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CCm's processes reclaim natural resources and return them to the circular economy

CCm has developed a range of patented and commercial “climate positive” processes that realise value across the whole waste inventory.

A unique combination of Carbon utilisation and resource optimisation has created a series of environmentally and economically sustainable techniques. In developing these processes, CCm have used direct captured Carbon to trigger significant Carbon retention and avoidance premiums, which ensure that our technologies deliver meaningful environmental benefits.

CCm systems produce high value, high performance fertilisers derived from low or negative value inputs/feedstocks. The new materials consisting of a range of formulations, including fully organic, have had their efficacy proven through independent trials at scale over the last five years.

Both the materials and the process that generates them are ready for immediate commercial exploitation. CCm's full-scale demonstration facility in Swindon (UK) is currently engaged on a range of accelerated deployment evaluations - with amongst others, Severn Trent and Yorkshire Water.

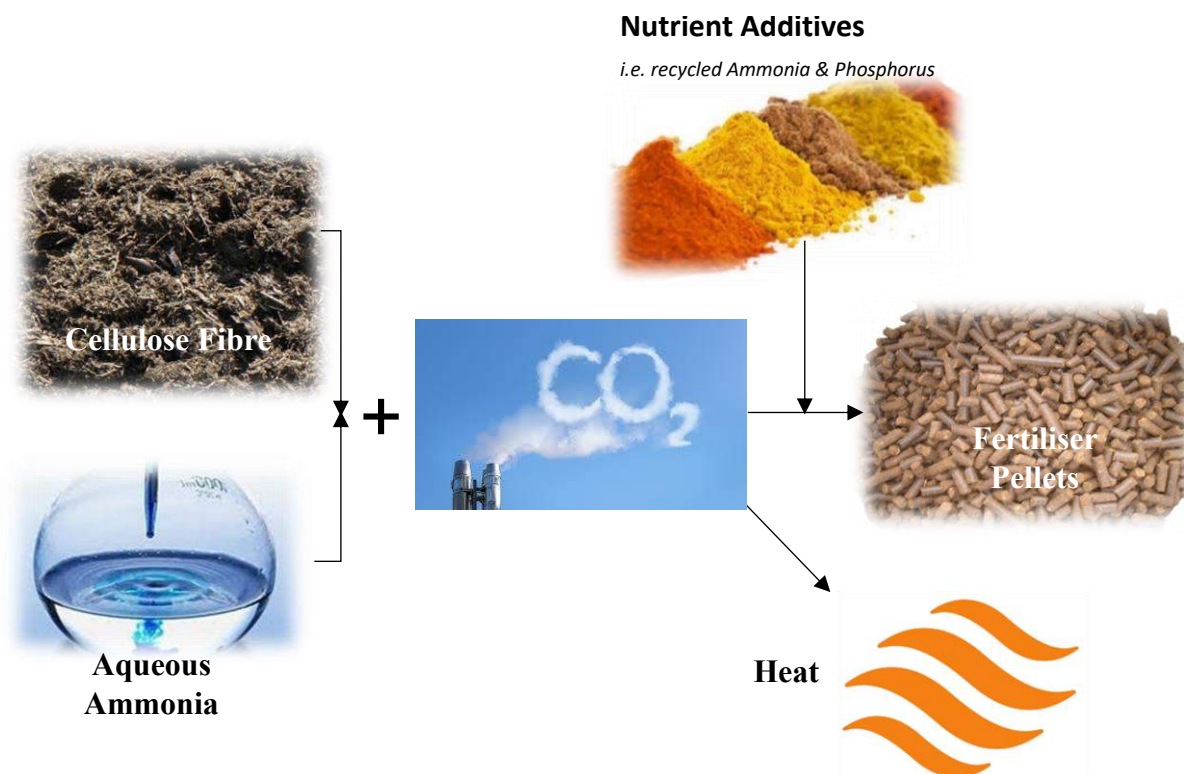
In addition to the creation of new materials containing high levels of entrained functional Carbon, CCm's technology is able to harvest thermal energy from within its own operations through its patented strongly exothermic processes.

