HOUSE OF COMMONS

Environment, Food and Rural Affairs Committee

Oral evidence: Plastic Waste, HC 556

Tuesday 18 January 2022

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Watch the meeting

Members present: Neil Parish (Chair); Kirsty Blackman; Ian Byrne; Rosie Duffield; Barry Gardiner; Mrs Sheryll Murray; Julian Sturdy; Derek Thomas.

Questions 198 - 243

Witnesses

I: Professor Andrew Dove, Professor of Chemistry, School of Chemistry, University of Birmingham; Kathy Page, Programme Manager, Environment, Science Policy Unit, Royal Society of Chemistry; Professor Rachel Rothman, Professor of Sustainable Chemical Engineering, Co-Director, Grantham Centre for Sustainable Futures, University of Sheffield; Professor Mark Miodownik, Professor of Materials and Society, University College London.

II: Richard Daley, Managing Director and CTO, ReNew ELP; Professor Steve Fletcher, Professor of Ocean Policy and Economy, Director of Revolution Plastics, University of Portsmouth; Professor Michael Shaver, Director, Sustainable Materials Innovation Hub, Professor of Polymer Science, University of Manchester; Jenny Grant, Head of Organics and Natural Capital, Association for Renewable Energy and Clean Technology.

Written evidence from witnesses:

– Royal Society of Chemistry

- Grantham Centre for Sustainable Futures, University of Sheffield

- ReNew ELP

Examination of Witnesses

Witnesses: Professor Andrew Dove, Kathy Page, Professor Rachel Rothman and Professor Mark Miodownik.

Q198 **Chair:** Welcome to the EFRA Select Committee. We are again looking into plastics, renewables and recycling. Would you introduce yourselves for the record please?

Kathy Page: I am Kathy Page and I lead on plastics policy at the Royal Society of Chemistry. For those who do not know, the Royal Society of Chemistry is the UK's professional body for chemical scientists and we have about 45,000 members across 120 countries. These include a broad range of people working in SMEs, as well as researchers, students and teachers. Our work includes supporting excellent chemistry education for all, publishing really high-impact chemistry research and advocating for the chemical sciences. To support our policy work, we engage with experts from our broad chemistry membership, including subject-specific communities. Thank you very much for inviting me to speak today.

Professor Rothman: I am Rachel Rothman. I am a professor of sustainable chemical engineering at the University of Sheffield and co-director of the Grantham Centre for Sustainable Futures. My work concentrates on development and analysis of sustainable processes. We have a large project, Many Happy Returns, on reusable plastic systems, and I lead on our lifecycle assessment work within that.

Professor Dove: I am Andrew Dove. I am a professor of sustainable polymer chemistry in the School of Chemistry at the University of Birmingham. My research really focuses on both how plastics—current and new—degrade and how we can make them degrade.

Professor Miodownik: I am professor of materials and society at University College London. I lead the UCL Plastic Waste Innovation Hub and we look into a wide range of plastic issues, addressing them from a multidisciplinary perspective, including behaviour change, chemical engineering, chemistry and material science, and lifecycle assessment. In particular, we have a strong research project at the moment on compostable and biodegradable plastics.

Q199 **Chair:** We are delighted to have so many eminent professors and others before us this afternoon, so thank you very much. The first question goes to Mark, Kathy and Andrew. What are compostable and biodegradable plastics and what role should they play in our future packaging system?

Professor Miodownik: Those two terms should be distinguished from each other. That is the first thing to say. "Biodegradable" does not really mean anything. Most things biodegrade; wood and paper biodegrade. Most plastics biodegrade over time, but it takes a long time. Biodegradability by itself is a non-term. It does not really mean anything.

"Compostability" and "compostable plastics" are very well-defined terms that describe a set of plastics that are designed to be eaten by micro-organisms. They produce carbon dioxide and water as a result of that. They do it under very specific conditions. They do not just do it anywhere; they do it either in industrial composting, which has a certain set of temperatures, humidity and micro-organisms in it that will degrade it, or in other very specialised circumstances, which we are investigating at the moment. That is the general feeling about those two terms.

What role do they or should they play? It is still to be determined, if you ask me. I will give an example of two extremes. On the one hand, we have teabags. For a long time, teabags were glued together by polypropylene, which is persistent in the environment and was ending up in the environment as a result of the teabags being thrown into the environment, either into landfill or being put into composting sites. There was a bit of an outcry when it was discovered and most of the brands have moved to using compostable plastics as the glue.

It is hard to understand how else we can solve that problem, so we hope that the compostable process of collecting food waste, including teabags, is going to biodegrade those compostable plastics. That seems to me a very obvious application of compostable plastics. Hopefully, it will work. We are still doing the analysis of whether or not the microplastics end up in the environment. *****

Then you go to the other extreme, where you have things like nappies, which are made mostly of non-compostable plastics. It is an enormous amount of waste that comes out of an average family that uses nappies. There is a groundswell: "Hold on a minute. There must be a better way to deal with these". Compostable plastics are being touted as a potential outcome, but a lot more research would have to go into finding out how to do that.

The important thing to say is that it is not just the material. There is no such thing as a sustainable material; there is only a sustainable system. I am sure that Rachel and Kathy will say more about this, but, essentially, you need to have a system for dealing with compostable plastics before it is an outcome that you want.

Kathy Page: I agree with what Mark says there and it is a nice segue into talking about a sustainable system. It is interesting that you mention packaging specifically, because a lot of the evidence that we see about the most useful applications for compostable plastics currently are things like caddy liners for food waste bins, which are partially packaging but perhaps not what you mean when you say plastic packaging. If we were to move towards more compostable packaging being on the market, we would need the infrastructure to support that. We would need education for consumers, so that they know where to put that. Often, people are confused by what "compostable" means.

Mark touched on "industrially compostable" as a concept, which is where these need to go into a specific waste stream and be treated in the proper way in order to properly biodegrade. That needs to be in place, if we are going to move to more compostable packaging on the market. As I said, there are specific applications currently where compostable plastics can be useful.

Another thing just to touch on, which we might go into more in a bit, is standards around compostable packaging. The current standards do not always match up with the way that that waste is treated in reality. That could be revisited in order to ensure trust from consumers and that there is a reliable system for dealing with these plastics at the end of their lifecycle.

Q200 **Chair:** Andrew, if I can bring you in and ask a slight supplementary of you, should the Government require compostables or biodegradable plastics to be used for certain applications such as teabags or nappies? How proactive and how specific do the Government need to be?

Professor Dove: Both Mark and Kathy have touched on it, but there is a huge misunderstanding of what these terms mean, even among really well-educated people. Marketing people have perhaps got hold of these terms and made them seem more than they are. There is an opportunity for some sort of policy view on the appropriateness of these terms and how they can be used around the standards. My preferred term would be something around "environmental degradability", which I am not sure an awful lot of plastics would meet at the moment, versus re-terming it "industrial compostability" or something like that. That is on the terms.

In terms of the short-term usages, as the food waste bags and the things that go into food waste get collected and processed, if we can get better infrastructure to deal with industrial composting, we can start to have plastic packaging that is industrially compostable and able to go into that bin, depending on how it is collected. This probably touches on the next hour of recycling, but how that is collected and the inconsistency across the country is a huge problem in terms of introducing things like this.

That is a short-term view, but I have a specific long-term view that, ultimately, we are not going to be able to collect every single plastic that we make and use. Some of that, almost no matter how good our intentions, will escape into the environment. You could take the long-term view that all plastic in 50 or 100 years' time has to be genuinely environmentally degradable if it is going to be used. That is a much bigger thing to think about.

How proactive will the Government need to be? It depends on where the legislation to use them is. If it is in teabags and food caddy liners, and there is going to be food waste collection throughout the country, I would have thought that will require some messaging, but it seems pretty obvious and straightforward to me that people will get their heads around how to deal with that waste. If it gets more complicated and we legislate

that some packaging, for example food packaging, is—I am going to use the term—biodegradable plastics or industrially compostable plastics, we start to complicate it. People get confused by what different plastics are. To a lot of the public, plastic is plastic. To us, it is not. There is much more subtlety and variation than that. The more complicated that request, the more proactive Government would have to be in giving guidance to make sure that it was really clear on what was intended for what bin.

Q201 **Chair:** Thank you, all, for those answers. Going back to Mark on the difference between biodegradable and compostable, anything is biodegradable, but it may take hundreds of years to degrade. Do we, as the public, understand the difference between what is degradable and what is properly compostable? In relatively simple terms, how do we get that out there, so that we know that what we have on labels on products means that it will properly compost and not just biodegrade over hundreds of years? I can remember, as a farmer, using plastic fertiliser bags. They will degrade to a degree over a very great length of time, but they never break down into the soil. How do we get this message over and how do we label it properly?

Professor Miodownik: That is a crucial question. There are two parts to this, as I see it. First, you need a system for dealing with whichever compostable plastics we, as a society, decide are necessary and the best outcome for the environment, whether they are only teabags, or teabags, liners and a few other products. It is going to be a reduced set, because we want to hold on to plastic. Plastic is a very valuable material. Recycling it around the system, not putting it into the environment or creating CO2, is the best outcome, so it is going to be a very reduced set of plastics that we are going to want to degrade into CO2 and water.

Once we have a system and we have decided about that—we have not at the moment, but let us say we get there soon, hopefully—what is the labelling issue? My attitude is that you are just asking too much of the average public. They often have two jobs. They have loads of kids. They have lots of other things. They do not care enough. You have to make it so simple that they do not have to think about it. At the moment, people can say anything about their packaging, and they do. Once the systems are decided and in place, which they are not at the moment, labelling has to be so simple. In our group, we are talking about labels that are about actions, not about the material itself: "Put in the food waste. Put in the recycling". It is as simple as that. All you have to do is know where to put it. They do not need to know anything else.

Chair: That is probably a very good point, so thank you.

Q202 **Mrs Murray:** This is to Kathy and Mark. I call you by your Christian names. Mark, I have no idea how to pronounce your surname and I do apologise. Should the plastics tax and extended producer responsibility for packaging apply differently to compostable and biodegradable plastics compared to other plastics? Should we have different charges?

