



Summary

CCm Technologies is a sustainable/cleantech technology company, based near Oxford, focused on resource optimisation, including Carbon Capture and Utilisation (CCU).

CCm's technology converts captured CO₂ and other waste streams (such as Ammonia and Phosphate) into stable value-added materials with multiple uses across global priority sectors of food/agriculture, advanced materials & energy storage.

The significantly exothermic patented process is based on high primary capture efficiencies from novel cellulose/amine capture material which retain 95% of flue-sourced CO₂. Heat storage is a separate application of the technology that stores thermal energy with a chemical reaction and following release can, like a battery, be recharged.

Project Status

The first full-scale commercial unit successfully commissioned at CCm's Swindon facility before its deployment in Q3 2019 to Viridor's multi-waste site in Somerset, focusing on their food waste treatment process. The unit will (1) transform 6,500 tonnes of waste Anaerobic Digestate cake into approx. 13,000 of high-grade compound fertiliser, (2) contribute CCm's process exothermic heat (1.98 GJ (551kWh) of thermal energy per tonne of CO₂; high storage density at 100kWh/m³) to Viridor's regulatory pasteurisation step, freeing up valuable bio-gas to be sent to the grid, and (3) capture and utilise CO₂ being emitted from Viridor's bio-gas generators.

The removal and disposal of the waste cake is currently a significant cost to the operator; whereas the transformed fertiliser will not only eliminate the cost but also generate considerable revenue as it can be priced in line with the market (in excess of £200 per tonne).

Application extensions have been developed for the sewage sector allowing for the capture of the waste Phosphorous and Ammonia, currently being discharged into watercourses, to be integrated CCm's upgrading of the bio-solids into fertiliser. CCm is working with two UK water utilities and one Australian on 2020 deployments.

Innovative Aspect

The innovative step centres on the simplicity of CCm's technology which is based around blending three constituents – CO₂, a fibre/cellulosic material (such as straw, grass or wood chip) and Ammonia. The CO₂ is drawn post-combustion from a chimney stack or bio-gas separator and flowed through the fibre coated with Ammonia at concentration levels between 9-100%. While the process can work with virgin fibre and primary Ammonia, the flexibility of the process critically allows for the use of waste materials driving enormous Circular Economy benefits through effective resource optimisation. As stated previously the process is very exothermic with a high storage density at 100kWh/m³ and produces 1.98 GJ (551kWh) of thermal energy per tonne of CO₂. This provides operators with a range of opportunities to exploit this very low carbon footprint thermal energy to maximise both their facilities and their financial returns.

Description

CCm's technology was initially developed because of its ability to utilise CO₂ (CCU); it has evolved significantly to integrate multiple waste materials, of which the Greenhouse gas is but one; thereby contributing significantly to the global Circular Economy objectives.

Current petrochemical derived production of fertiliser is highly energy intensive. Europe consumes over 11m tonnes of fertiliser annually, mostly nitrogen based, emitting on average 3.6 tonnes of CO₂ for every tonne produced (Source: Yarra); it estimated to cause emissions of over 40m tonnes across the region per annum.

Total Life Cycle Analysis (LCA) on CCm's current production process, including its production of exothermic heat, calculates a carbon footprint of less than 0.5 tonnes per tonne of fertiliser, approximately 85% less. In-process developments of the technology will drive that carbon footprint rapidly towards "net zero" emissions.

CCm was recognised with an international prize by Alberta four years ago and is developing commercial projects across the province; it is worth noting that Canadian emissions are significantly higher than Europe at over 6.5 tonnes (Source: Government of Alberta).

Through the re-launch of the [Bio-Economy Strategy](#) (11th October 2018), the UK and European governments have sent a strong signal that they are seeking to stimulate, promote and encourage far greater levels of resource optimisation. This vital legislative initiative clearly recognises, as does CCm, that the world's resources are finite and that society has to make significant and meaningful changes to its current profligate single-use resource mentality by understanding the enormous potential economic value that exists in waste/used materials.

Following five years of extensive field trials by two agricultural institutions (RAC Cirencester, Harper Adams) and two commercial agronomy firms (Velcourt, Farmacy); it is demonstrable that CCm's technology is capable of proving farmers with a customisable compound fertiliser that costs, looks and spreads the same as products they are currently familiar with. Critically CCm's fertiliser provides them with the same yield outcomes and yet the production process inputs are mainly derived from previously assumed "waste" sources. Dependent on which inputs are used, the "waste" component ranges from 55% to 85%.

While the consequences above the ground are compelling, the impact of CCm's fertiliser on overall soil health are remarkable. Albeit derived from only one year's data, the University of Sheffield's soil science facility, P3, has established that CCm's fertiliser material increases water and nutrient retention around the root ball by between 35-60% dependent on different control materials; replenishes soil Carbon, raises the pH and temperature of the soil and finally boosts the microbial activity in excess of 25%.

The UK's farming minister, George Eustice (14th March 2018) stated that the government will soil health "at the heart of its future agricultural strategy".

As well as reducing the overall carbon footprint of agriculture, the UK government's second major objective is the improvement of air quality through the reduction of ammonia emissions generated by farming; CCm's technology is applicable to 57% of DEFRA's critical management categories (Source: Code of Good Agriculture Practice for Reducing Ammonia, July 2018).

