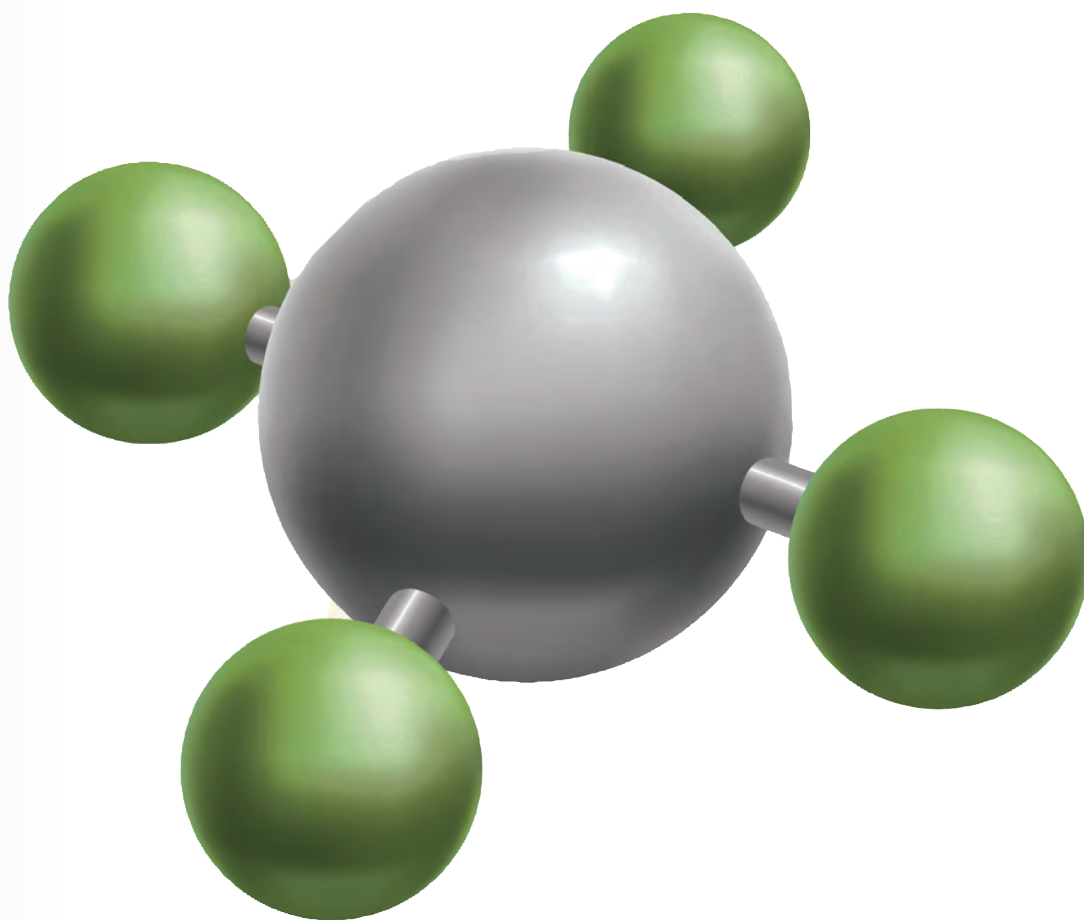


businessGreen

Insight Report



**Tackling livestock emissions:
the innovative, necessary and
rapidly expanding new market**

businessGreen

BusinessGreen is the leading source of news, analysis, and opinion for the burgeoning green market.

By helping to enable the transition to a low-carbon economy through its business-led approach to environmental issues, *BusinessGreen* attracts an audience of the UK's key business leaders and decision makers across the corporate and political spectrum.

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**This *BusinessGreen* Insight Report was produced in association with Zaluvida.
All content was fully editorially independent.**

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Editor-in-Chief: James Murray
+44 (0)20 7316 9234
james.s.murray@incisivemedia.com

Senior Reporter: Madeleine Cuff
+44 (0)20 7316 9331
madeleine.cuff@incisivemedia.com

Reporter: Michael Holder
+44 (0)207 316 9021
michael.holder@incisivemedia.com

Incisive Media, 28-29 Haymarket, London SW1Y 4RX Tel: (020) 7316 9000

Publisher: Alan Loader
+44 (0)20 7316 9733
alan.loader@incisivemedia.com

Head of Sales: Matthew Oliver
+44 (0)20 7316 9794
matthew.oliver@incisivemedia.com

Senior Marketing Executive: Ana Abeledo
+44 (0)20 7316 9194
ana.abeledo@incisivemedia.com

Senior Production Editor: Amy Micklewright
+44 (0)20 7316 9156
amy.micklewright@incisivemedia.com

Managing Director, Incisive Business:
Jonathon Whiteley

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Preparation is key



When you imagine what the low-carbon industrial revolution looks like, you probably think of some wind turbines or electric cars. This is entirely understandable. Renewable electricity and ultra-low-emission transport

technologies are now firmly embedded in the economic mainstream and have played a key role, alongside improvements in energy efficiency and the gradual side-lining of coal power, in delivering greenhouse gas emissions cuts in many industrialised nations.

However, if the world is to meet the goals of the Paris Agreement by keeping temperature increases below 2°C and building a net zero-emission economy, then the low-carbon transition will have to extend far beyond the power and road transport sectors, important as they are. But sadly the progress that has been made in curbing emissions from these industries is yet to be matched by other crucial sectors such as industry, aviation, shipping, and, of course, agriculture.

