HOUSE OF LORDS

Environment and Climate Change Committee

Corrected oral evidence: Nitrogen

Wednesday 19 March 2025

10 am

Watch the meeting

Members present: Baroness Sheehan (The Chair); Lord Ashcombe; Lord Duncan of Springbank; Lord Jay of Ewelme; Lord Krebs; The Earl of Leicester; Lord Mancroft; Lord Rooker; Earl Russell; Lord Trees; Baroness Whitaker.

Evidence Session No. 8 Heard in Public Questions 59 - 64

Witnesses

I: Vicky Robinson, Head of Sustainability, Agricultural Industries Confederation; The Lord Fuller OBE, Chairman, Brineflow Ltd; Pawel Kisielewski, CEO, CCm Technologies.

Examination of witnesses

Vicky Robinson, The Lord Fuller OBE and Pawel Kisielewski.

The Chair: Good morning, and welcome to the Lords Environment and Climate Change Committee. Today is the sixth session of our inquiry into the efficient use and management of nitrogen. We will take evidence from two panels of expert witnesses today. The first will focus on the fertiliser industry, both organic and synthetic; the second will focus on ammonia as a fuel for the shipping industry as it decarbonises.

I remind everyone that the session is webcast live on Parliament TV and that a transcript will be taken and made public. Witnesses will be able to review the transcript and make minor amendments with the agreement of the clerks. I also remind members that any relevant interests must be declared the first time they speak. That should also apply to witnesses.

I warmly welcome our panel of expert witnesses for the first session and ask them to briefly introduce themselves.

Pawel Kisielewski: Very quickly, CCm is a carbon capture and sequestration technology. In real terms, that means we use carbon dioxide to bind together waste materials. That is why it is relevant to this committee. From that, we produce an ultra low-carbon bio-based fertiliser that gives three outcomes. First, it gives the farmer exactly the same performance characteristics in precision, spreading and yield. More importantly, it allows them to grow a net-zero crop for a customer and put enormous amounts of organic matter back into the soil. Secondly, it allows CCm customers such as PepsiCo, Nestlé, Sainsbury's, a number of other retailers and some water companies to significantly reduce their scope 3 carbon emissions. Thirdly, and most relevant for this committee, is the ability of CO_2 to stabilise ammonium. We are in a situation where the Carbon Trust gives us a negative impact on manufacturing emissions and the Environment Agency allows us end-of-waste certification.

Vicky Robinson: I am head of sustainability at the Agricultural Industries Confederation, a trade association representing the agricultural supply sector. This includes over 95% of the UK's fertiliser supply industry: manufacturers, importers, distributors and those providing nutritional advice on the farm.

The Lord Fuller: I have a first-class degree in agriculture from Reading in 1990 and a Nuffield scholarship. I have been in the fertiliser industry for more than 30 years as well as being a director at Sentry, a large-scale farming company. I am a member of the Agricultural Industries Confederation's fertiliser committee.

The Chair: Thank you all very much for taking the time to be with us today. We are very grateful.

Q59 **Lord Ashcombe:** Good morning, and thank you for coming. It is always great to have the first question because it is the broadest reaching. What are the trends in the use of both synthetic and organic fertilisers in the

UK? What are the implications for domestic production and imports of fertiliser?

Pawel Kisielewski: From our perspective, for an industry that grows about 4% annually, the big trend was evidenced in the Ukraine invasion. The UK, like most European countries, imported about 60% of the nutrients it requires to grow its food. Primarily, we imported from Russia, Belarus and Ukraine. Application rates went down after the hike that we saw. The real key here is what happened to the remainder of domestic UK fertiliser manufacture. Of the 40% produced here, the major producer was CF Fertilisers, the American company, which closed down its two facilities so that 70% of that remaining 40% was gone. If food security did not previously meet geopolitics, it certainly does now. We produce very little of our own, and that leaves us very vulnerable.

Vicky Robinson: To pick up on the trends, we are obviously focused here on nitrogen. Mineral nitrogen fertilisers have seen a 40% reduction over the past 40 years, with less used now than 50 years ago. On organic fertilisers, I will break those down. With manures, we have 170 million tonnes of animal manure produced annually, compared with 2.6 million tonnes of nitrogen fertiliser. With manures, typically 6% to 10% is dry matter so requires an application volume about 50 times higher than the equivalent mineral fertiliser. We also have between 20 million and 25 million tonnes of anaerobic digestate each year. The third category is sewage sludge, of which we have 2.5 million tonnes spread on farmland and 50,000 tonnes on forestry. These figures come from the British Survey of Fertiliser Practice, an annual report on fertiliser trends funded by Defra.