Kathy Page: That is a difficult question. As it stands at the moment, the plastic packaging tax includes compostables and biodegradables in the plastic that will be taxed. As that relates to packaging—and we do not currently have the infrastructure for dealing with that packaging—we have not done a lot of work into exactly the economics of that. Until the infrastructure is there, there needs to be a bit more focus on creating that infrastructure, if we do want to have compostable packaging as part of our system.

As far as I am aware, the extended producer responsibility currently includes compostable and biodegradable under non-recyclable plastics, and so that would also include the charge there. Again, we have not done a lot of work on looking at modulated fees and things for that. It is about making sure that the destinations for those are properly facilitated. If, for instance, through extended producer responsibility, the money from that could be used to invest in the right infrastructure, that could be useful. Mark probably has more information on that as well.

Professor Miodownik: A useful way of looking at what should or should not be in it is not to look at the material, because materials are not sustainable in themselves. It is the system that is sustainable. You want to support sustainable systems with beneficial tax regimes and to reduce other systems that you do not want to be in place. We have a recycling system, and things that fit into and are designed for that system should get a tax break, because it helps everyone as well as the environment. The recycling bit makes sense. Some plastics are being taxed because they do not fit into our system. It is a very clear message to the market too.

With compostable plastics, we do not have a clear message because we have not, as a society, decided whether we are going to have a system for them. To then send a message to the market is difficult, because there is not a system for them at the moment.

Why should we have a system? As I said before, teabags are already going through the food waste system, which seems to be the only system that compostables are likely to go through. The question is what other compostable plastics should be allowed to go through that system. In my view, it should be the ones that can go through the system and demonstrate that they are good for the environment. We need to have a test: do they go through the system—i.e. the food waste system? Are they beneficial for the environment? If so, they should not be taxed, because they are doing a good job for us. If they do not go through that system—and that is the vast majority on the market at the moment—they are not helping, so you tax them.

Professor Rothman: Just to add quickly on Mark's point about whether they fit into the system and are beneficial, one of the big questions we have around compostables is how we know if they are beneficial. It is very hard to measure. As Mark said at the beginning, when they break

down they produce carbon dioxide, but there is also a certain amount of carbon or biomass left behind. What we do not have data for or understanding of at the minute is the impact of that on the soil. If you make compost with your degraded plastics, what does that do to your soil? If you take a lifecycle approach, we cannot measure the full system at the minute, because we do not have the data on the end of life to do that.

Q203 **Chair:** Mark, going back to you on the tax, one of the issues with applying a tax to a very light material is that, if you are talking about putting a tax on a tonne of plastic, and if you make millions and millions of whatever things out of it, the amount of tax on that is almost negligible. If we are going to put a tax on plastic, how do we make it stick and change behaviour? You may as well just pay the tax and be done.

Professor Miodownik: That is a difficult problem. Essentially, the compostable area is a sort of Wild West of packaging. There are very few constraints on the claims that people can make and, therefore, get a beneficial, favourable view by their customers. It is not just penalising them for that.

On the other hand, almost all the people we meet in our work from compostable packaging companies want to do the best for the environment, so we can take the view here that these are people and companies that are on our side, in the sense that we are all trying to help the environment. I do not think you need to overly penalise them. It is a market signalling. It is saying, "If you fit into the system, we are not going to tax you. If you do not, we are". Most of them will stop making the claims that they are making, because it will be clear. We will have made a decision as a society.

Q204 **Chair:** We use the tax thing as a sort of sword of Damocles to hold over them, so that they will change their attitude and what they are doing.

Professor Miodownik: Yes, but 95% want to do the right thing for the environment. The reason they started these companies making compostables is that they believed it was the right thing. It is just the fact that the system has to be in place for their product to work that is letting them down. They also often do not have faith in the recycling and, to be honest, in the past, recycling has been very poor, so they have been right about that as well. I do not think we need to overly penalise most of these companies now because they have fallen on the wrong side of a systems approach, which is the right approach.

Professor Dove: The big challenge with compostables at the moment is that there are not many and they do not have a wide range of great properties. There almost might be the flipside that you want to incentivise making better compostables.

Chair: Sorry to interrupt, but, while you are talking about compostables,

how can we differentiate the ones that properly compost and go right into water or are absorbed into the soil and not just left there? A lot of these compostables break down but not right down. I had better not go too much into that question, because that is Ian's next question. I will pass on to Ian and perhaps Andrew could cover my point at the same time.

Q205 **Ian Byrne:** This question is directed to Rachel, Andrew and Kathy. Mark, you can put your feet up and get a cup of tea. The Government have said that they are minded to ban oxo-degradable and oxo-biodegradable plastics due to their role in producing microplastics, subject to further evidence and consultation. Is there a need for further evidence on this, or is the current evidence base strong enough to support a ban?

Professor Rothman: From a lifecycle perspective, what is interesting to me is not just whether they make microplastics but how long the degradation takes and what forms the plastics go through on the way there. It is well enough to say that, in X years, there will be nothing left and it will all have turned into carbon dioxide and water, but, if it takes X years to do that, what impact has that piece of plastic had if it is in the environment along the way?

One of the challenges you have with the oxo-degradables is that they are almost billed as: if they end up in the environment, it does not matter. There is a danger that that gives people a licence to litter, because you are saying that, in an unmanaged waste system, it is okay, because they will vanish.

You see all the images of animals with plastic on their heads etc. If it takes however many years for it to degrade, you are going to go through big chunks of plastic to smaller chunks of plastic and, even if you end up at nothing, you will have gone through a stage of microplastics in order to get there. That understanding of what happens in the chain is not currently included in the standards. From my perspective, it is not just where you end up but how long it takes to get there and what happens along the way that is really important.

Kathy Page: Oxo-degradable plastics, through the balance of evidence, have been shown to be harmful, because they produce microplastics and do not truly disappear in the environment. We have sufficient evidence to say that now.

You mentioned oxo-biodegradable. There are other terms such as "triggered degradation plastics". These are newer materials that claim to offer the benefits of additive-induced degradation without the harms of oxo-degradation. They follow a similar initial process, which is breakdown by heat or UV, but then they are often claimed to undergo further bio-degradation in the environment and disappear more quickly.

More impartial assessment is necessary to determine the impact of these newer types of plastics, and that includes, as Rachel was saying, timescales and impact on the environment. Some of these are claimed to

be safe for recycling, and the impact on the waste management system is also really important to consider here. To prevent the unintended consequences that we see in the case of oxo-degradable plastics, more independent assessment is needed before we determine these to be useful or safe on the market.

Professor Dove: Rachel and Kathy have given you excellent answers already on the oxo-biodegradables. I do not really have a lot to add, other than that there is a bit of a challenge here. Part of the reason why a lot of the common plastics that we use perform so well is that they are semi-crystalline. They have crystalline regions of really well-ordered chains.

It is like if you have a crystalline sugar versus a really crushed up, small piece of sugar. It dissolves more quickly when it is in smaller bits. They have these and they give strength to the material, and the amorphous regions that are very disordered give the ductility to the material. Those are the bits that will biodegrade or compost more quickly, and you are left with the little crystalline bits that go into microplastics and then degrade down to nanoplastics. They are the bits that are the most challenging environmental degradation to deal with. That would require some really inventive chemistry to get around, but it is not impossible.

In answering this question and that of the Chair, the other way that you can assess it is that there is a European standard on compostability, which is generally followed to assess whether plastic can biodegrade in an industrial composting environment. We could question if that is stringent enough and if it answers some of the questions that Rachel raised about what impact there is on the soil structures going forward.

As far as I am aware, at least, there is not a standard on environmental degradability to follow, where we could look at what their impact is and the timeline of that in the environment, should a plastic get out to waste. Irrespective of what we do, we do not want to encourage littering. For the environment to dispose of our problem for us is a last resort, really. We hope that things will not get out, but we have to be realistic that some stuff will.

Q206 **Chair:** Andrew, before we leave this one, putting my farming hat on, if you are using compost that has a biodegradable plastic in it, we are really conscious of whether this is going to break completely down and be taken up by the plant as a nutrient, or whether it is just going to stay in the soil as a small particle. The jury is still out, is it not, on a lot of these compostable plastics? What is your view on it?

Professor Dove: My view is that the European standard does not go far enough in terms of what the plastic has to break down to under the conditions at a given time. They are quite forcing conditions for a degradation. You are talking about 55 degrees centigrade, with added microbes, which you are not going to find on the average field in the UK. It does not get that warm.

If you get these plastics that are not fully degraded—and there will be these little nanoplastic crystalline regions—and you put them on your field, or I put them in my garden, they are not going to continue to degrade at an appreciable rate. You are still left with them and you are introducing these nanoplastics into the environment. If you can get the standard and the process right to get those crystalline regions to degrade as well, or the chemistry of the packages right, such that you do not have crystalline regions that are left in the future, you can sort that problem out.

Q207 **Barry Gardiner:** Professor Dove, the trouble is that the Government's innovation strategy last year said that biobased plastics would play a significant role in the economy by 2035. "Where fossil-derived fuels or plastics are required, biomanufacturing will deliver biobased and waste-derived alternatives in 80% of the cases"; that is what they said.

What the Committee takes from what you have said today is that we do not really know and we do not have enough information about the full lifecycle of these, how they break down in the soil and what the impact may be. Could I ask you maybe to get a piece of paper, draw a line down the middle, do what we all do when we have a problem—put "pro" and "con"—and tell us what the pros and cons are of traditional plastics versus compostable biobased plastics?

Professor Dove: That is quite an activity to do on the fly. If you want to keep talking for a little while longer and give me some time to think, that would be great.

Q208 **Barry Gardiner:** Let me tell you about one of the things that I was thinking might be on the con side. If we are going to produce 80% of these plant-based plastics that we require by 2035, that is going to take up quite a lot of land, is it not? That is going to impact on many other areas where we need to be thinking about agriculture, climate change and usage. I see Kathy Page and Professor Rothman put up their hands fleetingly on this as well, so while you are doing your chart down the middle of the page, Professor Dove, I will turn to Kathy.

Kathy Page: I know that Rachel will have a lot to say on this as well. I just want to jump in quickly and make the differentiation here between bioderived plastics and what we have been talking about, which are biodegradable and compostable plastics. You can make traditional plastics from biomaterials like starch or waste materials, and those can behave in similar ways to traditional plastics, for instance being recycled. You can also make biodegradable and compostable plastics from bio sources such as PLA, which is made from starch, so there is a slight differentiation.