Agriculture, forestry and land use account for nearly a quarter of global greenhouse gas emissions, with emissions from livestock alone accounting for nearly 15 per cent of all anthropogenic emissions. More worrying still, evidence suggests that these emissions are likely to rise as global demand for meat-based diets increases.

It is an issue that may not get much media or political attention, but it is one that will have to

be tackled in the coming decades if greenhouse gas emissions targets are to be met.

One option is use policy levers to try to accelerate trends in some industrialised economies towards more vegetable-based diets. Such moves are no doubt welcome, but they face an uphill struggle to deliver emissions reductions big enough to compensate for the growing demand for meat in emerging economies.

Thankfully, as our new special report demonstrates, there are several companies working on technical solutions to the problem of livestock emissions which promise to deliver deep reductions in methane emissions from the cattle that boast the largest greenhouse gas footprint.

Sponsored by Zaluvida, this independent report reveals how there is a growing but under-reported ecosystem of companies that have identified supplements which promise to curb emissions while also bolstering cattle health and agricultural productivity.

No one is suggesting that the 7.1 gigatonnes of greenhouse gas emissions that come from livestock each year can be tackled overnight, and it is clear that policy interventions or some form of carbon pricing may be required to ensure farmers start to take the issue of methane emissions seriously.

But as growing numbers of consumer-facing businesses seek to cut emissions from their supply chains, it can only be a matter of time before pressure on farmers to embrace methane-reducing best practices increases. And, as our report shows, when that point comes, a network of scientists, agricultural experts, and supplement developers stand ready to deliver.

■ James Murray is Editor-in-Chief of BusinessGreen

Methane-busting cattle feed – livestock's climate saviour or a load of hot air?

Every year the average cow releases between 70kg and 120kg of methane, a potent greenhouse gas that causes much sharper short-term atmospheric warming than carbon dioxide.

It's a big, and growing, problem. Enteric emissions from livestock already account for 22 per cent of all US methane emissions, and 14.5 per cent of global CO₂-equivalent emissions each year, according to the UN Food and Agriculture Organisation (FAO). And even as global carbon dioxide emissions begin to flatten out thanks to improvements in energy efficiency and the emergence of cleaner energy sources, methane emissions are on the rise – a study published in December 2016 by a team of researchers at the Global Carbon Project found that methane concentrations in the atmosphere have jumped from growing at 0.5 parts per billion per year in the early 2000s to 9.9 parts per billion in 2015.

Much of this increase can be attributed to rising rates of meat consumption across much of the developed and developing world. And demand for meat and dairy shows no signs of tailing off any time soon – the FAO predicts global meat production will be 16 per cent higher in 2025 than it was between 2013 and 2015, while world milk production is expected to increase 23 per cent over the same period.

Cattle are far and away the largest source of livestock emissions, with enteric emissions from ruminants accounting for 39 per cent of total livestock emissions. So the race is on to find effective ways to curb methane production from cows. The promotion of diets that are less heavily reliant on red meat no doubt has a role to play but such moves, while welcome, will struggle to make a significant dent in demand for meat on a global basis as more and more emerging economies look to emulate western diets.

Consequently, farmers, policy makers and scientists are considering a range of technical and policy solutions to the problem of livestock emissions, from radical steps such as fitting cows with backpacks that capture methane emissions directly from the rumen to considering extra taxes for beef to cut consumption.

However, one of the most promising ways to

reduce methane emissions is to simply change the cow's diet. There is a growing body of evidence that links diet and emissions: most recently a 2016 study led by the University of Aberdeen found Swedish and Finnish cows suffered some of the highest emission levels compared with other European cows due to their silage-rich diet.

For some years scientists have therefore been working on creating animal feeds that optimise digestion and cut emissions. Such feed supplements are derived from a range of sources, from linseed to cinnamon and garlic, and many have shown to deliver promising results. Feeds were found to cut emissions anywhere from 10 per cent to more than 50 per cent, depending on the feed technology, geography, and rest of the cow's dietary make-up.

This report takes a closer look at this under-reported but potentially hugely significant market, which promises to deliver millions of tonnes of emission reductions while simultaneously improving agricultural production and livestock health.

We interviewed a wide range of the market-leading manufacturers and distributors of emission-reducing products and found an emerging and competitive market with enormous potential. We spoke to nine organisations operating in this growing market: Dumoulin, Mootral, Valorex, Trinova, Alltech, Nor-Feed A/S, Delacon, ForFarmers and research body Bleu-Blanc-Coeur. However, this market snapshot is not comprehensive, as others such as Agrosom and Provimi are also active in the space, and there is little doubt that the world's largest agri-tech firms are keeping a watching brief on a market which is ripe for expansion over the coming decades.

The report offers a valuable insight into the products and technologies currently on the market, as well as providing a peek into the future prospects for innovation and advances in the industry.

Key incentives

For the vast majority of firms we spoke to, the primary job of their feed additives is to improve a cow's digestive health, which in turn leads to better milk quality, higher yields, improved growth rates and higher fertility. For many farmers, potential

"Farmers, policy makers and scientists are considering a range of solutions to the problem of livestock emissions, including fitting cows with backpacks that capture methane emissions"

emissions reductions from a certain feed do not yet have the same selling power as higher milk yields or improved fertility rates. There is currently little incentive in the market for farmers to pay extra to cut emissions from their farms — “there is no money in reducing methane”, one executive told us.