The Lord Fuller: It is 35 years since noble Lords examined this. The Library has dug out the report from 1988. I remember that because, as a student, I corresponded with Lord Middleton at the time. The important thing is that the underpinning demand for fertiliser is driven by the fact that we need a productive agriculture. Without nitrogen fertiliser the world would carry 3 billion people, but we have 10 billion. To put that into context, 16 of the 23 people in this room would have to go if we did not have nitrogen fertilisers. Even converting some people away from meat will hardly move the needle.

We have done some work using the National Atmospheric Emissions Inventory[1], which is the UK's published data from 2023 used by Defra and DESNZ, to try to divine the amount of nitrogen that goes into the system. In total, there is a mass balance. Some 200 million tonnes of nitrogen-containing products are applied to land. Of that, 2.6 million tonnes—or 1.3%—comes from manufactured fertilisers, so you can see that, by difference, something like 97% of all materials applied to farmland come from either organic sources, digestates or manures. The big difference between 35 years ago and today is that out of nowhere there are 22 million tonnes of digestates now applied. This is particularly aggravating because they are very low analysis, very expensive to store

[1] Note by the witness: see https://naei.energysecurity.gov.uk/

and quite runny. When they are applied to the land, they are more likely to run off into ditches. Of course, the co-mingling with phosphate absolutely drives eutrophication. This, combined with the huge increase in the amount of organics, is one of the principal driving forces there.

The Chair: Do we have any evidence for that?

The Lord Fuller: This comes from the National Atmospheric Emissions Inventory, NAEI, used by Defra and DESNZ.

The Chair: Are those the most recent figures?

The Lord Fuller: They are.

The Chair: Are those figures separated out into sources?

The Lord Fuller: Yes; they separate them into two sources. One is the inputs, which is how much material is physically applied to soil.

The Chair: Is that for both synthetic and organic sources?

The Lord Fuller: Correct. The other one is the emissions. On removals, 54% is removed in the crops—which is good news—with 26% leached into groundwater and 20% into gaseous losses. The further aggravating point about some organic materials is that they tend to become available later in the season, when the crop has died and the soil has warmed up.

The Chair: Later in the session we will come to how we reduce those negative environmental impacts.

Lord Ashcombe: We obviously produce a huge amount of these organics. What can we do with them if we do not put them on the land? We must find somewhere. Possibly later we will hear that it is quite expensive to do anything with them.

The Lord Fuller: It is essential that we put them on the land.

The Chair: Nods cannot be picked up on the transcript. If you agree, please say "yes".

Pawel Kisielewski: Yes. Incineration is one outcome. Environmentally, that is extremely damaging. The only thing is to transform this into a valuable product.

The Chair: Vicky Robinson, you were also nodding.

Vicky Robinson: Yes. One challenge is how we handle this. Later we will come to geographic distribution. It would be good to pick up that point further on in the questioning.

Lord Duncan of Springbank: I am curious about the risk to supply trends that you picked up on with regards to Ukraine and so forth. That would mean we rely more on indigenous fertilisers. What is the difference in efficiency and efficacy between synthetic and organic fertilisers?

Pawel Kisielewski: From our perspective—and I would say this—it is exactly the same, but the work done over nine years of field trials, with everybody from NIAB, the National Institute of Agricultural Botany, to Tesco and Pepsi, suggests that you get slightly better yield outcomes because the organic matter holds the nutrients closer to the root ball. It has always staggered me that, for a product that is £300 a tonne, on a good day 50% of those nutrients will never reach the root ball of the plant. They will end up either in the atmosphere or in a river.

The Lord Fuller: The question was on the efficacy of manufactured fertilisers. It is important not to forget that 2 million tonnes of fertilisers are used every year. They tend to be applied in a very precise, accurate and timely way, at the moments when crops are able to take them—earlier on in the season. That has really driven efficiency.

The Chair: We will come to efficiency of use in a later question, and a lot of these questions will be picked up later in the session. In case we miss anything on urea, we have a table here that says that in 2022 imports of ammonium nitrate declined, together with an increased share of urea in UK use of fertilisers. Can we talk a little about urea and its impact on ammonia emissions?