It is definitely necessary to move away from fossil fuel sources for making our plastics, which can be through using bio sources. You mentioned the slight tension there between using, for instance, land and water for growing those materials. There are some innovations that use things like waste materials for making new biobased plastics, so we do

not necessarily have to rely fully on raw materials for those as well. We can also use recycled plastic for the new materials that we are making if we have a closed-loop system there.

I will pass over to Rachel, because I know she will have other things to say.

Professor Rothman: I was going to say the same thing about the distinction. You can be biobased and not biodegradable at the same time, and that is important. Where you get your bio source from is hugely important. You are absolutely right that you end up with the contention of land, waste and food. As Kathy said, you can make them from waste, but what is important to understand is that turning a bio source like a plant into a plastic takes a lot of energy. We have done a lot of work looking at what the carbon footprint is if you make biobased plastics now and what it would look like in five, 10, 15 or 20 years' time. You need to de-fossilise or decarbonise your energy system in order to make biobased plastics make sense.

If you make a biobased plastic today, there are very few that are better on a carbon footprint basis, because of the enormous amount of energy that is required to make them in the first place. It is not just the source of the plastic that we have to de-fossilise but the energy that is used in the processing as well. Because there is so much processing, it takes a lot of energy.

With some biobased plastics, when you get to about 2032, they start to overtake the fossil-based ones, and the carbon footprint of the biobased is lower. That does not mean that we should not work on them until then, of course, because at the point they are going to become better we need to be ready to roll it out, so there is a bit of a balance there, but it is really important to bear in mind how the energy changes.

One really good thing that we could do is use a biomaterial to make plastic that is durable. Rather than chucking it away after a single use, we are going to make something that is going to be around a really long time. In effect, you have now sequestered carbon in your plastic. If you start with a bio source and a renewable energy supply, you are putting carbon into a product that can stay around for a really long time, so plastic can be used for carbon sequestration if you never get rid of your product, or not for a long time.

Q209 **Barry Gardiner:** Why is the pivot point in 2032 in terms of CO2 benefit and negative? What happens around then?

Professor Rothman: That was just one example for one material. The analysis that we have done looks at the BEIS projections for decarbonisation of electricity, whereby, over time, you get more and more renewables on your grid, and there are some projections of how that happens.

The other thing that we have looked at is if you move away from gas as a heating source to, say, hydrogen generated from renewable electricity. In order to do that and to make those biobased plastics have a low carbon footprint, you need an incredible amount of renewable electricity, because, all of a sudden, you need your renewable electricity for electricity and to provide your heat source in some way. There is an enormous amount of both renewable energy and infrastructure needed in order to make those biobased plastics have a lower carbon footprint.

Q210 **Barry Gardiner:** Thank you very much. That is really helpful and clearly explained. Professor Dove, I am not sure if you have got any further with your page.

Professor Dove: I have got a little bit further. Some important points have been raised in terms of achieving the biobased targets. You can make polythene from biobased resources. It is still the same material and will still persist in the environment for the same amount of time as oil-based polythene, with all the challenges that Rachel pointed out in terms of energy intensity. Also, the chemistry of having to do that may involve some other, not particularly pleasant chemical processes that we may want to avoid, if we can.

Where I got to on the pros and cons, there are a lot more pros in the current way that we live from petrochemical, non-biodegradable plastics. A lot of that is because they are established. They have been preferred and designed around for 50 years. Let us be honest: they have really great properties for what we want them for. We like to use them because they are convenient, lightweight, strong and ductile—all of the things that we want to use them for—and they are cheap. Ethylene is not far off a waste product from the oil industry that they can then make into plastic.

The scalability question has also been dealt with. These are made in millions of tonnes a year. In my lab, going from a 10 gram scale to even a 10 litre or 10 kilogram scale is a really difficult thing to do, never mind up into the tonnes.

There are a lot more pros for current plastics. As for the cons of them and where biodegradable plastics really have the advantage, I have written down "environmental legacy". That is the con or the downside of plastics, and it is not intended. I do not think anyone set out to litter the world with plastics. There was a report just this morning that I saw on the news of how far and wide plastics are and how long it is going to take us, if ever, to have a world that they are not polluting from what we have done already. There is a recent study that showed that there is more to come, and there is an awful lot more in our land and rivers than are out there in the oceans at the moment.

It is how you weight the convenience and the pros of the current system against the massive damage that we did not intend to do.

Q211 **Barry Gardiner:** You have very clearly articulated that the present is

weighted because it is cheap, but that the cost of continuing with the present is a very expensive future in terms of pollution. You drew that out very nicely, so we do need to make the transition, given what Ms Page and Professor Rothman have said.

In that respect, I understand that the Government's plans for the extended producer responsibility scheme for packaging, and their plastic packaging tax, also intend to apply to bioplastics and biodegradable bioplastics. Should this Committee be, for example, making recommendations to Government to distinguish those, so that we incentivise that process from the current production model to what we hope, by 2032, might be a better one?

Professor Dove: There should be a very clear distinction between "bio-sourced" and "biodegradable" or "compostable", or whatever term we can agree upon, because those are two completely different things that are often confused. As soon as you put the word "bio" in there, you jump to thinking that they are the same thing, and they are absolutely not. You can make polythene from sugarcane. The distinction needs to be made. Rachel raised the point that it is probably no better than making it from fossil, other than you are not digging up the fossil from the ground, but that is probably going to get dug up anyway, for other reasons.

Professor Rothman: I just wanted to add one extra thing there. It depends on what you are hoping to achieve by having the tax. Is it to reduce waste and the plastic in the environment, or is it to reduce the carbon footprint? The two are not necessarily achieved by the same thing. If you take a PET bottle like you buy soft drinks in, you can make that from fossil sources or from biobased sources. There are two main ingredients in it and you can make both of them from either fossil or bio sources.

With one of those ingredients, if you switch to biobased sources, you will have a lower carbon footprint than the fossil equivalent, which is why a lot of bottles are 30% made from plants. The carbon footprint of making the other 70%, which is that other ingredient, from bio sources is huge compared to using fossil sources. In that example, we should not be incentivising switching that second ingredient, if carbon is the thing that we care about. If what we care about is the bottle and whether it will end up as waste, it does not really matter which source it came from in the first place.

Q212 **Barry Gardiner:** Those are nice distinctions and very helpful, but be a little more helpful to us and tell us what distinctions we could be recommending to the Government. I take your point that there is no point in saying that you should not be taxing the compostable bioplastics in the same way, but if you are trying to reduce emissions now, because they are more intensive and emitting CO2 in their production, you may need to do that. How are you going to get to that 2032 point?

Professor Rothman: You have to incentivise renewable energy and electricity. If you incentivise the use of biobased materials, as in we take in carbon in the production of plastic within the plant, and you also incentivise a switch to renewable electricity and energy, you are in a much better place. Mark has something to add there.

Professor Miodownik: We are talking about the taxes on one side of this equation, but it feels to me that the tax on fossils is going to be the most effective market signal. I understand that it is difficult, but, if you want—and we do—to transition away from fossil fuels, the tax regime on those and on the production of plastics from them has to go up. That will do it for you.

Q213 **Derek Thomas:** Professor Rothman, I want to come back to your point when you suggested that, to get this right, we just need to find something that lasts a long time—a cup or whatever we might be making. The Government want to encourage greater use of reusable and refillable plastics, but there are still risks in terms of negative environmental impact, unless we can get that right. I know that you have been doing some work along those lines. It may be too early, but is it possible yet to draw any conclusions at the moment about the kind of reusable and refillable models or items that work best? Do we yet know that information?

Professor Rothman: "It depends"; that is the short answer. There are two types of reuse. There is return, which is where a business owns the container. As a consumer, I would borrow it and give it back, and the company is responsible for it. Then there is refill, which is where I own the container. If I own my own coffee cup, I could go and get it refilled, or I could take my jar to a store and refill it with pasta, for example. Return and refill will be preferable in different circumstances, because of the ease of engagement with them.

Your traditional return example is the milk bottle. Okay, it is not plastic; it is glass, but it has been around a long time. The dairy owns the bottle and takes it back. That system works and they have a really high return rate because it is a captive audience. You put your empty bottle on the doorstep, it is taken away, and a new one is returned to you, full. There is very little that the customer has to do for that.

It is when you start to get to more complex systems that require the customer to do more in order to engage with them that it becomes difficult. That is where our big multidisciplinary project comes into this in terms of trying to work out how to incentivise reuse. One thing that they have looked at is people's willingness to reuse. There is quite a lot of evidence that people want to reuse something only if it still looks new at the minute.

There is a question there of whether that means we should be designing all of our plastic products that we want to reuse such that they are so durable that they always look new, or whether we have to change the

public perception such that it is now a cool thing to use a packaging that is dented or scratched because it shows that it has been used more times and is now better for the environment. That kind of public perception and selling of it is going to be so important to engage reuse.

We do not have much reuse as a system in the UK, but if you look at western Europe a lot of drinks bottles are reused glass. They all have the ring around the outside where they have gone through the bottling plant loads and loads of times. It is just accepted that that is a good thing, because it has been reused a lot of times.

Some of our researchers are looking at household reuse and found that, within households, people reuse a lot of things but it is more repurposing. People use old biscuit tins for things, or they keep jam jars and reuse them for different things. What they are now looking at is how you move that behaviour from out of the home, because it is one thing to have lots of packaging or plastic at home that you reuse, but how do you get people to take it out of their home?

The classic is the supermarket carrier bag. People buy bags for life but we have been working with a supermarket, which, when it interviewed people at the checkout, found that 44% of people had left their bags at home so were not reusing them; 44% had left them in the car, so were not reusing them; only 10% of people had their reusable bag with them at the checkout. If people do not do it in that example, how do you get them to reuse everything else? That really is the challenge now.

This comes back partly to tax and partly to incentives. There is a lot of research from other angles, working with our psychologists, about how you get people to engage. Think about speeding signs. If you get a thing thanking you for not speeding, that encourages people more to not speed than telling them that they are speeding. You can do the same thing with packaging. They are looking at how you say, "You have saved this much carbon dioxide by reusing your packaging". That work is ongoing at the minute, so there are no conclusive answers, but there are a lot of things that we can do to incentivise that reuse.

