³⁶ [UK Food Valley Brochure - The Fresh Produce and Controlled Environment Agriculture Investment Opportunity \(2022\).pdf \(greaterlincolnshirelep.co.uk\)](#)

³⁷ https://midlandsendengine.org/wp-content/uploads/2024/02/Midlands-Engine_Food-White-Paper.pdf

³⁸ [Government food strategy - GOV.UK \(www.gov.uk\)](#)

b. The Role of Fresh Produce in Diet and Health

More broadly the fresh produce grown in greenhouses and vertical farms is aligned with other key areas of national policy including:

- Health and diet – the 5 a day campaign³⁹ is over 20 years old and one of the most widely known consumer messages, but despite being widely recognised after 20 years achievement of the 5 a day target is low amongst the UK population, with a British Dietitian Association report in 2019 (before Covid) showing⁴⁰:
 - *'The latest information suggests that a mere 8% of children (11 to 18 years), 27% of adults (19 to 64 years) and 35% of those aged 65 years and over actually achieve the 5-A-Day recommendation. Those from deprived areas are less likely to achieve the recommendation, and females are often better than males when it comes to portions of fruit and vegetables'.*
 - Sustainably increasing the supply of UK sourced fresh produce is a key part of how this dietary issue could be addressed.

The development of the National Food Strategy (2020 and 2021)⁴¹ preceded the Government Food Strategy, led by DEFRA Non-Exec and co-founder of the Leon restaurant chain, Henry Dimbleby. Having been started in 2019, the process was disrupted by Covid, leading to the review being published in two parts: summer 2020; and summer 2021. It also changed the report's focus due to evidence that Covid 19 was much worse for those who were overweight or obese. As a result, part 1 of the strategy gave clear warnings about the British diet, highlighting that since rationing ended in the 1950s, when only 3% of the population were overweight or obese, by 2020 this had grown to over 60% of the population. Part 1 of the NFS concluded that:

- *'Diet-related illness is one of the top three risk factors for dying of COVID-19. This has given a new urgency to the slow-motion disaster of the British diet. Even before the pandemic, poor diet was responsible for one in seven deaths in the UK (90,000 a year) This is a medical emergency we can no longer afford to ignore' and 'obesity alone costs the NHS £6 billion a year (5% of its budget)'.*

A recent report in December 2023 by Frontier Economics⁴² reported that wider analysis suggests poor dietary choices cost the UK £98bn per year when the impact on people and society of living with obesity and overweight are factored in. Increasing fresh produce consumption, as advocated in the 5-a-day campaign is a key way to address this health challenge.

³⁹ [Why 5 A Day? - NHS \(www.nhs.uk\)](http://www.nhs.uk)

⁴⁰ [Are we achieving 5-a-day? \(bda.uk.com\)](http://bda.uk.com)

⁴¹ [The National Food Strategy - The Plan](#)

⁴² [The Rising Cost of Obesity in the UK | Frontier Economics \(frontier-economics.com\)](http://frontier-economics.com)

c. Environment

As shown earlier in the report, the change in land use on the site will lead to a net increase in food production, even if only 7 acres of greenhouses replace 200 acres of arable production, due to much higher yield and crop value per hectare for greenhouse production. The development thus does not reduce UK food production as most development proposals for greenfield sites do. This means the development will not lead to a growth in food imports, with resultant indirect land use change (ILUC) in other countries. The proposed development internalises and directly addresses the loss of arable land.

These arguments are gaining ground with the Environmental Audit Committee in a December 2023 report⁴³ becoming the latest parliamentary body to promote the need to increase domestic food security, whilst balancing this with the need to improve the environment. Their report recommended: *'Government designate food security as a public good and incorporate food security and environmental goals more explicitly in the design of Environmental Land Management schemes'*.