The Lord Fuller: Nobody is building new ammonium nitrate facilities any more. The facilities that exist tend to be 30 or 40 years old, and in some cases 60 years old. The world is moving towards either urea production or ammonia and UAN, which is urea ammonium nitrate liquid fertilisers.

The Chair: Are urea-based fertilisers always liquid?

The Lord Fuller: No. There is solid urea: white granules that you can hold in your hand. UAN liquid fertiliser are a combination of urea and ammonium nitrate, which can be dissolved at quite a high concentration. That is a fluid that you pump and spray with a sprayer, rather than spin on with a spreading disc. The key thing is that there has been a global shift in where fertilisers are produced. It is now preferred to have them produced in the Arab states and hot countries. It is not just where people do not need to heat their homes; it is where there are ready supplies of natural gas.

The Chair: Could you focus on urea?

The Lord Fuller: That is where urea is produced, coupled with the fact that the gas price in western Europe is six times higher than US shale in New Orleans. This[2] is a structurally uncompetitive place to produce any form of nitrogen fertiliser. This morning on the wires—I was on a conference call earlier—we heard that the EU has a 2.5 million tonne shortfall of nitrates.

The Chair: Thank you, Lord Fuller. Would anyone like to say anything else on urea?

[2] Note by witness: Western Europe

Pawel Kisielewski: There are only two points to make on urea. First, in the 12 months from July 2022 to June 2023, the European Union doubled its imports of Russian urea. That began three months after the start of the invasion. That goes back to the geopolitical point. Secondly, urea is much more volatile than ammonium nitrate. Heat and other temperature conditions will mean it volatilises into the atmosphere much more quickly.

The Chair: We will move on to the second question. I hope some of the supplementary questions can be picked up. We can always come back.

Q60 **The Earl of Leicester:** Good morning, panel. I refer to the register of interests of my agricultural business and farming. We obviously use artificial nitrogen and have also taken part in a 10-hectare pilot using CCm fertiliser for potatoes. That is a drop in the ocean at the moment but had good results and net-zero production of potatoes.

Where do the emissions of different forms of reactive nitrogen arise across the supply chain—the manufacture—of primarily synthetic but also organic fertilisers? How might these be reduced?

Vicky Robinson: Picking up data from the National Atmospheric Emissions Inventory, 28% of gaseous emissions of reactive nitrogen—including nitric oxide, nitrogen dioxide and ammonia—come from livestock. Some 9% come from mineral fertilisers and 5% from others, such as compost, biosolids and anaerobic digestion. I can provide a more detailed breakdown of those individually, if that would help.

On reduction, we have already talked about the reduction in mineral fertiliser as a trend. That has been due to improved agronomic advice from the Fertiliser Advisers Certification & Training Scheme, FACTS, the advisers accredited to provide that nutritional advice. Also, there is increasing awareness of nitrogen use efficiency and, picking up on an earlier point, precision application. We also have inhibiting urea, which reduces loss of nitrogen to the atmosphere. We have nitrification inhibitors as well.

One challenge from organic manure, particularly farmyard manure, is the application and the timing of application. As a product, it tends to be available towards the end of winter when livestock has been housed, which are obviously not the ideal conditions in which to spread it. That can exacerbate emissions. It often tends to be applied on potentially waterlogged, frozen ground. We had some evidence of that in our written submission. Manures can be applied only at certain times of year in terms of crop growth as well. They tend to be applied in the autumn, before there is a standing crop. The ability to process that manure and remove that water element from it to create a product that can be stored and then applied at the correct time of year is really beneficial.

The Earl of Leicester: But expensive.

Vicky Robinson: Yes.

The Lord Fuller: If you look at total emissions in the national inventory study, 26% of all nitrogen applied leaks into the groundwater and 20% is lost to gaseous emissions. Within the gaseous fraction, there are losses of ammonia, nitrous oxide and some NOxes. The NOxes are potentially the most polluting of all, but the inventory demonstrates that 96% of those come from industrial, vehicular or transport sources. The key thing is that manufactured fertilisers are estimated to be responsible for just 9% of emissions, but 33% come from sludges, manures and digestates. That is aggravated by the point Vicky mentioned that, by dint of their volume, their dilution and their very nature—the timing—they are much more susceptible to leaching into groundwater and losses to the air because they are applied at times of year when either the field cannot absorb them or the crop cannot take them.