The one thing that is really clear is that, whatever packaging you have, a lower carbon footprint is obtained by using that packaging over and over again. The more times you use it, the better it is.

Professor Dove: A lot of this comes down to cost and value. For any of us who have walked around university campuses, when you walk past any lecture theatre there is a collection of drinks cups and bottles for life. They are not valuable enough to the people who own them. They have forgotten them. I have been past the same lecture theatres day after day, and it is just a pile that gets bigger. Those things do not necessarily go through the right recycling channels, because they are different materials to what we are used to dealing with. While I am not speaking against reuse, because it is a really good thing, there are challenges there. With a plastic bottle that you get when you buy your drink, why

does the drinks company not charge you a premium for that bottle? The plastic is so cheap as part of the cost of the drinks product that they are happy to give it away to you and you can deal with their problem going forward.

If it cost me £100 for a reusable coffee cup, it might be too expensive because it would put too many people off, but I would look after it and I would know exactly where it was. For me, it is probably even a tenner. There is a really complicated equation around that and I do not know if there are some policy recommendations or legislation around those sorts of areas that could help.

Q214 **Derek Thomas:** You would be stealing them from the lecture theatre if they cost that much.

Rachel, you mentioned supermarkets and the lifelong bags that just get left at home. Should we be looking at large retailers being required to dedicate floorspace, not necessarily to bags for life but to refill models, where they supply the ingredient that would go into the container? They have to create that space and that culture where the consumer goes along with the container. Where I live, we have a little unit out in someone's garden that does that with milk. You take whatever bottle and you pay for your litre of milk, which is brilliant, but that is on a tiny scale. Where should retailers be engaged in this or what they should their responsibility be?

Professor Rothman: Some of this comes back to whether we should be aiming for a refill or return system for any particular product. If you are doing a refill system and you are trying to do it for a lot of products, as the shopper, I am, all of a sudden, taking 20 or 30 empty containers with me to the supermarket in order to fill them up. Is that a practical thing to require or would some products be better on a return system? You can get milk in glass bottles in a supermarket. You do not have to take the empty with you but you can take the reusable container from the supermarket and return it in a different way.

Absolutely, we should be finding ways for large supermarkets and equivalents to do reuse, but for any given product we have to look at whether refill or return makes more sense. For dry products, refill is a lot easier than it is for liquid products, because you end up with an awful lot of mess when it is spilled. A lot of work still needs doing to understand how to make reuse mainstream and how to get people fully engaged, from both the customer and the business end. Some of the funds raised from EPR should be used to look into how we get reuse more mainstream. If we are looking at a return system, it works best when it is local.

Coming back to think about the lifecycle, if you are reusing packaging, you are reusing it lots of times, but in that reuse you are washing it and maybe transporting it to different places. To look at whether it makes

sense, you have to consider the washing and the transport that goes on within that supply chain as well.

If you are thinking about a local system, like a milk bottle from a local dairy, with short transport distances, that makes sense on a carbon footprint to do reuse. I talked to a beer manufacturer a while back. They were saying that they looked at reuse, but because there is one place where they make it and they distribute around the whole country. It did not make sense in terms of carbon footprint to have a reuse system because of the massive transport distances that those beer bottles would have to go. That did not work, because they were thinking about reusing their own bottles, whereas, if you can localise any given system such that a bottle may be filled and moved somewhere but then returned locally, because it is refilled by someone else, so everybody is using the same packaging but for different things, that is when reuse starts to make sense. Then you have to get the businesses to buy in to having the same packaging but maybe with their own label.

Q215 **Kirsty Blackman:** I did a very unscientific survey of my friends about plastic water bottles. Most of us use reusable ones, but sometimes you just cannot avoid having to pay the money, because you do not have water with you, particularly if you have kids. My friends said that you should never refill those. They are aware that there are health risks associated with refilling them, because it says on those bottles, "Do not refill this bottle" or that the bottle can only contain that brand name of water. So you cannot refill them. Is that something that is, for a start, wrong—that there are health risks associated with it? How do we overcome that? We are all keen to reuse and recycle things, but these manufacturers do not want you to put anything else in it and are making it very clear on the packaging.

Professor Rothman: The challenge that you have is if you are refilling it with the same thing it once had in it or with something completely different. Imagine you now have a single-use water bottle. You have drunk the water and taken it home. You have stored your bleach from under the sink in it because something went wrong with your bleach container. Unless you clean that very well, you should not then put a drinkable product back into that bottle. This is where your challenge with reuse comes in, not whether you should refill it with the same thing. If it is an edible product and you are refilling it with another edible product, that is okay, but has it been used for something that was not edible along the way? That is where you get the challenge.

Q216 **Chair:** Surely, the retailer also has a problem, because if you come back with a bottle or a container that is dirty, and the retailer puts a perishable product in it that then goes off, the customer might come back and say to the retailer, "You sold me a product that went off" when it was probably the dirty container that caused it to go off. How do we get not only the consumer but also the retailer to be confident to reuse some of this that customers bring in?

Professor Rothman: The more you move to return, the more you need centralised washing facilities that meet whatever standard is required for the product that you are putting into it. Take homecare products. Imagine you have a bottle of shampoo. You finish the shampoo and take the bottle back, and it is going to be refilled. Yes, it needs to be clean to be refilled, but you would not have to clean it to the same hygiene standards as if it was a bottle that you were putting milk into, for example. You have different standards for different types of products. The non-food and drink products will be easier to start from a reuse perspective, because you do not have to get over the hurdle of food hygiene along the way.

Q217 **Kirsty Blackman:** Just to confirm, if I have a plastic bottle of water that I have bought in a shop, and if I take it home, wash it and fill it up with tap water, there is no health risk associated with that.

Professor Rothman: No.

Kirsty Blackman: Because it literally says all over the internet that there is. It is one of these things that we have to overcome with people.

Kathy Page: I just wanted to make one quick point on the subject of reuse. While I very much agree that we should be moving further up the resource hierarchy, and looking at reducing plastic consumption and incentivising reuse where we can, there may still be some instances where recycling is the best option, perhaps for an on-the-go product, with packaging that is necessary for food hygiene. We do need to make sure that we are investing in recycling as well and that we are looking at reuse where it is the best environmental outcome, but there may be some instances where that is not possible.

Chair: It is the old cliché that not all sizes fit, so we very much take that from you all, thank you.

Q218 **Rosie Duffield:** I just want to put a plug in for Unboxed in Canterbury, which is a shop just like the one we were hearing about from Professor Rothman, where people can take their containers and get them refilled. It is a really lovely experience going into the shop, because you buy things in paper bags and you scoop things up and put them in your own containers. You are engaged with the whole process of what you are buying, so it is a really pleasant experience. Everyone on the panel is welcome to come to Canterbury and sample that if they would like to.

To Professor Rothman and Kathy Page, the Committee has heard that proper lifecycle assessments of all materials are essential for determining the most sustainable materials, but are they often hard to compare? How do we address this problem and how can the Government help? Professor Rothman, you already said, on an earlier question, that we do not have the data to compare, so is that relevant to this question?

Professor Rothman: It is very relevant. First up, we have a shop very similar in Sheffield called Unwrapped, and I highly recommend that as well. It is great for reuse.

The challenge with lifecycle assessment is always getting good data. There are some systems for which we have lots of good data, all the way from digging the raw material out of ground to the end of life, and we can make a really accurate assessment of the environmental impacts. That includes not just carbon footprint but water use, land use, ecotoxicity and all sorts of other things. The longer a system has been around and the more it is done, the more data there is available in order to make a good assessment of the lifecycle.

We did an analysis a few years ago now of published lifecycle assessments of biobased and biodegradable plastics. Some of the results that we found varied by over 400%, from things that were claiming to look at the same product. That is, in part, because some used a slightly different process to get there, but also, when you do an assessment, you have to draw a system boundary. In your assessment, you include everything that is in that boundary that you define. If two people define their boundary in a different way but do not express what that boundary is, you can end up with conflicting numbers for, nominally, the same product.

There are ISO standards for lifecycle assessment, but they do not prescribe the scope or the data quality. I would recommend that people follow the product environmental footprint, which is a method published by the EU that includes guidance on the method, the impact categories, the requirements for data quality and various other things. It is really important that, when people publish a lifecycle assessment, they include all of the information about how it was done and what assumptions were made.

The challenge at the minute is that you often see, "This is 12% better than that", and that is all you see. You do not see on what basis, or what was or was not included, so there is a lot of information out there that claims to be good lifecycle assessment but is not giving you enough detail. Sometimes you will find that people publish only some of their results, because they will tell you the bits that look good and not those that do not, so having standards about that is important.

There are different methods within lifecycle assessment, all of which are valid, and it is important to state what you are using. If we think about that biobased question that we had before, imagine I have a crop that I am growing. Normally, I would take the wheat and make a food with it. Any environmental impacts of that growing, like the fertiliser, I would allocate to the wheat. Now imagine I am going to use the waste and make a biobased plastic from it. That waste was a waste, so it did not have any footprint associated with it, because I had allocated all the footprint to the food, but now that I am going to make something from that waste I should allocate a portion of the footprint to my product from the waste. Do I do that on a weight basis or an economic basis? Is one of the things worth more than the other?

All of those are valid lifecycle tools. I am not going to go into the details of how you can do it, but hopefully that gives you a simple example. There are different methods that you can use and they are all valid, but they will give you different answers, depending on the way that you allocate things and the data that you use along the way.

There is another thing with plastic products that the lifecycle does not include. We already mentioned, with compostables, that the lifecycle assessment will not include the impact on the soil of any solid degradation product. There is no data for that in lifecycle assessment at the minute.

The other thing that is often not included is the impact of littering. When we are thinking about single-use plastics, we do a lifecycle assessment and that assumes a managed end of life. We assume that it goes to recycling, to landfill or to incineration, or we could assume that half of it goes to incineration and half to landfill, for example, but what we do not have is data in the lifecycle assessment on what happens if it ends up as litter. If my piece of plastic ends up in a hedgerow or in the ocean, the impact of that is not currently included. There are some projects going on, looking at the impacts on marine in lifecycle assessment, but they have not concluded in order to be able to build that into a standard lifecycle assessment.

