# The Association for Vertical Farming Summit and Greentech 2016

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# A report to the GCRI Trust

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## Introduction

The following report outlines trips to two concurrent events in 2016 with direct relevance to protected crop production. Both were held in Amsterdam between the 13th and 16th of June 2016.

## Association for Vertical Farming Summit

The Association for Vertical Farming (the name being somewhat of a misnomer) is an umbrella organization representing the interests of the fledgling area of crop production more commonly known as urban farming. Although still at a relatively embryonic stage this association includes a diverse, growing, worldwide membership and is now supported by most of the major horticultural technology producers and service suppliers.

The summit had the official title of ‘Vertical Farming, Circular Economy and True Sustainability’ and there was a large focus on circular economic thinking, focusing on the potentialities of recirculation of waste and energy streams within systems. The breadth of talks reflected a change in business strategy, which no longer is concerned simply by minimising costs, but also adding new value streams from production of novel products from waste. There was also a focus on improving overall efficiency of systems by co-location of different industries, such as those with waste energy, heat or biological material (note that there are already some notable examples of this in commercial protected production here in the UK).

A talk by EU Commission representative José Ruiz-Espí also made a great deal of the circular economy in agricultural and horticultural systems. The EU has recently released its circular economy strategy (Dec. 2015), which will lead to legislative outputs to encourage greater use of waste streams from various industries. These steps are thought necessary to contribute to carbon emissions targets, but also to drive diversification in respective economies and improve the long-term sustainability of core industries. The initial drive is likely to come from the funding and promotion of research and development, eventually leading to a mix of regulation of ‘waste’ outputs and incentivisation of best practice. Of course, at the time of writing our relationship with the European Union is in a state of flux and the wider food producing industries within the UK will need to lobby hard to maintain and simplify standards around energy efficiency, subsidies and waste management. Import volatility produced as a result of new trade terms may lead to an increased drive for food sovereignty measures, making technologies linked to year-round production more attractive.

### Major Technological Trends

There was an array of different approaches to whole-system design; ranging from completely enclosed, partially enclosed degree of integration, location

##### Lighting

Three lighting companies were prominent within the summit: Philips Horticultural Lighting (Netherlands), Valoya (Finland), Illumitex (USA) and Fluence Bio-engineering (USA). An all-panel discussion focused on the basics of light spectra, the relative pros and cons of including different wavebands and aspects of luminous efficiency. There was limited discussion on spatial configuration and optimization of beam angle, heat exchange and advances in systems that allow for modified spectra by use of dimmable systems.

##### Incorporating novel product production

Mushrooms were also on the menu. Kasper Moreaux from Mycelia (Belgium), who are one of the largest spawn producers in Europe, gave a fascinating talk on the possibilities that may exist by utilizing the CO2 producing capacity of fungi. This is also a topic that has been researched in Japan in recent years although currently there are no facilities operating on a large scale that utilize the potential for cycling of CO2 and O2. There was also some discussion of aquaponics and other novel methods of nutrient production.

There is increasingly more talk about crop diversification within these systems, moving on from the initial focus on leafy salad crops. Some topics that were highlighted were:

* Propagation systems
* Hardy nursery stock and bedding
* Soft fruit
* Algal product production

I was surprised that less emphasis was placed on high-value pharma and nutraceutical crops in these production systems.

##### Efficient use of energy and resources

There was some discussion of the potential use gain of macro and micro-nutrients, CO2 and heat from anaerobic digestion of municipal waste, commercial plant waste and animal waste. Potential perceptions around food safety concerns and methods for sterilization were discussed.

### Retailer and Consumer Trends

The final talk of the day was from the Metro Group (<https://www.metrogroup.de/en> one of Germany’s biggest retail companies). The salient point from this talk was that retailers are becoming increasingly aware of new production techniques for multiple applications (even though at the moment it appears to be more of a marketing tool than functional).

### Potential for uptake and areas of interest

The field of closed environment agriculture is moving quickly and interest is growing from established horticultural enterprises around the world. Systems that offer a greater degree of control over plant morphology, energy efficiency and inputs are now coming to fruition.

CEA is providing a focal point for integration of many technologies that may be extremely useful in protected cropping. Even as it stands, the market is dictating that producers should be looking for additive benefits and synergies where possible.