Pawel Kisielewski: On the Earl of Leicester's point about supply chains, another aspect is that as well as animal manures there is human waste through the sewage plants. As Vicky said, some 2.5 million or 3 million tonnes of biosolids go to land. A huge amount of nitrates within those can be captured and transformed, but it is a big issue.

The Chair: You mentioned nitrous oxide. In 2023 Cambridge University did a study assessing the life cycle of fertilisers and concluded that the supply change for nitrogen fertilisers was responsible for 5% of global greenhouse gas emissions. Quite a lot of that—two-thirds, I think—comes from post-application of fertilisers. Do you have any comment on that? Is that quantified and addressed in your production of fertilisers?

Pawel Kisielewski: For us, it was the biggest single issue when that Cambridge University report was published two years ago. The other thing that put it into context is that the 2.6 gigatonnes of emissions from synthetic fertilisers and manures is more than aviation and shipping emissions combined. That is why this is such a major issue. For us, the biggest opportunity is to capture those nitrogen elements and put them back into fertiliser.

The Chair: Absolutely. It is quite hard to reduce that waste and it needs to be managed. Presumably it would be a good thing if we can recapture and reuse it, replacing the use of artificial fertilisers.

Pawel Kisielewski: Extremely good, especially in the context of the High Court judgment last week that classified chicken waste as industrial waste. The challenges for the chicken suppliers in this country were tough before last week. I was with a major chicken supplier on the day that judgment was released. It is a major issue. That company has 21,000 tonnes of chicken waste that now needs to find a home.

The Lord Fuller: Can I just be clear that we must not conflate things here? This is a committee on nitrogen; greenhouse gases are carbon. While I accept that there are some nitrous oxides involved in greenhouse gases, the majority by far of GHGs come from CO_2 through the Haber-Bosch process. We should not conflate greenhouse gases with nitrogen,

particularly here in the UK because we do not produce any. There is no primary production of ammonia fertilisers in the UK any more.

The Chair: The reason why I raised the question of nitrous oxide is that the agricultural sector is mainly responsible for its production. It is a very potent greenhouse gas, nearly 300 times more potent than carbon dioxide in its global warming potential. It says "Environment and Climate Change Committee" on the tin, so it is a very pertinent point to consider.

The Lord Fuller: I accept that, but the NAEI does not agree with that assessment.

The Chair: Thank you. We will move on to Lord Jay's question, as we are up against the clock and already running very behind.

Q61 **Lord Jay of Ewelme:** How can the application of synthetic and organic fertilisers be improved to reduce nitrogen losses to the environment? To what extent are fertiliser companies involved in that process? To what extent is it down simply to on-farm practices?

Vicky Robinson: Obviously, one challenge we have touched on is the geographic location of livestock and arable farmers, with manure predominantly produced in the west. We have already touched on the fact that it is heavy. Arable farming is more predominantly in the east. How do you remove this high water content? There is also the variable nutritional content and balance of manures, which brings in the processing. I know Pawel will touch on that. Mineral fertilisers are more concentrated, can be applied with greater precision and have a known nutrient content, which is key. You have things such as sensors. John might want to come in on the application of liquid mineral nitrogen.

On urea and inhibitors, in England there is a requirement for any urea-based fertiliser to be inhibited from 1 April to 14 January if it is applied. That is an industry-led approach introduced last year. There are industry-led initiatives looking at how to reduce emissions. I will let my fellow panellists comment on their aspects of this.

Pawel Kisielewski: I go back to the point that 50% of the nutrients in a pellet never reach the root ball of the plant. You have to improve the nutrient efficiency rate. The way to do that is by stabilising those nutrients, not just the nitrogen but the phosphates. In our case, that is by using CO_2 as the binding agent. That improves the outcome. The National Institute of Agricultural Botany made a human error five years ago when it applied our fertiliser versus a synthetic equivalent on behalf of Tesco. It found that they had the same yield outcome. In fact, there was a 10% difference. We have now stretched that to 20%. There are mechanisms to increase the stabilisation of those nutrients.

