

Resource efficiency

Infrastructure that can
make better use of our finite
natural resources



Gresham House

Specialist investment



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The world's cattle alone consume a quantity of food equal to the caloric needs of 8.7 billion people - more than the entire human population on Earth²

2. PETA - How does eating meat harm the environment?



We have identified six subsectors that we believe have the potential for the largest impact and financial reward within our real asset-based Sustainable Infrastructure strategy. Resource efficiency is one of those subsectors.

This short paper will explore resource efficiency in more detail with a focus on food production.

Land and water are two of the planet's most precious resources and they are under tremendous stress to keep up with the needs of growing populations across the globe. Overuse of these natural resources has resulted in several challenges which now require solutions as well as changes to many aspects of our current way of life, including the way we produce food.

Agriculture is a resource-intensive industry and uses over half of all habitable land.¹ This level of land use applies mounting pressure on our ecosystems to feed growing populations.

1. World Economic Forum - 50% of all land in the world is used to produce food, 11 December 2019

Food and biodiversity

Biodiversity is crucial to food production. Plants, animals, and microorganisms provide ecosystem services to the agricultural industry including pollination, water purification and protection against pests and diseases. However, many farming techniques, including extensive use of irrigation, herbicides, fertilisers and pesticides, are causing biodiversity loss and soil degradation.

The National Biodiversity Network's State of Nature report observes that agriculture has been identified as the key driver of biodiversity change in the UK over the past 45 years, with mostly negative effects. According to the report, there has been a 41% decrease in the abundance of wildlife in the UK since 1970³, with 73 million birds vanishing from the UK's skies in the last 50 years.⁴

Reliance on land

The UN's Food and Agriculture Organisation (FAO) reports that the amount of arable and productive land per person globally in 2050 will be a quarter of what we had in 1960.⁵ The reduction of available land is due to various factors including urbanisation, climate change and soil degradation.

77% of arable land is used for raising livestock or to grow plants to feed animals, but this land use only produces 18% of global food calories⁶

Soil degradation and erosion are occurring at an alarming rate, and the result is lower crop yields and a reduction in the availability of soil for carbon storage. Soils are the second largest active store of carbon after the oceans.⁷

More widely, many of the practices used in food production actually harm the natural world that production processes also rely upon for their success. The agricultural industry is therefore being challenged to produce higher yields but using less land and natural resource in order to protect the natural world it relies upon – it's a vicious cycle and a catch 22.

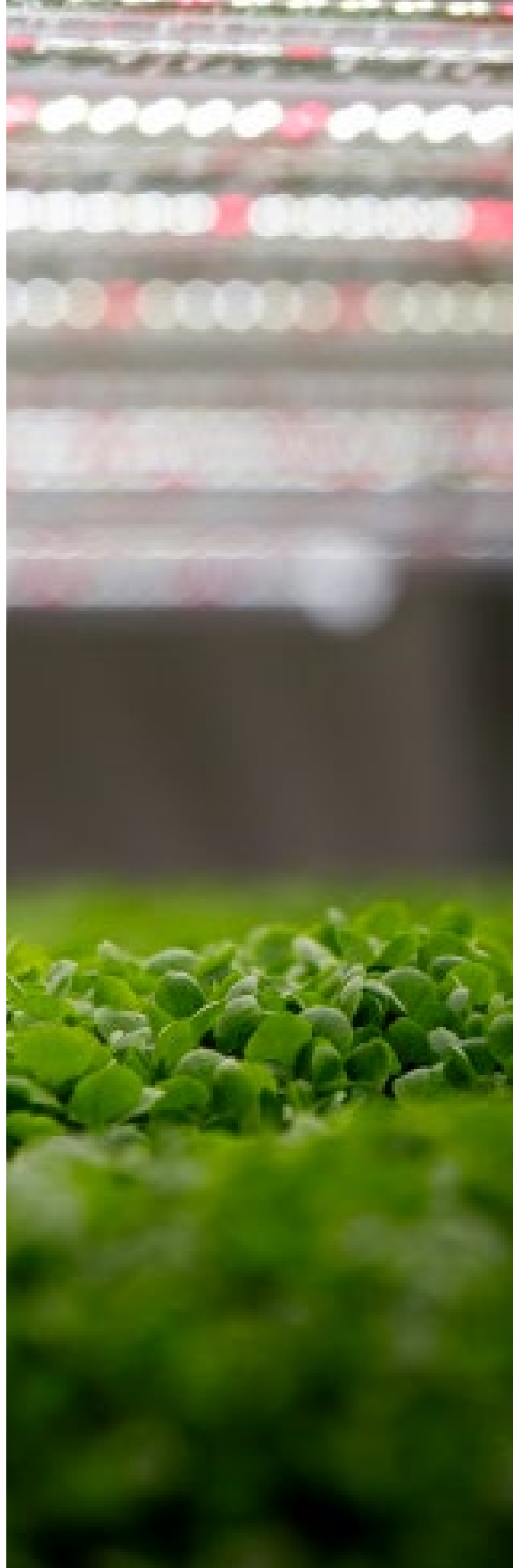
3. National Biodiversity Network - State of Nature 2019

