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U.S. Senate Date: Thursday, October 26, 2023

Committee on Environment  
and Public Works

Subcommittee on Chemical Safety, Waste Management,  
Environmental Justice, and Regulatory Oversight

Washington, D.C.

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## EVALUATING MATERIAL ALTERNATIVES FOR SINGLE-USE PLASTICS

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Committee on Environment and Public Works

Subcommittee on

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The subcommittee met, pursuant to notice, at 10:00 a.m. in room 406, Dirksen Senate Office Building, the Honorable Jeff Merkley [chairman of the subcommittee] presiding.

Present: Senators Merkley, Mullin, Carper, Whitehouse, Capito.

STATEMENT OF THE HONORABLE JEFF MERKLEY, A UNITED STATES SENATOR  
FROM THE STATE OF OREGON

Senator Merkley. Good morning. Welcome. The Environment and Public Works Subcommittee on Chemical Safety, Waste Management, Environmental Justice and Regulatory Oversight hearing on evaluating alternative materials for single-use plastics will come to order.

There is a saying that waste is a design flaw. Today we have an enormous volume of single-use plastics, from utensils to bottles, and an even larger amount of plastic packaging. Single-use plastics and plastic packaging are often not recyclable or biodegradable. They often end up, as the phrase goes, burned, buried or borne out to sea. All that waste does represent a pretty large design flaw.

Ideally, we would love for all of our products to be sold in 100 percent reusable containers or biodegradable packaging, so we don't have this challenge. The damage done by plastic pollution has inspired many companies to develop alternatives to fossil plastic, often marked as green or natural. Some of those alternatives are referred to as bioplastics.

That sounds like a win for everyone. Companies get the benefits of continuing to use single-use items and packaging that is lighter and more durable than glass or aluminum. In the most successful implementation of this vision, consumers will

get the peace of mind knowing that the packaging or single-use item that is discarded is being re-used or composted.

But the world is more complicated than that. It is exciting to see how many small companies are working to develop alternatives on the front-end that can be recycled or can be re-used. Hopefully out of those many research efforts and investor-funded laboratories, we will have more alternatives.

But the goal is to understand now, where do we sit at this moment? What alternatives exist on the front-end? What is truly recyclable? What is truly compostable? Does it require special laboratories or special facilities to be compostable, as opposed to a compost bin in one's yard? That leaves consumers very confused about how they are participating in our consumer economy in the best, most responsible way.

So today we have witnesses who bring expertise to bear on this topic. According to the World Wildlife Fund, which is represented here today, 450 million tons of plastic are produced each year, a number that is expected to triple between now and 2050. Plastics are made from climate chaos-causing fossil fuels. They generally don't biodegrade.

They do break down into microplastics. We have had testimony in this committee about the challenges of microplastics. The average adult in America consumes some 800 particles of microplastics per day, or estimated to be a credit

card's worth of plastic per week that ends up in our blood, in our lungs, even in the breast milk that we feed to our babies.

Also in these plastics are toxins that expose us to a number of endocrine disrupting chemicals. So that is certainly a challenge as we think about our various daily activities, our hot coffee cup that we get from Starbucks, what is it actually lined with, and what is the result of those particles ending up in our body. We also have the production of plastics often occurring in front-line communities where it creates toxic pollution that endangers the health of the people who live there.

So there are many aspects to this complicated world. We look forward to learning more today from our panel of experts. We have Dr. Marcus Eriksen, a marine scientist and co-founder of 5 Gyres Institute, which seeks to understand the extent of plastic pollution in our oceans and what we can do about it. He and his colleagues published the discovery of the microbeads in the Great Lakes in 2013. That is an example where there was a very definable product, a very definable reaction. We can live without these microbeads in our cosmetics or skin care lotions. And now they are not there. That is good.

Also joining us is Erin Simon, Vice President for Plastic Waste and Business at the World Wildlife Fund, helping companies to reduce plastic pollution. She spent 10 years working as a

packaging engineer, so she knows a lot about the packaging side.

And we are joined by Humberto Kravetz, Founder and CEO of GSF Upcycling, which breaks down used plastics to make them into new products.

Thank you for the time and for sharing your expertise with the committee. I will turn it over to Ranking Member Mullin, Senator Mullin, for his remarks.