The Lord Fuller: A huge amount of work is going on. I recognise the 54% nutrient use efficiency figure. The fertiliser industry is totally committed to increasing that by 1% a year for the next 20 years to get up to about 70% or 75%. That is probably a practical limit. It sounds ambitious, but in the last 30 years the amount of manufactured nitrogen

applied to farmland has gone down by half and the use efficiency has gone up by 30%. This is an achievable outcome. A huge amount of technical work is being done with emerging technologies such as NBPT, cyanoates, Nitrobacter, urease inhibitors, a whole load of biological signalling compounds, amino acids and soil inoculants. There is a huge effort here, in addition to other stabilising uses. This is a practical point. The suggestion that we just leave it to farmers because the industry is not doing anything or interested is disproven by the facts.

Lord Krebs: I cannot make any sense of this measure of nitrogen use efficiency. It is a ratio so does not distinguish between a ratio of 9:1 or 90:10; they are exactly the same. But if I were a farmer, those would be hugely different. If my output was 90 as a result of applying 10, it would be very different from an output of nine by applying one. Why is nitrogen use efficiency a sensible measure? That seems to make no sense at all.

The Lord Fuller: First, it is a value-for-money point. Let us not forget that nitrogen fertiliser is very expensive.

Lord Krebs: But it is not a value-for-money point because the farmer's value comes from the yield. The farmer is interested in the difference between the cost of inputs and the money they get from outputs.

The Lord Fuller: Exactly.

Lord Krebs: That is not a ratio.

The Lord Fuller: But the proportion of the money they spend on fertiliser that resolves into the crop is important. Efficiency in farms comes most likely from applying it at the precise moment that the crop can use it. There is no point putting it down in the off-season. In the last evidence session, for which I sat in the gallery, it was suggested that farmers have changed their practices by not applying nitrogen in the autumn any more. Some practical changes have driven this. I did not quite agree with the evidence given last time that farmers are not using nutrient management plans. In my experience, they all are. There are powerful incentives to use this more effectively, using technology and machinery, sometimes fitted with GPS or NDVI sensors. There is a huge drive there. We must drive efficiency of use, and that leads to value for money.

Vicky Robinson: As well as yield, obviously there is specification, particularly in meeting specifications in things such as milling wheat. That is part of the decision that farmers make. It is ultimately about looking at how to achieve that farm nutrient balance approach through nitrogen and phosphate use efficiency. How do you look at the nutrition you have in your soil from the previous crop? What do you want your crop to achieve in yield and specification? How do you fill that nutrient gap? That is the concept of which nitrogen use efficiency is a key part.

The Chair: On NUE, we have in our notes that system-level NUE would be a useful measure and can be improved by making better use of

existing organic nitrogen resources. Who measures system-level NUE?

The Lord Fuller: This is what came out of the Government's National Atmospheric Emissions Inventory. That is where you extract this data from. The most recent data is from 2023. I referred to some of those calculations earlier. That data shows that 14% of total emissions come from, if you like, manufactured fertilisers and 80% come from manures, digestates and—

The Chair: But is it not the case that a good measure of system-level NUE would mean that less new fertiliser was needed to get the same harvest outputs?

The Lord Fuller: More effective use of organics would be a much better way than focusing—

The Chair: Yes, making better use of existing organic nitrogen resources.

The Lord Fuller: I think we can answer a question on that later.

Q62 **Lord Rooker:** Lord Krebs's supplementary question covered a point I was going to raise. The next question follows from what Lord Fuller just said. How do technologies to increase the reuse and sustainable application of fertilisers made from organic materials work? Overall, are they commercially viable?

Pawel Kisielewski: This question is probably for me. The answer is yes. Our current production costs slightly higher and we have a customer, Pepsi, eating the difference. Within 12 months, we will commercially use it at the same cost of production as with synthetic fertiliser. It can absolutely give the farmer exactly the same precision, accuracy and yield, with the ability to grow net-zero crops for Pepsi. We can also feed significant soil fertility through the organic matter put back into the soil.

Lord Rooker: That is useful. Generally speaking, how easy is it for farmers to sell their excess slurry or manure? Bearing in mind the geographical problems we have in this country, how easy is that? Transport and weight must be factors.