But that could be about to change. Farmers supplying large corporate customers, such as Walmart or Ben & Jerry’s, can expect to come under increasing pressure to cut their emissions so those firms can meet emissions targets for their supply chains — known as Scope Three emissions. In fact, Walmart — which has a target to cut a billion tonnes of emissions from its supply chain by 2030 — told *BusinessGreen* earlier this year that it is considering expanding its ‘Climate Smart’ agriculture programme to livestock farms.

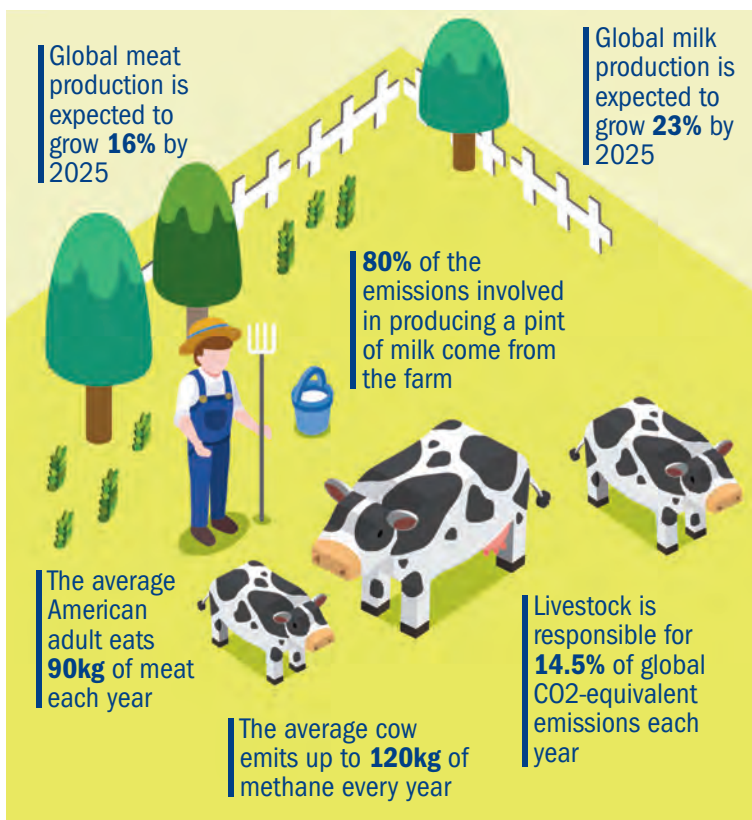
Meanwhile, one firm is already predicting the “creep” of such retailer sustainability concerns into the livestock industry, while another — Zaluvida is positioning its business of its Mootral division to target these growing concerns.

Policy pressures could also have a role to play. Having imposed a price on carbon from industrial sites, the EU has expanded the reach of its carbon market to take in aviation, and is now looking at bringing shipping into its cap-and-trade scheme. With agriculture a similarly large source of under-regulated emissions, it is easy to imagine farmers one day facing carbon taxes that would provide a financial incentive for them to tackle emissions.

Similarly, on a national level countries such as the UK with national legally binding carbon targets and commitments to the Paris Agreement will struggle to meet their obligations without more ambitious policies for tackling agricultural emissions.

Farmers who keep an eye on the long term will be aware of these potential policy and commercial drivers.

We heard mixed reports, however, about the pace of innovation in the methane-tackling market. Some firms reported great potential for future innovation in emission-reducing feed, while others envisaged only incremental improvements on current feeds. Some exciting research is indeed taking place in laboratories — tests are currently



under way on a species of Australian seaweed that cut methane emissions in cows by 99 per cent in laboratory tests — but it is still unclear when, if ever, such a product would enter commercial production.

More certain is that advances in big data collection will soon provide farmers with much more detailed information on the health, productivity, and emissions of their cows. For example, a couple of experts we spoke to highlighted the role that smart sensors and improved genetic data will play in enabling the creation of bespoke dietary plans for individual herds, allowing feeds to be optimised in a way that slashes emissions still further.

Agricultural emissions are becoming an increasingly pressing problem, both for governments and large corporates under pressure to cut their climate impact. Our report shows there is plenty of technology out there with the potential to have a significant impact on this ballooning problem. But for this nascent sector to really take off, awareness of the co-benefits associated with emission reduction need to be more widely promoted, and policy makers need to recognise that their intervention may soon be required.

Alltech and Alltech E-CO2: Data-first farming

Alltech is a US-headquartered company which specialises in the development of agricultural products for use in livestock and crop farming, including the development of animal feed.

In February 2015 Alltech acquired E-CO2, a UK firm founded in 2009 that uses specialist software to monitor emissions from farms. Alltech E-CO2, as it is now known, carries out in-depth farm audits of emissions sources and is approved by the Carbon Trust to give advice on reducing on-farm emissions, making it the only company globally to have Carbon Trust-certified audit models for all ruminant classes.

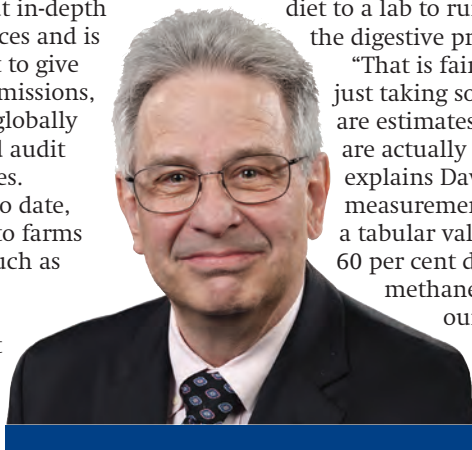
It has audited 7,500 farms to date, and provided tailored advice to farms supplying major corporates such as Tesco and McDonalds.