A growing body of evidence shows benefits for water, carbon and biodiversity of intensifying production on some land, to spare other land for nature⁴⁴. Furthermore, Sir David Attenborough in his 2020 book, *A Life on Our Planet*⁴⁵, argued when talking about Dutch farms that: *'These innovative, sustainable farms are now amongst the highest yielding and lowest impact food producers on Earth' ... 'If all farmers in the Netherlands and indeed the rest of the World farmed with the ethos of these pioneering Dutch families, we would be able to produce much more food on much less land'*.

The UK farming sector is facing a period of substantial change, as the Agricultural Transition replaces the Basic Payment Scheme (BPS) with payments for public goods, mainly through the Environmental Land Management Scheme (ELMS)⁴⁶.

The proposed development of the Tech Park will also lead to over 100 acres of the site gaining environmental features which promote bio-diversity and sustainable land management. This is in line with government policy on ELMS and the incentives they are providing to farmers to create new environmental features on farms. This means the development will directly support government policies for restoring nature, as set out in the Environment Bill (2021)⁴⁷. The Humber Tech Park does this through creating priority habitats including:

⁴³ [Environmental change and food security \(parliament.uk\)](https://www.parliament.uk/business/committees/committees-a-z/all-committees/environmental-audit-committee/reports-and-publications/2023-24/2023-24-environmental-change-and-food-security/)

⁴⁴ [The environmental costs and benefits of high-yield farming | Nature Sustainability](https://www.nature.com/articles/s41566-023-01000-0)

⁴⁵ Sir David Attenborough (2020), *A Life on Our Planet: My Witness Statement and a Vision for the Future*

⁴⁶ [Environmental Land Management \(ELM\) update: how government will pay for land-based environment and climate goods and services - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/news/environmental-land-management-elms-update-how-government-will-pay-for-land-based-environment-and-climate-goods-and-services)

⁴⁷ [Environment Act 2021 - Parliamentary Bills - UK Parliament](https://www.parliament.uk/business/bills-and-legislation/bills/2021-22/environment-act-2021/)

- Woodland – tree planting targets were set out in December 2023 by Natural England and the Forestry Commission⁴⁸ as aiming to: *'increase tree cover from 14.5% in 2023 to 16.5% by 2050. Forestry Commission and Natural England's joint vision is to create a more resilient, nature-rich and productive landscape framed by a diverse range of forests, woodlands, copses, hedges and trees outside woods including treescapes in our towns and cities'*. It also specifically identifies that tree planting should be focused on agricultural land classes 3a-5.
- Wild flower meadows – Natural England reported in 2020 that 97% of wildflower meadows have been lost since the 1930s⁴⁹, with consequential impacts for bio-diversity of both plants and wildlife. The creation and sympathetic management of wildflower meadows, cut for late season hay can help to address this decline and is therefore supported by multiple ELMS options under current agricultural policy.
- Open water and wetland - the wetland habitat attenuation areas would potentially produce a type of lowland fen, or their edges will be fen like habitat. The Humber estuary was ancient fenland habitat until successive cultures, from the Romans to Vermuyden, reclaimed the area. The creation of lowland fen habitat is included in the list of 'irreplaceable habitats' in the environment act; Biodiversity Net Gain (BNG) rules⁵⁰; and the National Policy Planning Framework (NPPF).

The greenhouses proposed at the Humber tech Park will use 'waste' heat recovered from the cooling needed by the data centre. This is in line with government policy as set out in the Government Food Strategy⁵¹ (2022) which said, when talking about expanding intensive horticultural production in greenhouses or other forms of CEA, that: *'we will also incentivise the sector to make use of surplus heat and CO2 from industrial processes, and renewable sources of energy'*.

Furthermore, with heat being a key determinant of economic sustainability in the greenhouse sector, using onsite 'waste' heat will allow the development to be both sustainable economically and environmentally. In the food chain this is critical as the sector seeks to deliver the Net Zero transition, with the supply chain moving faster to address these issues than government policy. Most supermarkets are targeting Net Zero for: scope 1 and 2 by 2035-'40 (only Lidl is opting for a later date); and scope 3 reduction targets by 2050 (NB Aldi and Marks and Spencer have both adopted a scope 3 target date of 2040). Any greenhouse currently planned will thus have to meet these targets well before the end of its design life, which for a greenhouse is 25-40 years.