It is a really useful tool, and we have said that we would only do this if it made environmental sense. We have to use lifecycle assessment to help us work out whether it makes environmental sense to do it, but we still have to bear in mind that not everything—

Chair: Rachel, I am sorry to interrupt. This is really good evidence, but we are beginning to get a little bit tight on time, so can we just tighten up the answers? It is really good stuff; do not get me wrong.

Professor Rothman: That was me on that. I have nothing to add.

Chair: Sorry to cut you off, but we need to keep going.

Kathy Page: That was very comprehensive from Rachel. There are current guidelines on making environmental claims, which came from the Competition and Markets Authority. There are guidelines out there about what claims you should and should not make, as a business, about the environment and the sustainability of your product. I would agree that there are guidelines on how lifecycle analysis can be used. We would say that increased investment is needed in research, which Rachel briefly touched on, including into different impact categories, and potentially also looking at database technologies that could help with some of the transparency and comparability of LCAs.

Professor Miodownik: From the citizen public perspective, these things are very opaque. The calculations and datasets are highly complex, and yet it is often described as "yes/no—it is better than this". It is much more complicated than that. For instance, water usage is a societal good

or bad, depending on the product's energy use, CO2 emissions or ecotoxicity, which is how it affects the soil health. Different stakeholders will have different worries about that.

How do we then, as a society, say—and this is the truth—"All materials have an environmental impact"? There are no sustainable materials out there. We are judging one with another—paper versus glass—and we are always doing this as a society. The LCA is the way to work out which is the best material system for the product, but we need to be explicit about those criteria—water, energy or CO2. We can trust the public with this complexity, but we need to talk about it more and to educate them more. LCAs need more publicity, not less.

Chair: Thank you for some very good answers. If we can keep these last couple of questions down to under five minutes each, I am mindful that we have another panel of very good witnesses as well as your good selves, who are excellent.

Q219 **Kirsty Blackman:** The first question that I have is about the types of materials that we use for each different thing. It is really important that we choose the right kind of material for each different thing. So much of our clothing, for example, is made of plastics right now, but maybe that is the best thing to use. Fleece jumpers, for example, are unbeatable. Maybe there is nothing else. How do we make the decisions about which things are okay to use plastics for and which things we should not be using plastics for?

Professor Rothman: I agree with you; it is a tricky problem. As Mark was just saying, are you basing that on a carbon footprint, a water footprint or a land use footprint? You also have to think about where the product was made. If you are talking about clothes, has it been shipped a long way or has it been made locally? There is a footprint of moving things around in your supply chain. It is not the case that you can say, "This material is better than that material", because, if one was made locally and one was made a long way away, you might flip the answer round.

It is complex and being able to ascribe a carbon footprint, a water footprint, or whatever it might be, to things in order to help people make that choice is really important.

Professor Dove: The reality is that a lot of these assessments demonstrate what happens at the end of life. A lot of—they are a little old now—lifecycle assessments will show you that a polyethylene bag is better for the environment from its conception to when we have finished with it than a cotton bag, by a long way, because of the environmental impacts of the fibre and the cotton. The problem comes when we have had enough of it. It does not need to be a single-use plastic bag. You can keep reusing so-called single-use plastic bags, but what happens at the end of life, what does it go to and what impact does that have on the environment as it degrades, if it fails to get captured? It is a really

important point to add. It is not just the lifecycle but the end-of-life options.

Professor Miodownik: Yes, exactly. A better way to look at this is to think not about the material but about the system. Is there a system in place for plastic clothing that is circular? No. Until there is, there is a big question mark over that type of clothing, if you ask me. Is there a system for paper? Yes, there is. Is it in this country and does everyone have access to it? Yes. That is a big tick, if you ask me—aluminium, ditto; steel, ditto.

On plastics, which is what this is about, we have very good infrastructure for three plastics: PET, polypropylene and polyethylene. For packaging, that makes sense. Let us get those systems more efficient and reduce the number of plastics.

It is not so much about which materials we should make this out of as about whether there is a system in place for this packaging that we want to make. If the answer is yes, let us make it more efficient and do that. If the answer is no, we have to make the case for why the system does not exist, which is where compostable plastics come in. We do not have a system for them, so we, as a country, either have to make a decision to have one, and then we can design for the system, or we say that we are not going to have one, so we are not going to have them.

Q220 **Kirsty Blackman:** I take it that you would agree that kids' toys are similarly in the same box as plastic clothing.

Professor Miodownik: Exactly, and kids' toys with electronics in them in particular are a nightmare for the waste processors. There is a fire a week in almost every waste processor, because people put a plastic toy with a battery in it, it shorts in a big pile of waste, and up it goes. Talk to them and they will say that it is horrible, and yet the thing itself costs 99p. Everyone else, including the environment, is picking up the cost for this trivial, briefly alerting and wonderful thing. I do not know why, as a country, we have allowed this. It really makes no sense.

Kathy Page: I was just going to make two quick points. First, LCAs are a really vital tool and just one part of the decision-making process. There are also social and economic considerations when we are thinking about materials, processes and infrastructure.

Second, you touched on a really interesting area for potential new innovation in materials, which is clothing that can potentially shed microplastics and how chemistry could provide a solution there for longer-term plastics that do not have those negative consequences.

Q221 **Julian Sturdy:** My question is regarding the Government setting up or improving current standards for biodegradable and reusable plastics in order to improve investor confidence in new plastics. There is the issue of investor confidence and whether we can really up that. Is there enough

investor confidence there and what can Government do to really improve and drive that forward?

Professor Dove: I have some thoughts about this. We have a lot of research in batteries in Birmingham, a lot of which is driven by the target to have electric vehicles by 2035 or 2040—you will have to correct me on the exact date. A big statement like that drives the need for innovation, supported by large Government funding in investments like the Faraday Institute. There is a need for these improvements, and investors are savvy. They know where they are, hopefully, going to make some money from this. If there is a real drive to bring something through to market, that gives investors the confidence to at least take the chance that this solution might be the right one, if the science is right.

Something similar around plastics would be a very strong message: "By 2030, 2040 or 2050, this is what is going to happen". It will drive the market, which will drive innovation. That would be a really good way to give investor confidence in new plastics that are coming out, as well as to drive current companies to realise that perhaps what they are doing will not be sustainable in the long term, and drive innovation through those routes as well.

Professor Miodownik: Investor confidence in waste management and processing is where we really need it. That is what we are lacking in the UK. We have amazing innovators and materials people. The UK is world leading. There are so many start-ups from UCL in this area, but it is quite rare to find people innovating in the waste processing side of things, which is exactly where we can be world leaders as well. Signals from Government could help grow that industry. Let us look in the black bin of every household and say, "We want all of those things not to be in there". How are we going to redesign them so that the waste processing system can handle them? That is automatic sorting and chemical recycling, which you are going to talk about in the next session. These are amazing growth areas.

The Government need to be very clear about the direction of travel. The black bin is going to shrink to zero in a certain amount of time. What are we going to do about nappies? Let us not put them in landfill, which is what we are currently doing. Let us not do that. Let us have a research project and development money for companies to move away from that—ditto wipes. There is so much to be done there and this is going to be a worldwide industry.

Julian Sturdy: That is a very interesting point.

Professor Rothman: What Mark is saying is that, in effect, we have to design for end of life, which we have not done for many years, as well as for use. The trouble with plastic is not the plastic but when it becomes waste. Most of this session, we have talked about things getting out of unmanaged waste systems, which is where they are a problem, or how we get them in the right place. If we design for end of life in the first

place, as Mark says, it means that we need confidence in the systems that we have for end of life. We have really good recycling for some systems, as you are bringing in food waste recycling etc, but it is about having confidence in those end-of-life systems existing, such that you can then design your product to fit into that system.

Q222 **Chair:** Those were really good answers, thank you. Andrew, Kathy, Rachel and Mark, thank you. It has been a really great session because you have given us some really good ideas and thoughts. It is how we differentiate between the different plastics, how we encourage more people to use the right thing and, as you pointed out at the end there, Mark, how we shrink the black bin. It is absolutely essential that we get these things right. Not everything is as environmentally sound as we think it is, and we have to try to differentiate between all of these things. I thank all four of you very much for a great session. You are most welcome to stay and listen, and we are now going to ask you to leave the stage, so to speak. Thank you very much for your altogether very valuable evidence. I am going to bring in the new panel, so thank you all very much.

Examination of Witnesses

Witnesses: Richard Daley, Professor Michael Shaver, Jenny Grant and Professor Steve Fletcher.

Q223 **Chair:** Could you please introduce yourselves for the record?

Jenny Grant: I am Jenny Grant, head of organics and natural capital at the Association for Renewable Energy and Clean Technology. We are the largest trade association in the UK. We cover renewable and clean tech. I head up the organics forum, which promotes the benefits of composting, aerobic digestion and other biological treatment techniques, and then the use of those biologically treated materials on land for the enhancement of the environment.

Professor Shaver: I am Mike Shaver, professor of polymer science at the University of Manchester. I am director of Sustainable Futures, which is an overarching, multi-thematic research platform at the University of Manchester that deals with lots of sustainability systemic issues. I am also director of the Sustainable Materials Innovation Hub, which is an industry-academia interface, where we help SMEs and large organisations make that transition to more sustainable plastic systems.

Richard Daley: My name is Richard Daley. I am the managing director of ReNew ELP. We are an advanced recycling processor and currently building the first commercial-scale application of the technology on the old ICI site up in Teesside.

Professor Fletcher: My name is Steve Fletcher. I work at the University of Portsmouth, where I lead the university-wide Revolution Plastics

research initiative to tackle the negative effects of plastics across the entire lifecycle. We work on many different topic areas, from independent policy analysis, the effects of plastic in the environment and on human health, plastics in the global south, how we can encourage changed behaviours through creative methods, and the enzyme digestion of plastic waste. I work on plastics policies, primarily, where I advise the UN Environment Programme and the World Bank.