4. British Trust for Ornithology - 73 million birds gone since 1970 – but which have vanished near you? 11 May 2023

5. Food and Agriculture Organisation of the United Nations 2012

6. World Economic Forum - 50% of all land in the world is used to produce food, 11 December 2019

7. British Society of Soil Science - Science Note: Soil Carbon, May 2022



Unlocking solutions

Recent advancements in technology have unlocked one potential solution - vertical farming. This farming method grows plants in trays stacked in a closed environment system under Light-Emitting Diode (LED) lights and hydroponic watering systems inside large industrial units. This approach to producing food has significant environmental benefits, when compared to conventional farming methods.

Gresham House first invested in vertical farm producer, Fischer Farms in 2018. Fischer Farms' aim is to lead the way in scalable food production to provide a more resilient and sustainable way to feed the world. The business, which was first established in 2017, uses the latest technology and innovation to grow high-quality fresh produce, 365-days-a-year, grown in a stacked, bio secure, climate-controlled environment, whilst minimising the impact on the surrounding landscape.

With Gresham House funding, Fischer Farms' first vertical farm opened in 2019 in Burton-on-Trent, UK. More recently, we have funded a new farm (Farm II) believed to be the largest in the vertical farming sector to have fully automated the end-to-end growing and harvesting process. The Fischer Farms team had identified an opportunity to benefit from an early mover advantage in the vertical farming space, which is proving significantly more efficient, cost effective and environmentally friendly than conventional farming.



The Water Footprint Network has calculated that on average one kilogram of beef needs about 15 thousand litres of water⁸

8. NFU - Water use and beef: what we know, 21 August 2017

Not investment advice. Capital at risk.



Positive outcomes

The essence of Fischer Farms is to use finite planetary resources much more efficiently. The key benefits include:

- **Reduced land usage:** Growing plants vertically requires much less space to grow the same crop output. For each acre of land that Fischer Farms occupies, over 250 acres of conventional farmland would be needed to produce the equivalent amount of food⁹ - a staggering 250x increase in land productivity (or to put it another way, less than 1% of the land needed for field grown crops);
- **Reduced water use:** Vertical farming uses up to 95% less water than required by field-grown crops¹⁰. Fischer Farms' closed loop hydroponic system allows water to be continuously recycled - the only water lost is in the cell structure of the plants;

9. Fischer Farms analysis, 2021

10. Based on analysis by Carbon Responsible, November 2021

- **No pesticides:** Bio-secure facilities exclude all germs and pests, and require no pesticides, herbicides or insecticides. Since the system is closed, there is no chemical run-off as often seen in traditional farming, which causes damage to nearby waterways and the natural environment;
- **Less food miles:** Higher yields and less need for space mean that farms can be based closer to urban centres. This cuts down the distance food has to travel to reach the end consumer. It also allows for year-round production, cutting out the concept of seasonal produce, and the associated need to import food that can only be grown overseas. Fischer Farms is able to produce leafy greens with a carbon footprint of up to 680x lower than imported field grown crops from Europe (Italy) to the UK¹¹;