Around 80 per cent of the embedded emissions in a pint of milk come from the farm level. And despite most farmers assuming it is their tractors, farm machinery or energy use that contribute most to their greenhouse gas emissions, the reality is that cattle are by far the single largest source of greenhouse gas emissions on an average beef or dairy farm. Cattle contribute around 45 per cent of farm emissions, according to Alltech E-CO2 joint business general manager Andrew Wynne, with transport and energy representing just four per cent.

So alongside giving farmers advice on how to make their farm operations greener, Alltech E-CO2's audits often focus on how to improve the health, efficiency, and productivity of the animal herd, curbing methane emissions in the process.

Data remember

Alltech also tackles this challenge with an emphasis on hard data. "Our approach is more of a total systems control, so we depend a lot on auditing what's going on on the farm, keeping pace with what's happening there, and then coming back with recommendations, whether it be formulation or management practices on the farm that can change the overall emission problem or emissions from that farm," explains Dr



"Our approach is more of a total systems control, so we depend a lot on auditing what's going on on the farm, then coming back with recommendations that can change the overall emission problem or emissions from that farm"

Dr Karl Dawson, Alltech

Karl Dawson, the firm's vice president and chief scientific officer. "There's not a single magic bullet that's going to solve the problem for everybody."

To get the most accurate data on the emission reductions available by tweaking a cow's diet, Alltech is expanding its use of in-vitro feeding models which send a sample of the cow's complete diet to a lab to run it through a simulation of the digestive process.

"That is fairly unique in that we are not just taking someone else's values which are estimates for a given feed material; we are actually able to give an exact value," explains Dawson. "If you compare an exact measurement with what would come from a tabular value, there can be as much as a 60 per cent difference in the estimates of methane production. So by combining our technology with what's going

on at E-CO2, we can give a much more precise estimate of what's happening there and give some more recommendations than if we were just working off a tabular of standard values."

Dawson says that Alltech is in the "early days" of applying this method to specific herds, but predicts its work is paving the way for designing tailored diets and achieving much more accurate test results for various feed additives — an

industry first, he believes.

"If we are able to do that with the feed, we can actually test out a feed supplementation strategy in that same laboratory test," he says. "So we can say 'here's an additive that we think will help this process', and we can stick that in and do the measurement to say what to expect when an animal starts using a particular feed supplement or feed supplementation strategy."

In this way, Alltech's approach to producing and selling cattle feed is based on building up "feed packages" for farmers rather than selling a single feed type, additive, or product.

Depending on the herd, the package is based on a combination of technologies including yeast cultures, minerals and exogenous enzymes, and can reduce methane emissions from cattle by up to 20 per cent, Dawson says — results that have

been validated not just in laboratory tests but also using so-called ‘methane chambers’ in China, where cows are placed in sealed rooms and their gas emissions monitored using controlled airflow. “You’re not looking at indirect measurement of methane production from these enteric sources, you are actually measuring the gas that’s coming off these animals,” he explains.

It is a fast-moving field of research and development, and most of Alltech’s know-how is kept as a trade secret rather than using more formal patent protections, Dawson says. “We’ve always found it’s better to go out and find the answers and introduce them to the community

and to agriculture overall, rather than getting too hung up on the fact that somebody else might do the same thing down the road,” he observes.

But although the research into new feeds is hotting up, Dawson believes it will be Big Data that ultimately revolutionises agricultural efficiency. Already he points to examples of robotic feeding systems and animal imaging that can track the frequency of a cow’s feeding and drinking patterns, as well as precise tracking of milk production per cow, as examples of the kind of data collection that is now possible. “I think you are going to find that becomes much more precise as time goes on,” he predicts.

Trinova and Extrulin: Harnessing the benefits of spring feeding

Trinova is a Swiss distributor of animal feed, including the cattle feed Extrulin, which the company says can cut methane emissions from cattle by up to 30 per cent.

The feed is made with extruded linseed, which helps to reduce the number of methane-producing bacteria in the cow’s rumen, the first of a cow’s four stomachs. “The goal of the feed material is to push back the protozoa. By pushing back the protozoa you can also push back or decrease the number of methane-building bacteria,” explains Dr Alfred Michel, Trinova’s technical manager of feed.

Trinova works closely with Valorex, which developed Extrulin, and the collaborative research institute Bleu-Blanc-Coeur, which was set up by Valorex in 2000 and has a number of member companies across the farming industry.

Bleu-Blanc-Coeur has developed a UN-approved methodology to prove Extrulin’s reliability. The composition of the milk from a cow on Extrulin can be analysed to accurately determine the reduction in methane emissions delivered, which can then be exchanged for an emission-reduction unit traded on the carbon market. “We

can prove that it works,” Michel said. “That’s the difference between this product and the other concepts. We are measuring the fatty acid composition of the milk, and with that we can prove

that the product is working.”

However, the strongest selling point of a product such as Extrulin is not its methane-reduction abilities. According to Michel, most farmers purchase Extrulin because it mimics the nutritional benefits of natural spring grass, which is rich in energy, protein, vitamins and fatty acids for cows. It also helps to stabilise the bacteria levels in the cow’s rumen, boosting the animal’s ability to absorb nutrients and produce milk.