Pawel Kisielewski: Back to Vicky's point, the bulk of manures are in the West Country—that is a slight generalisation. Between 75% and 80% of it is liquid, and there can be no thought of transporting that to East Anglia or Lincolnshire unless you transform it on-site in the West Country to turn it into something transportable. For farmers with an excess, I do not think there is a ready market at all. Biosolid sludge, which is the by-product of water companies, is shipped to farms in tankers, where it sits waiting for the opportunity to be spread. There is more coming in the front door and it is very difficult. I cannot see a market for excess manures unless they are transformed.

The Chair: Thinking about digestates rich in ammonia, what are your views on the potential for ammonia stripping—taking out the excess

ammonia by, for example, volatilisation to produce new fertilisers?

Pawel Kisielewski: That is something we are doing with the nitrogen within the solid part of digestates. Digestate comes in two forms: the solid fraction—which is, weirdly, 75% moisture—and the liquid fraction. The liquid fraction has maybe one unit of nitrogen in it. The solid fraction probably has three or four. If you can transform the solid fraction and take the one unit of nitrogen in the liquid, to supplement that into a pellet for a farmer, that is probably the best mechanism—unless you are looking for that liquid fertiliser.

The Lord Fuller: The interesting thing is that we can learn some lessons from the River Wye valley. We know from Defra figures that of the 200 million tonnes of products applied to land, only 1.3% comes from manufactured fertilisers. By difference, 98.7% comes from these organic sources. We know how dilute they are. The problem is not just that because it is dilute it needs to be transported, which is expensive. It has to be stored and then applied, with application at very heavy rates. I spoke a long time ago, when I was on the road, to a farmer who said he had asked his contractor to put 10 tonnes on an acre twice—and where did he want the rest? These are hugely high application rates, with huge propensity to go into watercourses.

One potential solution for chicken muck in the Wye valley is to digest it in digestors in Lincolnshire. There is a quite a movement of product to go to Lincolnshire. But all you are doing is substituting and creating more dilute liquor to come at the end, and it is a problem. We really need to think about this. Of course, the Government's cancellation of grants for storing organic manures and digestates only aggravates the problem.

One strong potential is pelletisation. That is composting at high temperature, which will sterilise soil and kill weed seeds but also reduce the mass. That gets put into pellets. Therein lies a mass-market solution that can be stored and transported more efficiently. More importantly, it can be applied at the right time out of theatre—that is, out of the area in which it was produced—and ideally on more acidic soils that can better extract the nutrients.

Pawel Kisielewski: Another point about the Wye valley is that three digestate planning permissions have been turned down—so, as John mentioned, it is going to Lincolnshire at 75% moisture. That is madness when planning permission for the three digestors in the theatre, as John described it, is already there. Planning has to be a part of this solution. As of last week's High Court decision, that material is now industrial waste and the costs and complexity of getting rid of it have exploded.

Lord Ashcombe: John mentioned drying it. I imagine that is very expensive if you use electricity. If you use gas, you then have the problem of CO_2 emissions. One and one do not make nothing.

The Lord Fuller: I am engaged with Defra on this narrow point at the moment in my professional life. There are some tried and tested

technologies in Mexico, the US and Brittany—where there are huge dairy, pig and poultry farms—for composting this material. At high temperatures—accelerated composting—the temperature gets up to 70 degrees in the stack. It not only sterilises but reduces the mass.[3] You do not necessarily have to burn fossil fuels to dry it. There is also the opportunity to fold in, if I can put it that way, other materials. For example, the chicken manure power stations that are dotted around produce quite a dead burnt ash. It is very dry; it is fly ash and flies away. The idea of folding some of that in to absorb moisture and then pelletising it is an opportunity for not just agricultural soils but substrates, horticulture, amenity use and in garden centres in little pouches.

Pawel Kisielewski: On the power station ash that has been described, one in Thetford will now close down because the renewables obligation certificates are running out. Suddenly, those chicken suppliers around there will have to find another mechanism to get rid of that material. In our view, the way to do this is to transform those nutrients into a more stable form by reacting with CO_2, which is normally considered a bad thing. Then you start a pelletising process because you are already soaking up some of that moisture.

Lord Ashcombe: Does the CO_2 subsequently get released at any point?

Pawel Kisielewski: It will be in the cycle but, according to statistics from Finland, that takes probably in excess of 25 years.

Earl Russell: You may have just answered my supplementary question. On this issue of the River Wye, you talked about the need for pelletisation but also said that, as a result of the court case, this is now classed as industrial waste and that planning applications have been refused. What should be the future direction?