11. 680x less carbon (0.003tCO₂e per tonne of yield vs. 2.029tCO₂e per tonne of yield) compared with importing from Europe (Italy). 1,900x less carbon (0.003tCO₂e per tonne of yield vs. 5.771tCO₂e per tonne of yield) compared with importing equivalent yield from Mexico



- Longer shelf life: As the crops are grown in a bio-secure environment and are free of foreign objects and pesticides, the food is consumable without damaging chlorine-based washes, thereby substantially improving the shelf life of the products by up to 21 days; and
- Weather resistant/food security: Indoor farming means output is not at the mercy of erratic or extreme weather patterns that have been exacerbated by climate change, which helps increase yields and provide certainty on crop volumes. A key attraction for supermarkets and food service providers struggling with security of supply. Fischer Farms can produce the equivalent of 750 harvests per annum per m² of land used, compared to 5-6 harvests per year for field-grown crops.¹²

Importantly, all of these sustainability benefits can be delivered at, or below, the price of field-grown crops .

Commercial success is now following, evidenced by Fischer Farms products being sold through numerous trade channels and some consumer channels such as the Greene King pub chain here in the UK.

Ultimately, the medium-term goal for Fischer Farms is to be producing soy, wheat, rice and peas. When these crops can be produced economically, there is an opportunity for Fischer Farms and other vertical farming businesses to become the centre for a whole new food system.

Vertical farming also has exciting applications into the plant-based medicines sector and to support the rapid evolution of plant development to cope with new climate change induced weather conditions.

12. Fischer Farms analysis, 2021



A balancing act

In the pursuit of more sustainable solutions, we must acknowledge however, that there is no perfect solution. When taking steps forward, there is a balance to be found in the significant improvements that can be made in some areas whilst identifying the areas that need further mitigation in the future.

A commonly cited challenge of vertical farms is the large amount of energy used in lighting. Fischer Farms uses LED lighting to improve energy efficiency and powers their facilities use renewable energy to help mitigate this negative externality. With the efficiency of LEDs constantly increasing and the cost of both LEDs and renewables going down each year, unlike field grown crops, vertically farmed produce has a decreasing primary cost base¹⁴.



Together, the world's top five meat and dairy corporations are now responsible for more annual greenhouse gas emissions than Exxon, Shell or BP¹³

13. GRAIN and the Institute for Agriculture and Trade Policy (IATP) | 18 Jul 2018

14. Gresham House, at 5 November 2024

Forecasts are based on assumptions which may be subject to change.

Broad universe of investable infrastructure platforms

Looking beyond vertical farming, within the theme of resource efficiency there are many innovative solutions being explored to reduce the overuse of nature's resources. One such area is in alternative proteins, which is focused on replacing traditional animal protein sources (i.e. livestock) with plant based (typically from soy or pea) or biomolecular solutions e.g. fermented proteins or cultured meat. Meat production is one of the largest contributors to greenhouse gasses worldwide so finding an alternative protein source is vital to decarbonisation.

With this in mind, the Sustainable Infrastructure team are actively evaluating opportunities which provide an alternative to traditional protein sources. From an infrastructure perspective, investing in consumer facing alternative protein brands remains challenging given high marketing costs, high unit economics and challenges in achieving the required nutritional content to compete with traditional proteins.

However, by focusing on a niche segment of the market with products for ingredients tailored to Business-to-Business (B2B) customers, rather than the end consumer, the investment proposition becomes more compelling. The ability to secure medium-term contracts with customers in a market where there are less players, results in increased ability to differentiate and certainty over recurring business. For example, the team are actively reviewing functional proteins that can be used as an egg replacement. Eggs are a large domestic market, with the UK consuming 12.8 billion eggs in 2023¹⁵, but the focus could be on developing an ingredient for pastry producers looking to build out their vegan offering. This creates the opportunity to focus on a smaller segment of the market, but also creates higher exit potential for customers looking to vertically integrate their supply chain.

15. eegginfo.co.uk - UK egg industry data, 2023

Investment opportunity in alternative proteins may or may not materialise.

Modernising food security

Our ability to produce food is inherently linked to the health of our natural world. Climate change and biodiversity loss will increasingly test our ability to grow sufficient food for our growing populations.

We therefore need to modernise and design new ways of growing food, as well as re-thinking our eating habits.

The food revolution is only just beginning.



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