Basic Process

The process at the core of the CCm fertiliser production system is simple; it combines:

- an organic waste fibre,
- recycled Ammonia and
- CO₂.

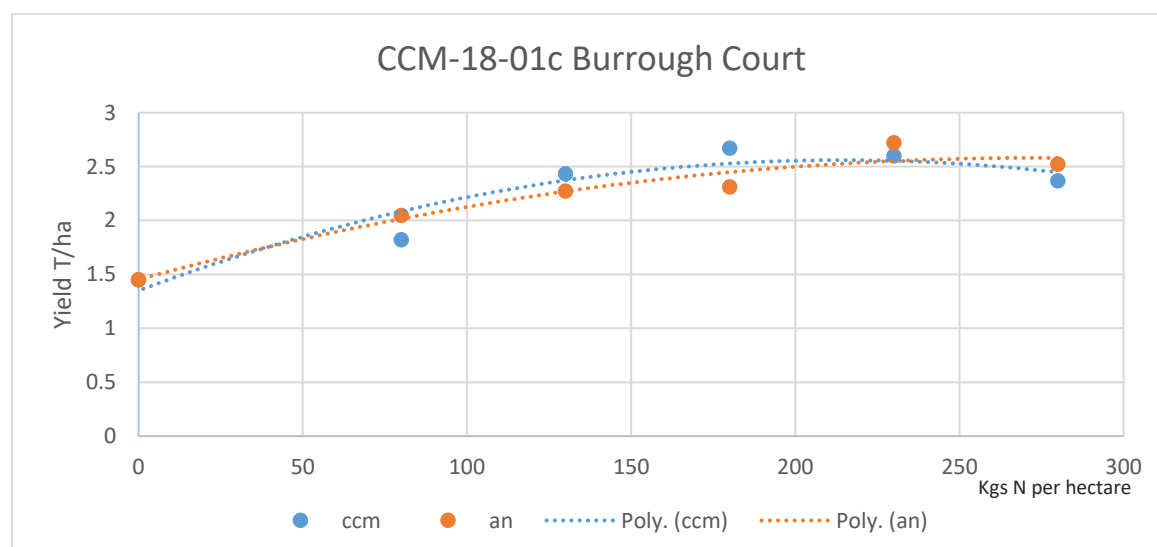
The ammonia acts as a Nitrogen source for the plants and allows the capture of CO₂, which in turn stabilises the ammonia allowing it to be converted into a more useful form. This step is potentially followed by the addition of further nutrients to supplement those held with the feedstock streams that are feeding the CCm process and allow the production of the exact desired end-formulation of Nitrogen, Phosphate & Potassium (N-P-K).



Validation

CCm has carried out independent fertiliser field trials over the last five years (2015-19) with commercial agronomists and agricultural institutions (Royal Agricultural University, Harper Adams University and Velcourt) under the supervision of Professor Philip John from the University of Reading. The agronomy trials have taken place on various farms across the UK and crop types, where CCm's fertiliser has been spread using good agricultural practice, standard farm equipment and alongside a fossil-fuel derived commercial equivalent (Nitram[®] 34.5N).

An example of the trial results, focused on cereals, grass and oil seed production, are set out below and are typical of the constituent outcomes achieved using CCm fertiliser against Nitram[®]. CCm fertiliser have always achieved equivalence in yield terms and protein quality with the industry standard, if not sometimes fractionally better:



During the 2018 growing season, the field trials looked beyond simple yield equivalence and investigated the benefits CCm materials bring to the overall soil health. These benefits have been summarised in an article recently published by the University of Sheffield (July 2019) of the highly regarded peer-review **Journal of CO₂ Utilization** ([Link](#)):

- Enhanced nutrient delivery – allowing the use of less Nitrogen, Phosphate and Potassium (NPK);
- Enhanced bio-fauna and floral activity directly contributes positively to overall soil health (microbial activity +20%);
- Returning “Recalcitrant”^{1,2} post-combustion Carbon (C¹³) to the soil ecosystem (slower release);
- Boosting water retention contributing to lower N and P run-off greatly reducing pollution/nutrication of water courses. (+35-60% better than control materials).