Benefits

Financial – As stated above this sustainable technology is stand-alone financially viable and is not reliant on government subsidies. Following a six-month assessment, the global engineering consultant, Mott MacDonald, created a complex and extensive financial model of CCm's process. The base case internal rates of returns (IRRs) for the process generate between 15-18%.

The input assumptions to generate these base returns are that all feedstocks, other than CO₂, are primarily produced (and are not waste) and priced at spot market levels without any bulk volume discounts. On the income side the only revenue comes from the sale of the fertiliser at 20% discount to current commercial equivalents; no account has been taken for any benefits available such as the value of the exothermic heat or the elimination of the cost of removing the digestate.

The reality is that a high % of the feedstocks will be derived from waste sources, the price achieved for the end-product is likely to be much closer to, or even at a premium to, current spot prices and there will be additional non-financial environmental benefits allowing the returns to operators to be well in excess of 20%.

Soil Health – As stated above the impact of CCm's fertiliser on improving soil quality, damaged by decades of industrialised farming, is likely to be considerable. Further analysis by P3 is required but CCm's technology will contribute to the reversal of poor soil that the UN and other advocates are seeking. The UN report (2015) stated that at current degradation rates all the world's topsoil will be gone in 60 years (source: Scientific American) and the world will be unable to feed itself.

Clean Air – The UK government is leading an initiative to stall the increasing levels of Ammonia in the air, of which 88% is generated by agriculture (Source: UK government 2018). CCm's technology is capable of transforming Anaerobic Digestion dry-matter that is left in fields over the winter months leaching Ammonia vapour into compound fertiliser that can be stored safely in the normal way.

Waste Water/Sewage – The technology is capable of transforming sewage bio-solids into fertiliser but more importantly integrate waste phosphorous and ammonia that is leaching into water-courses and causing enormous environmental damage.

Reducing the Overall Carbon Footprint of the Agriculture Sector

Intellectual Property Protection – CCm's two core patents have been granted in twenty-four jurisdictions (including UK, USA, China, India, France, Germany, Italy, Netherlands, Spain, Portugal, Denmark & Australia). The company has a further twelve grants on various "daughter" aspects of the process technology and an additional 27 patents pending.

First full-scale unit to be deployed to a commercial waste operator in Q1 2019 and capable of producing 10,000 tonnes of fertiliser per annum.



References

BBC's environment and energy correspondent, Roger Harrabin, published an article "*Climate Change - Cashing in on CO2*" focusing on three pioneering British companies making a profit out of CO2. (July 2019) Link to [article](#) and to [video](#)

BBC's "*Farming Today*" released a piece on CCm's low carbon footprint fertiliser, also highlighting the work done by **U Sheffield's Institute for Sustainable Food** on the positive impacts of the fertiliser on soil health. (July 2019) (scroll to 09:33mins). [Link](#)

Marketplace.org's article – "*British business seeks to cash in on carbon dioxide*" (July 2019). Marketplace provides intellectual content to over 800 radio stations across the US, with in excess of 14m weekly listeners. [Link](#)

Carbon Capture Journal (July 2019) – "*Carbon dioxide captured from the atmosphere could be used to restore degraded soils, save water and boost crop yields.*" [Link](#)

UK Energy and Clean Growth Minister, Claire Perry (July 2017) commenting on Viridor's announcement of collaboration with CCm:

"I'm really excited that we have used funds from the Energy Entrepreneurs Fund to support this innovative project – to use waste resources and CO₂ to reduce the cost and carbon footprint of fertiliser production. Projects like this can help us meet our climate change targets and drive clean economic growth."

Letsrecycle.org - UK Waste Industry trade press coverage (July 2017) [Link](#)

Scottish Government Carbon Dioxide Utilisation (CCU) Report (June 2017):
Inorganic fertiliser case study (Page 38 of main report) [Link](#)

EU Smart CO2 Transformation (ScotVision) Project (Nov 2015):
"A few innovative companies are already seizing opportunities related to CO2 utilisation, and new and better processes are emerging." [Link](#)

BBC Radio 4 - Costing the Earth programme "Putting the Fizz Back into Planet Earth" (Nov 2016) highlighted CCm's technology as a commercial reality today. Tom Heap, the BBC's rural affairs correspondent talks to CCm's CTO, Peter Hammond, between 05:50 mins to 09:00mins. [Link](#)

Philip John, Professor Emeritus, School of Biological Sciences, Reading University (Dec 2017):
"Enhancements of both yield promotion and "greenness" were virtually identical to those observed with a commercial N fertiliser.

CCm Technologies Ltd. – Corporate Information -
(previously CCm Research Ltd – name change 21st February 2018)

Website: [Link](#)

Videos: [Link](#)



1. Sustainable Agriculture, Forestry and Bio Diversity

2. Organic Resource

DISCLAIMER - RISK FACTORS

The Company is an early stage technology company, with all the technological, commercial, managerial and financial risks attached to such companies. Although the Company's pilot plant has performed in line with expectations, the technology has not yet been manufactured or operated at commercial scale and it cannot therefore be guaranteed that the forecast parameters of efficiency or cost will be achieved. Although an encouraging number of commercial discussions are in progress, the Company is still to earn any significant revenues. The Company's financial projections only provide an indicative illustration of the possible financial performance of the Company based on certain assumptions, which may or may not turn out to be accurate, individually or together.