The result, Extrulin’s makers claim, is a healthier cow, higher yields and milk with a higher nutritional content. It is these benefits that help justify the cost of Extrulin for farmers, Michel says. One kilogram of Extrulin — approximately the daily allowance for one cow kept inside on silage feeds — costs between 60 and 80 euro cents, but Michel suggests that this investment is more than recouped via higher milk yields and a higher price at market.

As a product already on the market, most of the initial research on Extrulin has been finalised, but Michel says more work is ongoing to investigate the potential to support the cow’s liver in metabolising fat, which will be complementary to the effects of Extrulin.

Michel, who is also the development manager of LifeCircle Nutrition, a research and development subsidiary of Trinova, explains that he is working on this idea.

“About 25 per cent of Extrulin is pure fat, and fat is not a normal feed for cows,” he says. “So you help the liver to transform the fat into available energy for the cow.” He hopes to have tangible research to present in this area within the next three to four years.



Mootral: Putting livestock emissions top of the agenda

Mootral is a new technology from Zaluvida, founded by one of its R&D centres in Wales: Neem Biotech. Unlike many other developers in the field of natural animal feed supplements, Zaluvida, a life-science group, is primarily highlighting how its product — Mootral — helps combat greenhouse gas emissions from cows, sheep, and goats.

A decade of research in the making, Mootral is designed to aid the healthy development of cows by helping them gain weight faster, boosting beef production and enabling them to produce more milk from the same volume of feed. But the Swiss company, which also boasts one of its R&D labs in Abertillery, South Wales, believes the product's big selling point could well be its climate change benefits.

"The main effect of Mootral is that it is a natural feed supplement that helps reduce the methane emissions from enteric fermentation," says Michael Mathres, president of Zaluvida's Mootral division. "And, from what we know, it is the most effective method, because our research shows a minimum of 30 per cent reduction and possibly higher. Unlike other products, it is also sustainable, natural and scalable."

According to Mathres, if Mootral was fed to 40 per cent of the cows on earth, it would equate to a CO₂ equivalent cut of 1.3 billion tonnes, or 2.5 per cent of total global emissions — the same as taking 200 million cars off the road.

One hundred per cent natural, the product's active ingredients are compounds from garlic and citrus, which are mixed together into a powder that can be incorporated into the animal's normal feed.

"The proprietary combination of garlic powder and citrus extracts is uniquely effective in modulating the bacteria in the rumen," explains Mathres. "Mootral reduces the methane producing Archae, which in turn has positive effects on the good bacteria driving the animal's health, yield and fertility".

Another advantage is that Mootral is not transient, meaning cows do not need to be fed the supplement every day in order to have the desired effect. Indeed, although for the first few weeks users are recommended to feed around

10g of Mootral to each animal on a daily basis, ongoing research shows that the dosage can be reduced thereafter.

Although already available for purchase, commercialisation of Mootral is still in the early stages, with a pilot plant producing it in South Wales and with ongoing plans for further international piloting and marketing being developed — potentially in as many as six countries — before the end of the year. At scale Mathres estimates Mootral will cost around €50 a year to feed to a single cow.

"Combatting livestock emissions is going to become a booming industry," he predicts, adding that "we haven't seen another product that is as effective and is also natural".

Mathres highlights growing pressures from corporate customers such as fast food giant McDonald's membership of the Global Roundtable for Sustainable



Beef; and regulations such as major dairy producer California's statutory climate change targets as potential drivers of future demand.

Meanwhile, discussions are also under way to create two market mechanisms to distribute Mootral. The first is a 'Cow Credit' — essentially a carbon offset scheme that would enable companies and governments to purchase one credit for every single tonne of emissions reduction from a cow each year. Such an approach could provide farmers with an additional revenue stream, providing a financial incentive for tackling methane emissions from their cattle.

"We are currently speaking to three third-party standards to help validate the carbon offset," Mathres explains. "Initially it will be a voluntary carbon offset, but the idea is that it will become an accepted regulated approach."

The second mechanism is a Climate-Friendly Cow standard. "We would like to introduce the world's first climate-friendly cow," Mathres says. "Mootral could definitely be a multi-million if not multi-billion company if you look at the market, which includes all the cows on earth and potentially other ruminants."

Mootral certainly has big plans and is targeting the largest beef and dairy markets in the developed world as potential customers.

ForFarmers and Lintec: Cutting emissions could prove fertile ground for farmers

Lintec is the UK trading name for Tradilin, a product patented and sold across France and other parts of Europe by French firm Valorex. As Valorex's UK partner, ForFarmers claims to be the market leader for animal nutrition feeds and is the only supplier of Lintec in the UK.

Like several other products on the market, Lintec is made with extruded-linseed, which can improve the elasticity of a cow's stomach by reducing acid loading and fermentation in the rumen, thereby curbing methane emissions.

Yet ForFarmers' ruminant product manager Nick Berni claims that Lintec is different to rival products as it is produced via a thermo-extrusion process patented by Valorex. That process involves heating the linseeds – taken from flax plants – to very high temperatures before extruding them as a dye under heat and pressure to improve the digestibility of the resulting oil and proteins.

"Then the animal has a better chance of being able to digest the oil and protein, which gets absorbed through the small intestines," explains Berni. "It improves digestibility of straight linseed."

ForFarmers also encourages customers to use Lintec alongside its milk fatty acid analysis tool, Visiolac, which enables farmers to measure – and if necessary therefore modify – the nutritional impacts of the feed.