Carbon Footprint

CCm’s fertilisers have consistently delivered 83% lower Carbon Footprints (0.342 tonnes CO₂e) when compared with conventional fossil fuel-based fertiliser manufacture which has a staggeringly high Carbon Footprint (Total Life Cycle Analysis). On average Europe (EEA) emits between 3.6 and 4.5 tonnes of CO₂ for every tonne produced. The situation is even worse in North America where the amount is as high as 6.5 tonnes of emissions and 8 in Russia and China.

Recently CCm has delivered a new formulation to Europe’s largest environmental company and their very large potato customer that has a fractionally negative Carbon Footprint (-0.18 tonnes CO₂e).

End Markets

Key industries that can utilise the CCm process are:

- Anaerobic Digestion-based waste treatment operations:
 - Wastewater (sewage),
 - Food Waste, and
 - Agriculture Slurries;
- Food processing systems;
- General waste processing;
- Power Generation.

Key waste feedstocks that can be drawn from these industries and then transferred back into the economy at its starting point are:

- Carbon, Nitrous and Sulphurous Oxides;
- Fibrous and Particulate Organic waste streams;
- Phosphate and Ammonia rich solid and liquid waste streams.

Global Relevance

The problems that CCm’s process solve for wastewater/food waste and production/agriculture are the same across the world, in both developed and developing countries.

Scale impact

In 2018 the UK government's Department for Business, Energy & Industrial Strategy requested data on the Carbon Impact of scaling this technology. Whilst forecasting penetration rates of the technology is difficult to forecast, it is reasonable to estimate adoption rates based on four main reasons:

1. [European regulation](#) has now embraced N and P resource use from biogenic (recovered/recycled) sources as opposed to primary mineral and fossil fuel reliance ([May 2019](#)).
2. CCm's technology qualifies as a new entrant abatement technology under the EU ETS scheme for 2021 – 2030, recognising it as a formal offset against carbon intensive industries;
3. CCm's extensive patent portfolio is growing and covers UK, Europe, USA, India and China, particularly important is [EP 13759287.9](#) granted April 2019;
4. The main savings generated relate to the fertiliser industry but deliver significant benefits/optimisations to the water/wastewater industry;

The following table shows the effect of CCm's fertiliser production on energy efficiency and CO₂ reduction.

24% of all UK GHG emissions come from agriculture; 50% of these are derived from fertiliser production and use 2% of global energy production is used in the production of ammonia alone (Chemistry World 2018) and 85% of that energy is carbon derived.

CCm Uptake	5%		15%		25%		50%	
Avoidance	CO2 Mt (e)	TWH	CO2 Mt	TWH	CO2Mt	TWH	CO2 Mt	TWH
Region								
UK (3.5mt)	.44	0.13	1.32	0.39	2.2	0.65	4.4	1.3
Europe (22.5mt)	2.82	0.79	8.46	2.37	14.1	3.95	28.2	7.9
North America (48mt)	7	1.96	21	5.88	35	9.8	70	19.6
Rest of world (200mt)	25	7	75	21	125	35	250	70
Total	35.26	9.88	105.78	29.64	176.3	49.4	352.6	98.8

Conclusion - a 50% uptake of CCm's technology globally will reduce energy demand by 98.8TWh.; in comparison the UK industrial sector consumed 92TWh in 2017 (BEIS 2018).

Put another way a 5% uptake of CCm's fertilizer manufacturing process globally would be equivalent of removing 7.6 million cars from the world's roads annually; a target achievable within 5 years.

Financial Impact

CCm's commercially ready process generates project investment returns for the operator (Food Waste, Wastewater or Agriculture) at a conservative base level of 15-18% IRRs.