Q224 **Chair:** Thank you all for joining us this afternoon to continue our inquiry into plastic reuse. It is great to have you here. My first question is to Michael and Steve. Several Government policy areas aim to improve the amount and quality of waste collected for mechanical recycling. What technological or other improvements are required to get the most out of mechanical recycling in the UK? As we mechanically recycle, can we be sure that we separate it properly and do not just beat the plastic to death in the process? I have seen some of that going on.

Professor Shaver: The first thing to say is that this panel is really building from the last one, so the system that Mark talked about has to integrate all of these different pathways. Anything that we do in terms of that bio-composting side has to really work in concert with mechanical and chemical recycling. There is a real question in terms of quantity and quality.

There are challenges with the consistency of collections across different local council areas and changes in environment. Someone's practice in a high street might be different than at home, or even in their bathroom, which is a real challenge in terms of volumes, because people are confused in terms of what they are bringing in and what they are supposed to do.

Once we have those volumes in place, we need a more elegant sorting system. Right now, we are sorting based on what the majority of that polymer is, not on value. We have to be able to segregate and sort based on value. In those instances, there are then mechanisms or methodologies to dramatically increase the recycled content safely, retaining the properties of the plastic itself, without losing those issues. You move away from those challenges of losing your polymer properties, because you have a really high-quality product that you are inputting into the systems in the first place.

Q225 **Chair:** On mechanical recycling, several of us have been to a food waste plant. As they are mechanically getting the food waste out of the plastic bags, you land up with quite a lot of plastic in with the food waste. That food waste then goes into a biodigester, and the leachate from that is spread out on land. How do we get not only to a mechanical system—and I understand why we use it—but to one that is reasonably fool-proof? I am not convinced that some of these systems do what they are supposed to do.

Professor Shaver: What is interesting is why that is there in the first place. That is a practice. Someone has made the decision to put something into food waste that should be a segregated system. If you have one bin that is for plastics, or perhaps all recyclable components, that is different from the bin that you are going to be putting your compost in. Simplifying the system in which those two things exist allows people to make more automated decisions, so they do not have to think about it and the mistakes drop down.

Those mistakes work both ways. Because food waste is a contaminant on mechanical recycling systems, you have a degradation in the quality of both of those sides, because of the errors that are made in that system. That means that we really have to integrate those decisions together and probably to mark or to indicate on those packages what the desired fate is that is going to retain the material in their highest economic and material value condition.

Q226 **Chair:** Steve, do we have the right technologies yet? If we do not, how do the Government incentivise that? Could you mix that into your reply to the general question?

Professor Fletcher: With respect to consistent waste collection, the challenge is that any isolated intervention does not work unless the rest of the system is adapted to that intervention, or the system is somehow configured to allow that intervention to work as best as it could. Consistent waste collection will work only if we have a relatively smallish number of source materials—plastics—in use in the first place, if those materials are then properly labelled and then put into the proper waste disposal stream, and if the recycling facilities are there to deal with those specific types of plastic.

I would caution against trying to solve individualised parts of the problem in isolation without really thinking about the entire system. If I may, we perhaps ought to be aiming for a systemic shift, rather than trying to solve small problems throughout the system.

In terms of the right technology, it depends on what it is we are trying to achieve. If we are trying to reduce plastic leakage into the environment, then, self-evidently, we do not have the right equipment or facilities at the moment, because we see plastic pollution growing rather than reducing.

Can we change that? Yes, absolutely, by making sure that the system is internally consistent, essentially. How do we incentivise that? We could tax any form of activity that is not consistent with the system that we design or that we have in place. The inverse of taxing is how we incentivise. We incentivise innovation that supports a transition to a coherent and consistent system of production, use, disposal and recycling, and that recycled material then has a market back into the product design and production in the first place. System shift is my answer.

Q227 **Mrs Murray:** This question is for Professor Shaver and Professor Fletcher again. How can we improve the sorting of waste to allow more closed-loop systems? Should the Government, for example, focus on reducing the complexity of the plastic market or improving sorting technology?

Professor Fletcher: The answer there is yes to both, to some extent. Reducing the complexity of the plastic market is certainly one way forward. There is such huge diversity in the type of plastics that are out there that it becomes almost impossible to label them consistently and to have the recycling facilities in place that can deal with such a diversity. Practically, in terms of how we deal with such a range of materials, some reduction in the diversity of plastics would be extremely useful. As to the other part of the equation and the improved sorting of plastics, that would help as well.

There are various schools of thought on this. This came up in the previous panel to some extent. Do we place the emphasis on the user, be it a business user or a domestic user of the plastic item, to be responsible for correct disposal, or do we put the responsibility on the producer or the system, and take it away from the individual? That is quite a philosophical question in terms of who should be responsible for that.

We did some research in Portsmouth recently with households to look at how they choose plastic products, how they store those products within their houses in various ways and then how they choose to dispose of them. We found that around 50% of people really do not understand the system at all, but they think that the responsibility to make sure the plastic from their house is disposed of properly does not lie with them.

On balance, I would suggest that having a system that takes the responsibility away from individuals and households would probably be better.

Q228 **Mrs Murray:** Mike, when you respond, like the Chair asked Steve to do last time, could you also look at how we could improve the data available to recycling facilities to enable more closed-loop recycling?

Professor Shaver: Yes, for sure. Steve, thank you very much for the segue. We work on a project here at the University of Manchester that is called "One bin to rule them all", which started as a bit of a *Lord of the Rings* joke but turned into a whole massive research project that looks at these systemic solutions.

How can you build a robust supply chain where each member of that different community of businesses is incentivised to sort in the right way? That requires design. You first have to have a package that is recyclable, and recyclable at such a high quality that you can really circularise that product. You start with design, and you design for the system, not because you are hopeful that someone might do something about it. That allows us to segregate and put lots of different wastes in there but pull out the things that are really going to be valuable. That could even

integrate into a biodegradable system or a reuse system, if it were done elegantly.

We have done very similar household trials where we have given people bins and looked at their practice with different inputs. It is really fascinating stuff. That is then tied to all of the potential data that you are going to get out of that. If you sort in different ways, you are tracking the materials themselves. By putting a system in place in which sorting is enabled, you now get much better data on where your material flows are going through the community. You can identify where the challenges are, whether that be a location or a little bit of the supply chain that is not joined up.

We see that there is great pressure on grocery stores and a great understanding of the challenges by recyclers, but the person who filled your ready meal pack might not necessarily be aware of those challenges. If they are not linking up, the supply chain falls down and things break down. Data is essential in informing the right decisions. This feeds back into Rachel's point about data then informing better lifecycles in the system.

Richard Daley: I would like to make a point that follows from what was said. I would suggest that we need to look more at what we are looking at in the chemical recycling industry, which is this mass balance accounting approach: tracing material flows, what goes in, what comes out, where it goes and where it ultimately ends up, whether that be a circular application or an end-of-life application.

I absolutely support better enhanced collection and separation at source, but we also need to look at how we better regulate what comes out of mechanical recycling, so the residual streams. At the minute, the tendency in the UK is to blend everything together and use it as a fuel. Access to this material for a preferential route to more circularity is very difficult at the minute, given how the system is set up.

Q229 **Barry Gardiner:** Richard, you have neatly gone straight into the question that I was going to ask you, so thank you. Perhaps I can just take you back a step and ask you to identify the differences between the three types of organic recycling: open windrow, anaerobic digestion and in-vessel. Can you set out why those different approaches to organic recycling exist? What are the different costs and benefits in terms of their environmental outcomes? Perhaps Jenny might have something to say on this as well.

Jenny Grant: Composting is a natural process. It is the biological decomposition of biodegradable materials. It is the same as what happens in your garden; it is just on a commercial large scale. It is more managed; it is under very managed conditions. Open window composting is exactly what it says. It is done usually outdoors on a concrete pad to control emissions, and it is usually done for garden waste-type materials, so plant materials only.

In-vessel composting is the same process, but it is done inside an enclosed vessel, either a building or some sort of container, so that the emissions can be more managed. In-vessel composting in the UK is done where there is food or any animal by-product material involved in the process. If food waste was going to be composted, it would go to an in-vessel composting facility. Occasionally, it also has an outdoor phase once it has been through the in-vessel phase, which is generally where the high-temperature sanitisation occurs.

Anaerobic digestion is, again, a natural process, but it is with controlled decomposition of biodegradable materials in the absence of oxygen. It is done in completely sealed vessels. A number of materials are suitable for AD, but it is less the garden waste-type materials and more food waste, crops, manure, slurries and that sort of thing. It produces biogas, which can be used in a number of ways to generate renewable energy and heat. Biomethane can be used in vehicle fuels; it can be cleaned up and injected into the gas grid. It also produces a liquid material, a biofertilizer.

Q230 **Barry Gardiner:** In terms of setting out the costs and benefits of each, I take it that in-vessel has a higher carbon footprint, because it requires an injection of heat into the process whereas the others do not. Can you elaborate on what the different environmental harms and goods might be from each?

Jenny Grant: In the in-vessel process, the heat is not added; it is actually generated as a result of the natural process of the microbes breaking down the material. Heat is not added. There is a higher capital cost for equipment and an environmental cost, although for in-vessel composting the emissions can be more managed, and the same for anaerobic digestion. There is a higher capex and environmental cost for building the plants, but the emissions are very much controlled.

In anaerobic digestion, you have the potential to generate that renewable energy and use that in many different ways. What a plant is doing will have an impact on how the greenhouse gas emissions are for the plant. It very much depends on what they are doing with that gas. It can vary hugely. The vast majority of plants have a positive carbon impact rather than a negative one.

Q231 **Mrs Murray:** If a significant portion of plastics put on the market will be compostable by 2025—my question is to you, Jenny—will the UK organic recycling sector be ready for this? If I could go on to add another question before you answer, are the Government's reforms to kerbside recycling and extended producer responsibility going to make compostable plastic a more viable option?

Jenny Grant: It is a good question. While I do not have a crystal ball, I will certainly give it my best shot. At the moment, contamination is a massive challenge for the organics recycling industry. It is costing the industry significant amounts of money to remove and dispose of

contamination, typically by conventional plastics. Contamination is somewhere between 1% and 20%, depending on the site and the materials it is taking in. Many contracts allow for up to 5% of the input to be contamination.