So, by taking milk analysis samples, it is possible to see whether a farm is producing high or low levels of methane, Berni says.

Nevertheless, methane emissions reduction is only seen as a side benefit, he emphasises, and certainly not the main selling point for UK farmers using Lintec – even though producing methane uses up more of a cow's energy.

"We try to explain that using Lintec is an energy-saving step, so the cow has more energy to use for other things such as producing milk and rearing calves," Berni says.

Indeed, perhaps the main benefit of adding Lintec to cows' diet, so far as

farmers are concerned, is to enhance the omega-3 fatty acids in their animals' feed, which can boost conception and pregnancy rates.

"We tend to focus on the fertility benefits, because that's where the cost is incurred by the modern dairy farmer but also where you can produce huge improvements in performance as well," adds Berni.

Price lag

At roughly £700 per tonne and farmers feeding cows around 500g a day, products such as Lintec don't come cheap, he admits, whatever the longer-term benefits. The success of these products is therefore heavily linked to the price of milk.

"You find that when the milk price is low, as it has been for the past 18 months, farmers are more prepared to remove these products from their cows' diets to sustain their businesses," Berni says. "They would be seen as a non-essential. Milk and

fertility performance might not be as good, but the animals can get by without."

Still, the market for methane-reducing cattle feed has the potential to grow, he argues. Firstly, fat is directly correlated with methane, and by using products such as Lintec, dairy farmers can actually reduce the level of saturated fat in their milk. This is becoming increasingly important for health-conscious consumers, and Marks & Spencer now sells a range of milk it claims to be lower in saturated fat than others on the market.

Secondly, more supermarkets are looking to work with farmers who have the lowest possible carbon footprint and highest environmental standards. Tesco and Sainsbury's, for example, are both taking steps to better measure the carbon footprints of their farmers, with the aim of demonstrating that a low-emission farm is also a more efficient farm.

"It is starting to creep into the industry," observes Berni. "Retailers don't want to be aligned with farmers who are inefficient or don't have such a good green image."



Nor-Add, Nor-Feed A/S and Nor-Sap: Getting back to nature

The strongest markets for Nor-Feed's emissions-controlling natural cattle feed additive, including Nor-Sap, are not just on the company's home turf in Denmark and Western Europe, but also in many parts of South and East Asia, according to managing director Troels Elgaard.

Unlike in the US, where farming trends and marketing pressure have long favoured more synthetic, chemical-based products in agriculture, Elgaard reasons that China and the Indian sub-continent have centuries-old traditions of using herbal medicines to bolster human and animal health.

"That means that if we talk natural feed additives, they are more readily accepted in such societies," Elgaard says.

Nor-Feed sells some of its natural additives in Denmark under its own label, but the firm mostly manufactures its feed for other firms around the world to mix in with their own products and sell under different labels, although he declines to give an indication of the cost of the product per animal.

"We provide more on private labels — that is larger in this field than anything on our label," adds Elgaard.

Improving efficiency

Unlike some of the company's other products, there is no patent for Nor-Sap, however, and Elgaard believes that the best natural rumen additives on the market are often based on the similar concepts that contain various mixes of natural antioxidants and antibacterials.

"You are basically modifying and improving the efficiency of the animals' digestion — modifying the gut function," explains Elgaard. "You must improve the efficiency of the animals' feed conversion. That's what we do, and that is what the good companies and products do as well."

While he won't name names, he believes there are some poor products on the market which are "purely speculative", with little evidence to back up claims of efficiency or environmental benefits — yet even the good-quality products can't sell on the back of emissions reduction alone, he argues.

"There is no money in reducing methane,"

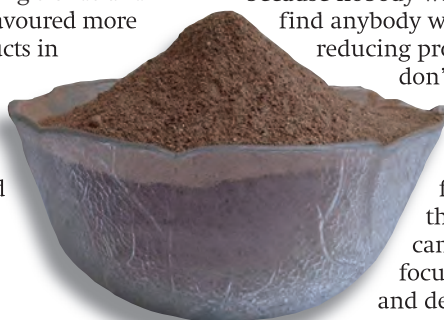
admits Elgaard. "You wouldn't pay for something you don't consider a problem, unless you are forced to by law. All our products and our competitors' products always have other benefits. I don't think it is very smart to position any product as being primarily a methane reducer, because nobody wants to pay for that. If you find anybody who states that their methane-reducing products are selling well, then I don't really believe them."

Overall, therefore, the lion's share of Nor-Feed's revenues come from pigs and poultry feed — gastric animals — rather than from rumen products which can reduce methane, and the focus of the company's research and development also follows the same pattern.

"We see much bigger and more attractive market potential for products that improve the easily servable parameters of pigs and poultry," explains Elgaard. "There you have a completely different set of environmental problems — that of antibiotic-resistant bacteria, for example. Most people across global markets agree that is the most important problem and so it is given much more attention than methane and ammonia."

However, he is confident that reductions in methane emissions from cattle can be delivered. In the right conditions, Elgaard claims that Nor-Sap is capable of reducing methane emissions from rumen by up to 20 per cent compared with other feeds. But farmers, he says, are much more interested in other headline benefits that can be gleaned from the same natural feed additives, such as higher milk quality with higher protein content and low fat content.

"Then farmers get their money back and are not so averse to paying," he observes.