Pawel Kisielewski: Our view on future direction is through the major corporates involved. If you can follow this chain—I am sorry it is complex—Cargill, one of the world's largest commodity companies, owns half of Avara, which is Tesco's largest chicken supplier, mainly out of the Wye valley. We are very engaged in this. We know the technology is at the commercial strategy board globally with Cargill because it produces chicken all around the world. Those will be the major drivers here because the fines they incurred out of Oklahoma in the United States were meaningfully large US fines. That has got attention. They will be the drivers to the solution.

The Lord Fuller: At the moment, the solution in the Wye valley for one of the producers that Pawel just mentioned—there is another one, which is not participating in this scheme—is to lorry-load raw chicken muck and dump it on the sides of fields in the Cotswolds or wherever, where it is then applied at the earliest possible opportunity in the season. It is

[3] Note by the witness: The mass is reduced through the evaporation of the water.

stockpiled in field locations. Given volatilisation over the winter, that is not a sensible solution. It needs to be processed.

The Chair: Before we move on to the question on green ammonia, I return to the more efficient use of nitrogen as fertiliser. I understand that micronutrients are often a limiting factor on increasing yield. How do you approach that? Does it feature in advice and in your relationship with farmers?

Pawel Kisielewski: For us, the micronutrients are mainly calcium, magnesium and sulphur. One unintended consequence of acid rain that most of us remember from 30 years ago is that farmers now need sulphur in the fields as part of the micronutrient profile. We find that access to those micronutrients from recovered sources is relatively easy and that it is not a limiting factor. Sulphur is the big one for most farmers now.

Vicky Robinson: On the role of advice, that is partly behind the drive for the reduction in mineral nitrogen application. There are more than 7,000 FACTS-qualified advisers who do annual CPD, which is evolving to include things such as the use of soil health—

The Chair: What is CPD?

Vicky Robinson: Continuing professional development. They have to undertake that to maintain their qualification. CPD has very much evolved, as have some of the challenges and solutions, in things such as the role of micronutrients in soil health, the role of nitrogen use efficiency and farm nutrient balance, to ensure that advisers are out there working with farmers to make sure that the best nutritional products, timing and application are undertaken on farm.

Lord Trees: I have a question on farming practices and their important role in reducing nitrogen pollution. We have compared organic fertilisers with synthetic, but what role do nitrogen-fixing plants have in naturally providing this, particularly to pasture? In our notes we find, even for pasture, substantial amounts of nitrogen—and we add on top. Is there not scope for nitrogen-fixing plants incorporated within pasture to do the job and virtually obviate the necessity to add more on top, which risks pollution?

The Lord Fuller: Take grassland, for example. In a dairy system, you would normally apply 400 kilograms of nitrogen per hectare. If you had clovers, alfalfas and other sorts of nodules,[4] and you could do some soil inoculation, you might get 50 kilograms or 60 kilograms. It would make a useful contribution but would by no means be the majority. That does not mean we should ignore it, but there are other ways in which you can use other organics more sensitively.

Q63 **Baroness Whitaker:** Good morning. I should declare that I live in a

[4] Note by the witness: of leguminous nitrogen-fixing plants

national park. What is the future of green ammonia in the agricultural sector? What are the challenges associated with it, both manufactured here and imported?

Vicky Robinson: Basically, it is very expensive because of the energy required to produce green ammonia. At the moment, it is not widely available in agriculture. Where it is available, it tends to be used on niche products with a high value, where you can factor in that cost. Blue ammonia could be more of a solution, where you have carbon capture and storage as part of the process.

Baroness Whitaker: What about importing it from sunny countries where it is cheaper to manufacture?

The Lord Fuller: That is where the future is. Morocco and Egypt are putting in several megawatt hydrolysers at the moment for the production of hydrogen, which goes into ammonia. We must not be starry-eyed about this. Ammonia is the world's most highly traded commodity. It is not just in fertiliser; it goes into paints and all sorts of other industrial products. They are producing solar furnaces in Morocco, where they are really geared up for this, and southern Spain. It is a pipe dream to think we will be doing this in north-west Europe, unless it is in a very niche term so that, rather than paying wind turbines to turn off, we somehow divert that into a hydrolyser. This is not something for north-west Europe, but in the long term it is what will feed us.