One of our members reports that it costs them about £156 a tonne to remove and dispose of that contamination. It is a significant cost to the industry. I know in Italy they have done a lot of work to look at compostables and they already use them in lots of food-related applications. They collect about 6 million tonnes of food waste with an average contamination rate of about 3%. It still costs them between €90 million and €120 million a year to remove and dispose of that contamination.

Compostables are not the solution for all plastic packaging and non-packaging items, but certainly in applications where they help bring more food waste, beverage waste or plant waste into organics recycling facilities, it is going to help us massively reduce that contamination and its cost. In the right applications, for sure, the industry would be willing and able to treat them. They currently do. A number of composting sites do currently treat compostables, particularly in closed-loop collections. For example, a number of companies offer a supply of compostable items to cafés and restaurants, and then co-collect them with food waste and take them back for processing.

When the levels of non-compostable contamination are low enough, they can go through the process. Composting has been shown to break them down really effectively.

Mrs Murray: Thank you, Jenny. Mike, you wanted to add something.

Professor Shaver: I think Jenny was just about to come on to this, so I am sorry for jumping in there. It is really important to understand the timescales. What we are doing with food waste in valorising it is really important. We have to be able to recover value from that carbon footprint. Thinking about that past conversation about biodegradables and compostables, it is really important that the degradation time is mapped on to the residency time of the food in those systems.

That is what we should be thinking about as those standards to ensure that the compostable plastics are degrading in the environment in which we are releasing them. If we decide that a system is going to be in place where that is going to be segregated with the food waste, as was talked about in terms of tea bags, that is great. That gives the target, and that is what should be rewarded or disincentivised through the system that is created.

Q232 **Chair:** Before we leave this question, what type of organic recycling is better for compostable biodegradable packaging? Is it a mixture of all?

Jenny Grant: Composting is best for compostables, but it may be that we get more integration of anaerobic digestion with composting facilities.

There are a few options. If they were to go with food waste to an anaerobic digestion plant, some plants might have equipment that enables them to process that through the digestion process.

There might in the future be more dry anaerobic digestion than we currently have in the UK. We currently have wet AD facilities, but compostables are more suited to a drier system. It might be that we have more systems set up for processing them through the system. If we have clean enough waste streams, those compostables might be able to be removed at the start of the anaerobic digestion process and then sent for composting at a separate facility.

There are a number of options. We need clarity to make sure that, if we are taking compostables and sending them to a composting facility, they are all compostable and there is not lots of contamination with conventional plastics.

Q233 **Chair:** Several of you have talked about the contamination of conventional plastics. Traditional garden waste compost that has been made outside produces good compost at the end, but the amount of little bits of plastic in that compost that is then going to go into the garden or into a field is just horrendous, really. There is nothing that you can do at that stage to get the plastic out of this heap of compost. How do we tighten up on the process of composting in that instance?

Jenny Grant: A number of things are ongoing at the moment. There are standards that compost sites have to meet, including limits on physical contaminants and plastics present in the finished product. Those standards already exist. At the moment the Environment Agency is looking at putting more controls on the front end as to what contamination can come into site. These sites are not adding the plastic; people are putting the wrong thing in the wrong bin and it is coming into the site. They are looking at it at all stages of the process.

Chair: In a way, you have to stop that plastic going into the compost in the first place. You will not get it out afterwards. That is the problem.

Q234 **Ian Byrne:** I will direct the first part of this to Richard. Do we know enough about the environmental impact and circular nature of chemical recycling to support its use in the UK?

Richard Daley: Yes, we do. It is a huge focus area for most people developing technologies, because we know we have to demonstrate that we are better than the alternatives to garner support. Part of the difficulty in LCA, as we touched on previously, which is a methodology to do this, is about where you set the boundary limits, the methodologies that you use and transparency.

We are doing a lot of work with Chemical Recycling Europe, a European organisation that represents the chemical recycling industry, to come up with a framework of LCA methodologies to make it a transparent process so you can clearly see the benefits.

Speaking from a personal perspective, our technology is the HydroPRS technology that we are deploying here in Teesside. In the next one to two weeks, we are about to publish an independent LCA that was done by the Warwick Manufacturing Group at the University of Warwick as part of an Innovate UK grant that we received in 2019. I can share the preliminary results with you, and I will share the report with the Committee once it is published. We can demonstrate that the liquids that we produce to be used as feedstocks for the chemical industries have a lower global warming potential than their fossil equivalents. For generation and production, on a straight comparative basis to fossil naphtha, we emit less CO2. Our feedstock tends to be the end-of-life plastics that cannot be recycled. We are diverting this material from incineration and energy from waste. On a tonne per tonne basis of material that we divert from an energy from waste application, we are saving over 2.5 tonnes of CO2 emissions.

There is a circularity aspect as well. The liquids that we produce can be used as feedstocks to make chemicals and new plastics, and there is no limit on the number of times. It is really a pathway to circularity and net zero, because we are reducing the dependency on the fossil economy. The only way to do this is to publish data and have it peer reviewed.

Q235 **Ian Byrne:** We had quite a lot of scepticism about chemical recycling by the representatives from the NGOs in the first session, because they believed that you were not transparent about the true impacts and outputs. Will what you have just outlined there go some distance towards removing that scepticism?

Richard Daley: Absolutely, publishing the data for peer review is the only way we will do this, along with agreeing commonality and standardisation on methodologies and avoiding people reporting only what they want to report. We use an ISO methodology and it is independent. It is not the industry regulating itself. This is an independent academic body that has come in and done an independent LCA review. We are quite happy. As I said, that data will be published. Transparency is absolutely needed.

One of the reasons why chemical recycling, non-chemical recycling, advanced recycling, or whatever term you want to use to define it, is perceived negatively is that it is an umbrella term that covers such a wide range of technologies. You have technologies that are looking at specific polymers, microwave solvolysis of PET or dissolution. Then you have technologies that are looking at general waste packaging recycling back to hydrocarbon liquids or traditional pyrolysis.

For ourselves, we are a hydrothermal liquefaction technology. There is such a broad umbrella of technologies that are used under the banner of chemical recycling. There is a lot of misconception, misuse and misunderstanding around the industry. The only way to get past this is to publish data.

Ian Byrne: Yes, that is a good point.

Professor Fletcher: I will just add to what Richard was saying, if I may. There are different types of chemical recycling, and of course that was the point that Richard just made. We have not really spoken about biological chemical recycling or the use of enzymes as a way of digesting waste plastic.

At the University of Portsmouth, we do a lot of work on enzyme digestion. I can just share some of the numbers that Richard was alluding to. If we put PET bottles, that type of plastic, through an enzyme digestion process that breaks PET down into its component parts, it allows a new PET bottle to be made in due course with virgin-like qualities. It can be recycled infinitely through this type of technology. That reduces by 80% the energy required to produce that recycled plastic bottle compared to using virgin plastic, and it reduces greenhouse gases by 40% compared to creating new virgin plastics. That is all published, by the way.

This type of technology has the potential to create value in waste plastic. At the moment, those enzymes can really only tackle a small range of plastics. If this technology is really developed and invested in, one potential future is that we could have a cocktail of enzymes that could be thrown into a mix of plastics, and a waste stream that does not necessarily even need to be sorted to break those plastics down collectively into their component parts. That is a dream future.

At the moment, we really need good separation of plastics into the correct recycling streams. Then we can target particular types of chemical recycling to those specific plastics that can be broken down through that approach. It is not the entire story, of course; it is not the entire solution. We need to mix mechanical recycling with this type of chemical-based recycling as well. Again, it is a system approach.

Ian Byrne: Thanks, Steve, for that comprehensive answer.

Professor Shaver: It is really important to understand that perhaps part of the reason why there has been a bit of a demonisation of chemical recycling is that it is not a panacea. It cannot work for everything and in every situation. If you were to imagine all of our plastic waste going to any one of these different solutions, we are going to have a system that does not work. It is really important to objectively evaluate each one of these different potential fates relative to each other.

If the LCA for Richard's system looks great, that is going to provide an end-of-life function for some part of our plastic waste stream. The challenge with the enzymatic stuff is the rate at which you are doing that degradation. If that is then competitive with the rate at which those waste streams are coming through, we can potentially have a pathway there. We really have to look at these technologies in concert with each other. It does not matter if something is biodegradable, compostable or recyclable if it is not biodegraded, composted or recycled.

Ian Byrne: That is a really good answer.

Q236 **Rosie Duffield:** This is for Richard, Michael and Jenny primarily. Do the Government have a clear picture of how chemical recycling will work alongside mechanical and organic recycling in the future of plastics?

Chair: That is a nice simple question. Go on then.

Richard Daley: Unfortunately, the Government are not clear about the role that chemical recycling has to play. As I said, because of the breadth of technologies that are available, it is not clear where it sits within the Government's policy and regulatory stance. I note that the resource and waste framework strategy in 2018, which underpins all of this, was relatively silent on chemical recycling.

The Government do not have clear policies that identify the role that chemical recycling can play. As we have said, it is absolutely complementary to mechanical recycling. Mechanical recycling can get us to a point, but chemical recycling can then treat the residual plastics and get us much further up to our recycling targets while reducing CO2 emissions. The capabilities of the industry are not clearly understood by policymakers, which is an issue, because uncertainty is married to investment in the industry as well. This is a new and emerging industry, and we need support to grow.

Professor Shaver: The short answer is no, but a lot of that is because it is a really hard thing to understand. Plastics is a relatively simple term for us to visually conceptualise, but, when we look at the nature of those materials, there are so many of them. Even if we think about something as simple as polyethylene terephthalate or PET, there is not just one grade of that. Not all of those packages are necessarily made just of that material. Sometimes there are really good reasons for that complexity, in that it enables the package to do what it needs to do, but sometimes that is unnecessary.

Sometimes legislation gets simplified to the point where it is no longer necessarily enabling things, but that does not mean that there are not really good programmes funded by the Government to do that. I would just like to highlight the investment that has been made in the industrial strategy challenge fund in smart and sustainable plastic packaging. That is really a big step towards a lot of sensible decisions. It is looking at a number of different technologies in concert with each other.

The idea of circularity has to be key here. It is really important to understand this. If I am going from a package to a package, that is a relatively small circle. Maybe I am going to go from a package, make some monomers and then make a new package, which is a bit bigger. If I am biodegrading that back to CO2, I get two circles, but those circles are of different sizes. That is why those technologies have to be viewed in concert with each other rather than independently. It means that policy has to have nuance.