Dumoulin – NUTEX: Re-engineering the rumen

Dumoulin is a Belgian firm which has been manufacturing animal feed since 1937, selling both direct to farmers as well as to wholesalers and manufacturers across Europe. It manufactures NUTEX, a range of feeds containing extruded linseed that can be fed to dairy and beef cattle as well as pigs and even birds.

Werner Reuter, Dumoulin's research and public relations director, explains that NUTEX can deliver a 30 per cent cut in methane emissions from cattle – a result validated by extensive testing at the Walloon Agricultural Research Centre, Belgium, in 2012. Further research with dairy cows at the University of Louvain-La-Neuve and Flemish research centre ILVO has validated a 15 per cent reduction in methane using adapted feed mix containing NUTEX.

Reuter explains that feeding a cow NUTEX helps to reduce the levels of free hydrogen in the animal's rumen by boosting the production of the compound propionate – which uses hydrogen in its production process – and cutting production of fellow compounds acetate and butyrate, which do not. "Most excessive hydrogen is used for methane production (CH₄) that is exhaled when the cow is ruminating," he explains, so any hydrogen that can be used in the digestion process itself is preferable as an emission avoidance measure.

NUTEX has been on sale for about a decade across Europe, and is particularly popular in Belgium, France and Germany – mainly thanks to its ability to boost milk production, improve herd health and fertility and enhance milk quality, according to Reuter. The five to 10 per cent price increase the addition of NUTEX to a herd's feed incurs for a farmer is largely offset by these benefits, he says.

There is less interest in the emission-reduction abilities of feed, Reuter admits. "Farmers do not ask for emission-lowering feed as long as they have no financial advantage (from retail) or as long as CH₄ lowering does not become mandatory (regulation)," he says.

Dumoulin developed NUTEX through internal research, but participates in extensive testing and validation studies with scientific partners including universities and research centres. Although Dumoulin uses patents to protect its research, these do not cover the methane emissions aspect as "for this topic, patents are not really a barrier for innovation because most of the know-how has been published in scientific papers and so cannot be used for patents," Reuter explains. That said, he believes further improvement to NUTEX's performance as a feed additive is possible, and research is ongoing.



Valorex and Tradilin: Hitting the methane-reduction sweet spot

French firm Valorex has been studying, developing and selling natural livestock feed for 25 years, with 120 employees, eight factories, and a laboratory now helping drive its annual turnover of €80m.

One of the largest European producers of natural animal nutrition additives — it produces 180,000 tonnes in France each year — Valorex has been instrumental in research and development in the field over the past two decades, publishing more than 280 scientific papers and filing 14 separate patents.

One of those patents is for Tradilin, its extruded linseed cattle feed additive which makes up around 65 to 70 per cent of Valorex's business. It is sold to feed producers largely within France, but also in Germany, Switzerland and the UK, with the resulting cattle feed, which is made up of roughly three to six per cent Tradilin, then exported to around 40 countries worldwide.

Costing roughly an additional 20 euro cents per cow per day, adding Omega-3-rich Tradilin to cattle feed can have a wide range of benefits, explains Valorex's commercial director Béatrice Dupont during *BusinessGreen's* visit to Combourtille, a small village in North West France where the company is headquartered.

"Well-fed animals are healthy, more profitable for farmers and provide healthy products to the consumer," she says. "Our extruded linseed products mean fewer fatty acids and a smaller carbon footprint."

As well as improving cows' fertility, boosting their energy, reducing saturated fat in milk, and increasing the nutrients and Omega-3 in beef, Tradilin can reduce methane emissions by around 12 to 15 per cent, according to Dupont, depending on the regional location of the farm. Moreover, linseed provides an alternative to using soya and genetically modified crops, which can potentially help combat deforestation.

However, while chopping and changing the make-up and proportion of Tradilin within cows' diets can boost methane reduction even further — potentially by as much 30 per cent compared with cows that are not given the product — doing so can have a detrimental impact on the quality of the milk produced. As such, Valorex believes the

12 to 15 per cent reduction is the optimal methane benefit for animal health while also ensuring the highest milk and beef quality.

Emissions equation

In addition to the feed itself, Valorex offers a milk analysis interpretation tool — Visualait — which automatically integrates farmers' milk data online to foster greater understanding of feed rationing, monitoring and bovine health.

From a farmer's point of view, the long-term economic benefits of the feed are clear, while more consumers and retailers in France are beginning to seek out higher quality milk and beef, according to Dupont. "It is a growing market because we create our market," she says. "The animals don't eat any more

than before of course, but we are taking the place of cereals and soya beans in cattle diets."

Valorex's extensive work to try to measure the impact of its linseed products on animals and methane emissions has also seen it develop, in partnership with non-profit label Blue Blanc Coeur, what it has dubbed 'Eco-Methane' — the only measurement methodology for reducing greenhouse gases from livestock to have been recognised by the United Nations.

In essence, it is a patented equation that can be used for commercial dairy cow herds, and following trials in 75 farms across eight different EU countries, Valorex estimates that within a decade as many as 30 per cent of European farms could be feeding their animals with similar feeds, potentially encompassing as many as seven million dairy cows. Using data from participating farmers, the company is developing an open portal allowing users to view the annual emissions reduction at individual dairy farms across Europe.

Now, based on all its findings for cows, Valorex is seeking to create similar products and measurement equations for other ruminant animals, such as dairy goats and sheep.

"We proved very early on that there was a link between climate change, the human condition and animals' diets," says Dupont. "People in cities often see farmers as polluters. We say to the farmers: work with us and you will be able to communicate a positive message to consumers."