Initial capital costs and lack of wider industry knowledge base are still the major inhibitory factors limiting uptake of CEA. The principles which underpin these types of production can at first glance appear overly-complicated and costly. More outreach and demonstration work needs to be conducted to allow producers and producer organisations to make informed decisions about potential investments. A talk by Vincent Fesquet of French architecture and planning consultancy New’rban View, who was previously a professional investor in private equity, focused on the economic case for vertical farms and particularly the need to educate the investor base as to the potential long-term ROI from such technological adaptations.

The major highlights of this event from my perspective came from conversations with some of the larger players in the horticultural technology market, investors and system designers who were present. My impression is that controlled environment systems are increasingly becoming a focal area for many of these enterprises and are therefore no longer seen as a utopianist solution with little feasibility.

Given the current political climate, now would be a good time to consider lobbying for greater importance and expansion of protected and controlled growing systems in UK agricultural production. Systems align well to long-term goals for increased national food security along with sustainable use (and reuse) of resources and reduction in CO2 emissions and should be foremost in the minds of policy-makers and investors.

## Timetable and summary of talks

9.10 **Keynote: The Vertical Farm as the Ecosystem of the City**

Prof. Dickson Despommier (Columbia University & AVF, USA)

9.30 **Building Integrated Agriculture & Circular Economy**

Oscar Rodriguez (Architecture & Food, UK)

9.50 **Closing the loops with Vertical Farming**

Dr. Ed Harwood (Aerofarms, USA)

10.10 **EU policy for Urban Agriculture and Circular Economy**

Jose Ruiz Espi, Directorate General, Agriculture and Rural Development (EU Commission, Belgium)

10.20 **State of the Vertical Farming Industry: The AVF Whitepaper**

Howard Brin (AVF, USA) & Vincent Fesquet (New’rban View, France)

10:40 **Introduction to ReGen Villages**

James Ehrlich (ReGen Villages, USA)

10:45 Networking Break

11.10 **Case Study 1 “Aquaponics Farm“**

Marc Durno (Urban Farmers, Switzerland)

11.25 **Case Study 2 “Insects”**

Dr. Peter Bickerton (Genome Analysis Center, UK)

11.40 **Case Study 3 “Mushrooms”**

Kasper Moreaux (Mycelia, Belgium)

11.55 **Panel 1: The Circular Vertical Farm (Moderator: Zjef van Acker)**

Mr. Durno, Dr. Bickerton, Mr. Moreaux, Mr. Ehrlich & Mr. Lanting (Proti-Farm)

12.30 Networking Lunch

14.00 **AVF Workshop**

Zjef Van Acker & Kerstin Schreiber

15.15 **How to address Architectural, Construction and Building Code Challenges for Vertical Farms**

Paul Hardej (Illumitex, USA)

15.35 AVF Award Pitch Winners of “Innovation Prize for Vertical Farming”

15.55 **The Fundamentals of Light and its Impact on Vertical Farming**

Nick Klase (Fluence Bioengineering, USA)

16.15 **Panel 2: Advancements in LED Technology for Vertical Farms**

(Moderator: Henry Gordon-Smith) Mr. van der Feltz (Philips, The Netherlands), Mr. den Besten (HAS, The Netherlands), Mr. Aikala (Valoya, Finland), Mr. Klase (Fluence Bioengineering, USA)

16.50 Networking Break

17.15 **Building your indoor farm, where to spend less time and make more money**

John Choo (Indoor Harvest, USA)

17.30 **AVF Sustainability Certification**

Mark Horler (AVF, UK)

17:40 **The Potential of Vertical Farming in the Netherlands and Worldwide: Critical Reflections**

Dr. Jan Willem van der Schans (WUR, The Netherlands)

17.50 **Future of Retail**

Fabio Ziemssen (METRO Group, Germany)

18.05 **Closing remarks**

Max Loessl & Henry Gordon-Smith (AVF Co-Founders, Germany & USA)

# Greentech 2016

Greentech is one of the world’s largest horticultural expositions and is widely regarded as the foremost showcase for horticultural technology. This year was the largest in the history of the event and included exhibitors and participants from all over the world.