Jenny Grant: The current reforms under the resources and waste strategy and the collection consistency are really very much welcomed by the organics sector, particularly for increasing the amount of food waste, but some changes still need to happen to enable the compostables element to reach its potential and make the system work properly, like we were talking about earlier. Just as an example, the liners that are used for food waste collection must only be certified compostable to enable them to go through the process and get more food waste into organics facilities.

Similarly, with the EPR system, the full range of compostable packaging materials should be properly recognised under the EPR, so the financial contributions made by those compostable packaging companies can be directed towards the collection and treatment of those materials. Like Mike said earlier, we want to make sure that, if it is compostable, it is composted. If they were properly included within the EPR system, that would go a long way to help with that.

Q237 **Chair:** Is there a risk that both chemical and organic recycling will compete for the same feedstock? Are we going to create competition for the feedstock? You are shaking your head. Go on; prove me wrong. I am very happy for you to do so.

Professor Shaver: Those are two very different fates. It is much more likely that you are going to compete with eminently mechanically recyclable plastics. Because they are very high quality and they have lots of carbon and hydrogen bonds, they could get diverted to chemical recycling. You need to ensure that there is no diversion of mechanically recyclable products into chemical recycling streams and that the focus for chemical recycling is on those systems that are more difficult to mechanically recycle.

Chair: That was the answer we were looking for. Thank you very much.

Q238 **Kirsty Blackman:** This segues nicely from what Jenny said earlier. There are various UK Government incentives and disincentives. There are taxes, extended producer responsibility and consistent collections. Does the sum of all of those create enough confidence to maximise private investment in the recycling sector—the sector more broadly, not specifically any one area?

Jenny Grant: They are a good start, but they do not go far enough. From the organics point of view, as I said earlier, we need to make sure that the EPR system enables that money to flow back into the biowaste treatment facilities to enable them to process the compostable materials. There needs to be more funding and certainty of policy to enable investment in facilities that are properly set up to process the compostables. It could be adaptations to existing infrastructure for anaerobic digestion plants, or it could be investment in new infrastructure, making sure that we have that certainty to enable the investment in facilities that can actually properly process them.

Professor Fletcher: To answer your question, all of those schemes that you mentioned are inherently good ideas, give or take some nuance here or there. The challenge for me is that, when you put them together, it does not really look or feel like a coherent, systemic approach. For example, what is the UK vision for plastic recycling in the context of the global plastics crisis, if you want to call it that? That does not come through very strongly.

The other factor to consider here is that there will likely be negotiations starting later this year towards a global, legally binding agreement on tackling plastic pollution, out of the next UN Environment Assembly. Whatever we choose to do at the UK scale will have to consider any global agreement that is down the track as well.

Looking at these individual interventions in isolation, we could discuss endlessly their strengths and weaknesses, and pros and cons, but we need to look at this system-wide approach to try to understand how they fit together and what we are trying to actually do through that system. Only then can we answer your question properly: are these individualised items actually working positively towards that system goal?

Professor Shaver: I want to contextualise a little those comments around the system. In our work here at the University of Manchester we do quite a lot on what the fate should be, so what we should be doing with a package to retain the value in its highest condition? To do that, there is a black box. If we pick up a package of food from the grocery store, we can look at that, see the ingredient list and know exactly what is in it, but from the plastic perspective we do not. What limits the potential fate for those materials, whether or not that is chemical recycling, organic digestion or mechanical recycling, is that we have to have a consistency in terms of that cocktail of additives and different components that they have put in.

Adding a layer of transparency about what the composition or the recipe is for those plastic packages allows you to identify the best end of life. That is the bit of the missing data that allows the system to be optimised really well.

Richard Daley: Just to pick up on what everybody has said there, with the systemic approach, it is about what the regulations are trying to achieve. Is it increasing recycling? Is it a reduction in carbon? Is it increasing circularity? All of these will have some sort of an impact on the overall system as a whole. It needs to be a co-ordinated thought about what we are trying to achieve across the value chain for this waste material.

Things like the recycled content tax are fantastic, but there is a second layer of regulations underneath that. Say, for chemical recycling, if we are making liquids that go into feedstock to make new products, how do we account for those materials? Approving a mass balance approach to liquids and where they end up allows us to account for or demonstrate

compliance with the recycled content tax. There needs to be additional legislation to enable us to demonstrate compliance with these things.

Q239 **Kirsty Blackman:** Richard, can I just check on that? You do not seem to think that there is a decision yet or an idea of whether it is reducing carbon or increasing recycling. You do not seem to think that there is a formulated end goal there yet. Is that right?

Richard Daley: To be honest, I do not think we know enough. On the regulations relating to that, under the EPR scheme, where will the collected taxes go? Will they go to recyclers or to local authorities? How is that to be distributed along the plastics chain? That is undecided. We are talking to HMRC about it recognising mass balance accounting with the liquid products from chemical recycling. I do not think that decision has been finalised yet. These are all things that are trending in the right direction, but we do not know enough about them yet, as an industry or a sector, to say they are enough or sufficient.

Q240 **Chair:** One of the challenges is that recycled or compostable plastic can be much more expensive to produce than new virgin plastics. What other market interventions could the Government consider to ensure recycled or compostable plastic is more economically attractive than using new plastics? I know there is the plastics tax, but are there other means beyond that? What level of plastics tax would we need to then make virgin plastic more expensive than or as expensive as some of the compostable and reusable?

Professor Shaver: The plastics tax rewards the inclusion of it, but it does not tax the virgin source. Taxing the virgin plastic is going to encourage lots of potential pathways, but we have to think about the numbers on that. If we take the context of the mass balanced approach, the concerns are on how you actually know that that is going to happen, so what is the proportion that actually is circularised? How that is audited is really important, but it is not enough. It would be more expensive for many organisations to pay for an audit trail to show that they can do that than the plastic packaging tax itself.

When you are thinking about the tools that you need in order to enable circularity, it really is about rewarding circularity and rewarding organisations that can show that those products are recycled.

Q241 **Chair:** Sorry to interrupt you, but how would we reward them? It is a good thing to do.

Professor Shaver: EPR is the beginning of that, but it requires nuance, because, right now, we are exporting plastic waste, which is being mechanically recycled, and we are importing recycled plastic back in. We have a dream here in the United Kingdom and, as a Canadian Commonwealth citizen, I really quite like it here. That dream to come back to our manufacturing roots really should be about remanufacturing. How do we retain the materials here? We invest in the right infrastructure, from the simplest mechanical recycling, up to complex

chemical recycling systems. That infrastructure unlocks change. This is a supply-and-demand issue. We need to push the infrastructure to enable supply to come down in price.

Chair: Thank you, Michael. I am very glad I did not say that you had an American accent when you are a Canadian. Well done. I am glad I did not fall into that trap.

Jenny Grant: I just want to make a point about the plastic packaging tax. Compostable plastics are actually treated a bit unfairly when compared with conventional plastic components because they do not have this 30% more recycled content. We have said that, if compostable plastic components have 30% or more biowaste content, they should not be taxed under the plastic packaging tax. This would allow them to be more competitive.

Mike has made a really good point already about the supply and demand. As there is more demand for these products, the supply will go up and the cost will come down.

Q242 **Chair:** Could I just ask you about compostable plastics? One of my pet worries is that some of them are not truly compostable in the end. How do we differentiate between those that compost properly, into water or carbon, or are dissolved into the soil, and those that still have particles left when they finish and do not truly compost?

Jenny Grant: There are some internationally accepted standards out there, and there are lots of independent certification schemes. We are very keen to ensure that, when we are talking about compostables—I know we had a discussion earlier about the terms "biodegradable" and "compostable"—we are clearly talking about independently certified compostable materials, so that they are certified to be complaint with those standards that set very clear pass and fail criteria and are accepted by our environmental regulators.

There is a lot of lack of clarity around claims and companies that are labelling things, with certain things not being certified. When we are talking about compostables, that independent certification is important.

Professor Fletcher: I would just like to treat the question in a bit of a broader sense, if I may. We are in the territory here of potentially trying to solve a problem we do not need to solve. If we take a step back, within the plastics economy, there are certain things we need plastic for and certain things we do not need plastic for. Rather than trying to tax or incentivise virgin or non-virgin, or compostable versus non-compostable, it is about having the right plastic for the right job, and maybe legislating around that and trying to rule out unnecessary uses of plastic, like the toys that were being talked about in the previous panel.

We do not really need that as a use of plastic. It then becomes virtually impossible to deal with within any form of waste treatment, let alone recycling, and, generally speaking, it ends up as some form of pollution. I

keep saying it, and I am sorry, but I would again encourage the systemic approach, where we consider what other things we need plastic for and focus on that; we try to either tax out or positively incentivise inwards the uses of the right types of plastic for the right types of application; and then we make sure, where we cannot reuse or remanufacture those, that we have end-of-life treatment that is consistent with that type of plastic.

Q243 **Chair:** You make an interesting point, because there is an end-of-life vehicle system, where you need to be able to dispose of that vehicle. It is whether we could use that on a broader basis and perhaps change public perception as well.

Professor Fletcher: Yes, indeed.

Richard Daley: The recycled content tax has been a huge benefit to the chemical recycling industry, because that ultimately has been a trigger for investment by the chemical industry into recyclers that can give us access to that recycled content. It has been a huge benefit and enabler for the chemical recycling industry to grow. One of our big challenges at the minute, from a system viewpoint, is access to feedstock and that waste plastic that, after mechanical recycling, which is our target feedstock, is currently used a fuel and is currently burnt. We should potentially think about taxation on the incineration of plastics and back to promoting plastics to the best use. We need to stop allowing the plastics to go to the worst environmental use. How we make that material available to the chemical recycling industry is something we should not lose sight of.

Chair: Thank you, again, for being a very good panel. It has given us a great deal of information to really help to put our report together. It also shows us some of the complexities of what we are dealing with; just one solution will not necessarily fit everything. Jenny, Michael, Richard and Steve, thank you very much for giving us your time and your words of wisdom this afternoon. We will put parts of them into our report. If there is anything else you think of in a blinding flash after you leave, please let us have it in writing. Thank you, all, very much.