Bleu Blanc Coeur: Emissions reduction with a UN stamp of approval

In the early 1990s, French dairy farmer Jean Pierre Pasquet made a simple yet crucial observation. He wondered why it was that in the springtime, when his cows were eating fresh grass, they were in better health and the butter they produced was softer and more spreadable than it was in the winter.

Pasquet's subsequent quest for answers prompted 20 years of research, testing and, in 2000, the formation of Bleu Blanc Coeur (BBC), the non-profit association of which he is now co-president and which provides a widely recognised food quality label across France.

Numerous scientific analyses and peer-reviewed papers demonstrated that Omega-3 levels are much higher in fresh grass in the spring, whereas by the time the grass is older in late autumn, Omega-6 is much more prevalent. It is the former nutrient, however, which offers the biggest benefits both for animal health and for the products they create, be it milk or meat.

Importantly too, clinical trials found, Omega-3-rich diets can reduce enteric fermentation and resulting methane emissions from cows. The trick, therefore, was to boost Omega-3 nutrients in cows' diets throughout the year – not just in spring – by using natural additives as opposed to just grass.

International recognition

While BBC is a general seal of quality representing a host of health and sustainability benefits, in 2011 the French and Belgian governments officially recognised BBC as a signifier of lower agricultural greenhouse gases. BBC's 'Eco-methane' approach to measuring emissions from cows, developed in partnership with French animal nutrition company Valorex, was then also recognised by the UN for its climate change benefits in 2013, with BBC representatives even presenting their findings to delegates at the historic COP21 Summit in Paris.

"It all came from this simple observation from one farmer," says BBC's international development manager Jérémie Renaud, who is based at the organisation's offices, alongside Valorex's HQ in Brittany – a region where enteric fermentation accounts for around 25 per cent of the region's total greenhouse gas emissions.

More than 650 farms are now participating in the Eco-Methane project, according to Renaud, representing 400 million litres of milk produced and a total emissions reduction of 19,500 tonnes in 2016 alone. BBC is targeting a near-44,000 tonnes annual emissions cut from 1,400 engaged

farms by the end of 2018.

There are now around 1,000 products in France with the BBC label boasting a total market value of €1.5bn. The scheme is also growing, as more retailers recognise the economic benefits of bringing their production in line with recognised environmental, nutritional and welfare standards.

After participating in the aforementioned scientific, clinical trials in the 1990s, Valorex helped form and now funds BBC, although the label has also since secured support from phone company Orange – which provides €80,000 of funding a year – and energy supplier EDF.

"The trials were very important for Valorex," says the firm's commercial director Béatrice Dupont. "We realised it was too big a project for the company, so we had to build an association in France to share this knowledge and boost this type of product."

BBC is working to expand globally and has set up national associations in Japan, Italy, Belgium, Canada, Switzerland, and Israel as it strives to promote sustainable and low-emission agricultural practices.



Agolin – Getting climate-friendly feed onto the farm

Swiss firm Agolin produces animal feed for a range of livestock, but it has placed significant research focus on developing feed for ruminants that minimises methane emissions.

In 2014 it partnered with clean tech innovation body Climate KIC and emission reduction specialist South Pole Group to launch RuMeClean, a project to promote the adoption of feed additives that deliver reductions in methane emissions. “The RuMeClean project is looking to unlock the

vast – and currently untapped – potential for methane reduction from enteric fermentation in livestock, which is responsible for nine per cent to 18 per cent of global methane emissions,” Agolin explains on its website.

It also took part in a 2010 EU research project to create a technological platform to bolster the development of methane-reducing feed additives. The SMethane platform was designed to help small and medium-sized feed businesses to pinpoint the most effective delivery method and dosage for animals and monitor the long-term use and potential side effects of feed additives.

Agolin also produces feed for cows – Agolin Ruminant – made from a blend of plant extracts including coriander, nutmeg and wild carrot. The firm claims this feed not only has a pleasant smell, but can cut methane production in rumen by up to 25 per cent. The company also says the product can boost dairy farm revenues by five per cent thanks to increased milk yield, and add €50 to the price of beef cattle by accelerating weight gain.



DSM – 3NOP and ‘Project Clean Cows’

Dutch science research firm DSM Nutritional Products was first established in 1902, but it is now tackling some very modern challenges.

The company claims trials of its cattle feed supplement powder have shown methane emission reductions of 30 per cent from livestock.

That product, the 3NOP (3-nitrooxypropanol) compound, works by blocking enzymes in a cow’s rumen that are needed to catalyse the final step of methane creation by microbes in the stomach.

The company, which also produces nutritional feeds for chicken, fish, pigs and pets, has not divulged 3NOP’s ingredients. However, it claims the product can also improve cattle health, with trials having found that cows fed with the supplement gained 80 per cent more body weight than other cows over a 12-week period, while crucially there was also no reduction in food intake, fibre digestibility or milk production.

Lead researcher on the trials and dairy nutrition professor at PennState College of Agricultural Sciences, Alexander Hristov, has said the 3NOP product could have a significant impact on

greenhouse gases from agriculture, but that demonstrating these economic benefits of the product to farmers was crucial to its future success.

“It is going to cost money for dairy producers to put this into practice, and if they don’t see a benefit from it, they are not going to do it,” said Hristov in a statement.

With 3NOP still in the development stage, the commercial price of the product is still unknown, but DSM hopes to launch it onto the market by next year.