### Highlights

## March of the robots

A common theme throughout the expo was the increasing relevance of robotics and automation in horticulture. There were a number of exhibitors showing new technology, including Priva, who unveiled their new De-leafing Robot. The robot uses spectroscopic sensing to detect leaves at a pre-set height in the canopy. The rotating arm then grips the base of the petiole, twists to ensure tension and then uses a cutting blade to remove the leaf.

## Alternative sterilization techniques

Another product on the market that seems to have impressive potential is the Triton bio-digester waste water treatment unit by Van Der Ende Groep. The principle behind this system is that recirculated water can be sterlised and re-oxygenated by providing optimal conditions for a specially designed composition of bacteria and fungi in a regulated filtration system.

## Improvements in software and systems for process control

Single nutrient dosing systems were being showcased by Argus systems. The advantage of these types of system is that a grower has greater control over the composition of the feed solution in order to run a number of feed mixes from the same tanks, easily correct imbalances and deficiencies and alter the overall concentration in terms of ratio of nutrients to water. This reduces losses and makes fertigation more efficient.

There were a small number of cloud-based systems for plant and environmental management and control exhibited. New entrants to environmental control market include the CoolFarm system from Portuguese startup company (IBM). The advantage of this system is that it implicitly allows for a learning process that can be used to identify influential parameters that govern crop growth and development. Given that the system is connected in real-time to your phone, issues can be flagged up and rectified immediately. With further development such systems will become increasingly sophisticated as tools for managing crop performance.

There were numerous advances in automation of common glasshouse functions including plant sorting, spacing and disease detection from companies such as Flier, Demtec and WPS.

PhenoKey’s C.H.I.M.P is a classic example of one of the more future-driven technologies that were also being highlighted at this years’ event. The system (currently in design and testing stage) is expected to be able to quickly phenotype plants for a large array of traits from large and complex breeding and selection systems. The first full systems are expected to be on the market in 2017.

## Biostimulants: Lack of wide evidence base holding back uptake?

There has been a significant amount of publicity and hype about various bio-stimulants over the past few years. A number of products were being showcased at Greentech from a number of different manufacturers that contained various combinations of biological extracts or microbes. Formulations marketed by companies such as Hefe Fertilizer and Biotechnica cover a wide array of amino acid derivatives, humic and fulvic acids, seaweed extracts, plant growth promoting rhizobacteria (PGPR) and mychorrizal fungi.

In principle a number of these products should have activity which may be beneficial to plants in production environments, but independent research is still lacking.

### Seaweed extracts

Evidence for the efficacy of seaweed extracts is thin, although claims are made about increases in production and greater disease resistance based on the foundation that extracts contain plant hormone-like compounds that may act to promote abiotic stress tolerance and elicit defense responses.

### Amino acids and amino acid derivatives

One of the suggested modes of action of these classes of compound may be modulation of nitrogen uptake and transport, direct antioxidant activity and/or chelation of heavy metals. This apparently leads to an increase in shoot and root growth rates in some species.

### Rhizosphere fungi and bacteria

There is a little more evidence for the benefits of specific bacterial strains as additives in conventional peat-based media. Enhanced mobilisation of N and P has been observed as has an increase in nutrient use efficiency in some crops. Some PGPR may produce plant hormone analogues as part of their communication strategy with plant roots. These hormones may act to increase root branching and hence water and nutrient uptake.

More research is required to prove the efficacy and modes of action for these products on horticultural crops.

## Improving on-site energy efficiency

Integrated geothermal storage solutions were being marketed by a number of companies including Certhon and Kubo. These systems allow for a larger capacity of heat storage from heat pumps, making their operation more efficient.

## Improving glass performance

Some companies have been concentrating in recent years on improving the optical performance parameters of glass. A new technology by ReduSystems claims a 2-3% improvement in transmission across the short-wave spectrum. This may be a cost-effective way to improve yield, given the oft-touted figure that a 1% improvement in incident light at certain times of year adds 1% to yield for some crops.

## Closed environment and vertical farming

Some of the larger horticultural technology companies are now beginning to offer whole or part systems for closed environment growing. The off-the-shelf systems are currently designed mainly for leafy salad production, but could be modified to produce other crops. They are still generally highly engineered and lacking in the efficient and cost-effective automation and decision management capacity that will make these systems more viable in the long-term.