Pawel Kisielewski: Pepsi's view on green ammonia is that it is a stepping stone to getting sustainable fertilisers into agriculture. It says that because, if you believe that about half the emissions from fertiliser come from manufacturing it and half from losses in the field, green ammonia will only ever attack that first piece—the manufacturing emissions. You will still put synthetic fertiliser on the field, with the damage it does through toxicity and other issues. Pepsi believes that both green and blue ammonia have a place in the medium term but as a stepping stone to the ultimate aim: recovered nutrients within waste.

Q64 **Earl Russell:** I have the last question in this session. If we run out of time, please feel free to write to us. What policy approaches would make it easier for fertiliser producers to reduce their nitrogen pollution?

Vicky Robinson: On take-up, this is about how we can extract more nutrition from those manures and ensure best practice, which is where it comes into processing and increasing nitrogen use efficiency on farm. That is one area. You could look at progressing the fertiliser product regulations as well. We have more unregulated products coming on the market at the moment. We would advocate for the Government picking up on those regulations again.

The Lord Fuller: Defra's figures show that the fertiliser industry is responsible for just 14% of nitrogen-based emissions. The industry is small but easily targeted. I think there needs to be a more intelligent approach to managing organics, not just farmyard manures but sludges, digestates and other things. It would be useful to recognise that the

fertiliser industry is already very highly regulated with commitments to nutrient use efficiency. The recent reduction in grants for slurry storage is mistaken. The reduction in SFI will mean that the only logical economic approach now is to push all your land as hard as you can. There was a suggestion that you might have low-input, low-output and somehow help the environment in that way. If you cannot get to eight tonnes a hectare,[5] and with regen you will not, that is an economic non-starter. That reduction in SFI will really damage the use policy here. Encouraging technologies such as GPS is another way forward.

Pawel Kisielewski: I have two quick points. First, there is the planning permission in the Wye valley for anaerobic digestors. Clearly, it was the wrong decision to turn the three down; that should be changed. Secondly, the primary piece of legislation for water companies is the Sludge (Use in Agriculture) Regulations 1989, which are 34 years old. In practical terms, a farmer takes sludge from Thames Water or Severn Trent and gets a local permit from the Environment Agency; 34 years ago, a clause said that any further processing would mean that the permit was invalid. It was not anticipated that processing could be positive. We have had Secretaries of State commit to looking at this under statutory instruments but it has never happened.

Lord Duncan of Springbank: Trying to bring this all together, we touched on supply chain issues before and are hearing now about issues in planning. Are we facing a crisis moment within the UK regarding wider fertiliser availability, use and deployment? We may indeed have enough fertiliser but in the wrong place or at the wrong time. Is there a crisis coming that we can anticipate and do something about?

Pawel Kisielewski: Yes, exactly. In addition, we import so much of it, which puts the geopolitical piece on to this as well. A report put out by Europe two years ago said that 83% of the nutrients that could grow Europe's food were already captured in European waste management systems. So they are there; we just need to transform them.

The Lord Fuller: You are absolutely right, Lord Duncan. The key thing is that there is plenty of nitrogen about but, rather like André Previn with Morecambe and Wise, it is all the right notes but just in the wrong order—the wrong time of year. Getting this at the right time of year, when crops can absorb it, reduces the nitrogen that goes into water and volatilises. That is really important. Recharacterising this not as waste but as a resource is critical. We have all this fertiliser and all the nutrients. Can we use them properly, encouraging and incentivising that use? We do not have time to talk about nutrient neutrality now, but it is an insanity that builders must pay £50,000 per kilogram of phosphate they remove when you can buy it from a fertiliser manufacturer at 68p. That needs full attention.

The Chair: Thank you. We are at the end of our session. It is always a challenge. There is so much interesting information that our panel of

[5] Note by the witness: of wheat yield on a farm

experts are always keen to impart. Do feel free to write in with any additional evidence that you feel the committee could benefit from in its inquiry but that you have not had time to impart to us. With that, we thank you for being with us today.

Pawel Kisielewski: We are very keen to invite the committee to the plant to see what happens in practice, if that is ever of interest.

The Chair: Thank you very much.

Lord Rooker: Where is it?

Pawel Kisielewski: One is in Swindon, another is in Diss in East Anglia and there is one in Shrewsbury.

The Chair: Thank you. That brings this first session to the end.