⁴⁸ [Natural England and Forestry Commission: Our position on woodland creation - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/news/nationally-important-wildflower-grasslands-get-increased-protection)

⁴⁹ <https://www.gov.uk/government/news/nationally-important-wildflower-grasslands-get-increased-protection>

⁵⁰ <https://defraenvironment.blog.gov.uk/2023/10/05/irreplaceable-habitats-and-bng-what-you-need-to-know/>

⁵¹ [Government food strategy - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/food-strategy)

5. Conclusion

This report looks at the food chain impacts of developing a data centre and linked greenhouse on land previously used for arable production at the Humber Tech Park.

We conclude that developing the data centre, linked greenhouse production and environmental features on the remaining land (trees, wildflower meadows and open water/wetland areas) will remove 200 acres (circa 80 hectares) from arable production.

The impacts of this will be:

- The loss of 688 tonnes of cereal production, modelled on wheat, plus 200 tonnes of straw. This will lead to a fall in output of circa £130,000.
- This level of lost production represents 0.04% of the wheat grown in Greater Lincolnshire and 0.005% of the value of agricultural output.
- This reduction in production, plus supply chain impacts will lead to the 'loss' of 0.65 FTE jobs, but with 14,407 agricultural jobs in Greater Lincolnshire this is a negligible change.
- Stopping arable production will also be expected to have environmental benefits on water quality and biodiversity, through more natural features on the land in the green areas of the development.

However, to offset these impacts the greenhouse, which has been modelled based on a 7 acre (2.8 hectare) unit growing tomatoes, will produce the following positive outputs:

- 1,736 tonnes of tomatoes per year (assuming a mix of tomato types), a food yield 2.5 times the weight of wheat displaced. If even more intensive, total controlled environment agriculture systems were used, the multiples of production could be increased further.
- This yield of tomatoes would generate a sales value of close to £3.5m, or over 27 times as much as wheat and across the supply chain support an estimated 38 FTEs, or over 58 times as many jobs as displaced.
- Modelling of other crops, including lettuce and berries, shows that there are many other greenhouse crops which could deliver similar large uplifts in crop tonnage, economic value and jobs when compared to the baseline arable production. This means that the unit would have multiple potential crops, insulating it from market changes over its design life.
- Furthermore, the greenhouse production will allow a large area of the 200 acre development site to be dedicated to trees, hedges, wildflower meadows and open water or wetland areas. This will create new habitats and enhanced bio-diversity benefits when compared to the baseline arable production.

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- The greenhouse will also utilise 'waste heat' from the data centre, offsetting the carbon emissions from greenhouse crops grown in the Netherlands primarily using natural gas.
 - Increasing the production of UK intensive greenhouse crops will also bring benefits through developing increased supplies of UK grown fresh produce in a sector which is currently very dependent on imports. This will help to increase the supply of local 'healthy' foods which can help contribute to an improvement in the UK diet.
 - Increasing the production of UK intensive greenhouse crops is supported by policy at multiple levels, because of the potential to deliver more sustainable production, increase supply chain resilience and grow the economy. Key policies supported include: the Devolution Deal (2023) and UK Food Valley programme in Greater Lincolnshire; the Midlands Engine Food White Paper (2024); the Government Food Strategy (2022), all of which champion growth of the fresh crop sector.
 - The fresh produce sector, including salads, vegetables and fruit, is also promoted as part of health and dietary policy through the long standing 5-a-day campaign. Through this increasing fresh produce consumption is seen as a public good due to the potential to impact health and wellbeing.

Our overall assessment is therefore that the greenhouse will, from a food production perspective, increase the yield of food produced, increase the crop value produced and support more jobs in the economy.

It will also replace imports and increase activity in the local economy, whilst delivering modern, efficient production aligned with environmental and health policies at the local, regional and national levels.

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