Two months ago, CCm shared our detailed financial models (created by Mott MacDonald) with a large global chemical company. Inputting their own superior procurement abilities and other circular economy benefits such as reduction in transportation miles, the financial returns were well in excess of 30%, critically without any reliance on government subsidies/incentives.

Two Commercial Examples

Wastewater

CCm recently announced a project with the UK's 2nd largest water utility, Severn Trent, to transform sludge/biosolids into commercial grade fertiliser using nutrients held within their waste inventory (primarily Phosphorus and Ammonia). ([Link](#))

One of the key benefits of CCm's technology to the water industry is the significant reduction of transportation miles of sludge. Best estimates are that the cost of transporting one tonne of sludge is excess of £0.60 per mile and an average haulage distance is 17.2 miles.

Processing approx. 250,000 tonnes of the sludge for the water utility equates to a reduction of 4.3 million transportation miles and a monetary saving of £2.7m annually for this one, albeit large UK water utility. This is before the reduction in carbon footprints and additional critical circular economy benefits are taking into account.

Food Waste

Working with a large UK waste processor, Viridor, over the last year at one of their food waste facilities has allowed CCm to identify four main key benefits for operators in this growing sector:

1. Transforming post-process waste digestate cake into commercial grade fertiliser on-site erases the transportation and spreading costs, estimated to be in excess of £15 per tonne (and that doesn't include the reduction in transportation emissions)
2. Using CCm's process exothermic heat to replace the operator's valuable bio-methane for the food waste pasteurisation step (EU regs) allows the operator to fully monetise the bio-methane for waste-to-energy (WtE) creation.
3. Utilising the CO₂ in creating fertiliser, which would otherwise be emitted to atmosphere, allows the operator to satisfy their annual sustainability criteria for RHI incentives.
4. Thousands of tonnes of costly digestate cake is transformed into double the amount of valuable commercial compound fertiliser providing an operator with a significant new revenue opportunity, in excess of £220 per tonne.

[Link](#) to CCm website.

[Link](#) to "Farming Today" & BBC News at One (July 2019).

[Link](#) to Marketplace.org (released to over 800 US radio stations 8th July 2019)

Conclusion – CCm's technology has the ability to materially reduce carbon and nitrogen emissions from agriculture; the substantive restitution of carbon levels in soils can engage global agricultural resources in a new positive manner, ensuring that agriculture can become a major force that combats and ultimately defeats its impact climate change.

“Waste is Only a Resource in the Wrong Place”

Mahatma Gandhi

Sources: ¹ <http://soilquality.org.au/factsheets/organic-carbon-pools>; ² <https://www.publish.csiro.au/en/pdf/EN10006>

HRH the Prince of Wales formally launched the Council in his keynote speech at the World Economic Forum in Davos on Wednesday. ([Link to HRH's speech](#)). CCm is honoured to be one of the sixteen founder members of the Council. ([Link](#))



“The Sustainable Markets Council (SMC) aims to accelerate a transition to sustainable markets and a decarbonised global economy. At a practical level, the SMC convenes coalitions of public, private and philanthropy leaders to demonstrate what is possible, showcase best practice and to accelerate global change. These efforts are deeply linked to wider global agendas, including the 2030 Sustainable Development Goals, the Paris Climate Agreement, the Addis Ababa Action Agenda, and the biodiversity agenda.”



[CCm Technologies](#) has been granted the coveted "Solar Impulse Efficient Solutions" label for its innovative, patented and commercial Carbon Utilisation and Resource Optimisation technology from the globally recognised [Solar Impulse Foundation](#).

CCm is one of only 352 companies in the world currently to have achieved this Label as the Foundation searches for the 1,000 efficient solutions that protect the environment in a profitable way.

The Solar Impulse Foundation's founder, [Bertrand Piccard](#), was one of the first to envision ecology through the lens of profitability. He has always advocated that protection of the environment would become a reality only if it was perceived as economically viable and requiring no financial or behavioural sacrifices.

Intellectual Property

A four-page document detailing CCm's extensive patent portfolio is available on request. Our main "umbrella" patent has been granted in multiple jurisdictions around the world, including India.

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