[The prepared statement of Senator Merkley follows:]

STATEMENT OF THE HONORABLE MARKWAYNE MULLIN, A UNITED STATES  
SENATOR FROM THE STATE OF OKLAHOMA

Senator Mullin. Thank you, Chair Merkley. I appreciate it. I thank you for allowing this. Mr. Merkley has a long history of studying plastics. While we may not agree on the solution, we definitely are in search of a solution to the problem. And we may be speaking on it from different angles, so I appreciate your having this hearing.

I would like to start by thanking our witnesses for attending this hearing. We appreciate you for taking the time to be with us. It is a challenge, and it is sometimes thankless. You are not getting paid, so we appreciate your time. Time is valuable, and you don't ever receive that back. So I do appreciate each one of you guys for being here.

As everyone knows, plastics exist in almost every aspect of our day-to-day life, from consumer goods to automobile parts, to even building materials. While improperly managed, single-use plastics can contribute to our plastic waste issues, certain types of single-use plastics are essentially invaluable uses for us, which needs to be considered in discussing alternatives. Notably a few examples of these single uses include blood bags, syringes, to help modern health care remain affordable, and insulate food packages to maintain hygienic standards while reducing food waste.

These uses play a vital role in our society and if restricted, would have detrimental impact on our daily lives. This series of hearings has made it abundantly clear that banning plastic production is not a real solution. Rather than wasting our time talking about banning plastics or mandating alternatives that consumers don't want, we should be discussing real market-driven solutions.

This includes state of the art developments and advanced recycling. Anyone serious about addressing plastic waste should support advanced recycling. This promising technology can address plastics that cannot be recycled by traditional methods.

It has the potential to turn the whole concept of single use on its head by converting previously unrecyclable plastics into valuable new commodities. Let's be clear: improving our recycling system is not only the solution, but it is without question a legitimate solution that warrants all of our attention.

You shouldn't just be taking my word for it, Mr. Chairman. I would like to ask for unanimous consent to enter into the record two studies, one from the Department of Energy and one from the National Academies of Science.

Senator Merkley. Without objection, so ordered.

[The referenced information follows:]



Senator Mullin. Both reports demonstrate the potential value of commercializing scaled chemical recycling. That is why I am very thankful to be joined today by Mr. Kravetz, of GSF Upscaling, who traveled all the way from Spain to be here with us today. That is a long flight, sir. I get upset having to travel back and forth from Oklahoma, so I appreciate that.

GSF is an innovative chemical recycling company that can accept the most difficult to recycle plastics. GSF's facilities can accept plastic ranging from single use to sun-scarred fishing nets. Sir, you are exactly the type of person we need here today, because listening to you, we can really start getting serious about addressing plastic waste. So I appreciate it, once again.

Innovation, not misguided regulation, is the correct way to move forward. I look forward to hearing from all of our witnesses today on ways we can facilitate this, and look more serious about chemical recycling and commercial skills.

With that, I yield back.

[The prepared statement of Senator Mullin follows:]

Senator Merkley. Thank you very much.

Mr. Eriksen?

STATEMENT OF MARCUS ERIKSEN, PH.D., CO-FOUNDER, EXECUTIVE  
DIRECTOR, THE 5 GYRES INSTITUTE, LEAP LAB

Mr. Ericksen. Good morning, Subcommittee Chair Senator Merkley, Ranking Member Senator Mullin, and all committee members. My name is Dr. Marcus Eriksen, co-founder and researcher at The 5 Gyres Institute.

Our team at 5 Gyres Institute has sailed around the world to study ocean plastic pollution, leading 20 expeditions across all oceans. We have collected thousands of samples, like the one that is right here. What you can see is that it is mostly microplastics.

We just recently published, about six months ago, a study looking at a 40-year trend from the late 1970s until the present of microplastic abundance in the world's ocean. I will show you a graph, really quickly, from our published paper. In the first 25 years, from 1980 until 2005, this quarter-century, the amount of trash in the world's oceans increases slowly. But since 2005, there has been this exponential increase, to the point that today, we estimate 170 trillion particles of microplastic in the global ocean. The point is that we need urgent action.

Why does this matter? Let me tell you a quick story. A few years ago, I went back to Kuwait. I had been there 30 years ago as a Marine infantryman back in the Persian Gulf War, if you remember those times, 1991. I returned there recently as a

marine scientist. Our team surveyed the Gulf of Arabia.

We also went deep into the desert, and we found a few camel skeletons. I will show you what I dug out of one skeleton. We estimate about 2,000 plastic bags are in this mass, in one camel's gut. This adds to the thousands of organisms worldwide that are impacted by our trash.

The point I want to make here is that I have been across oceans, our team, The 5 Gyres Institute, across oceans, across deserts, in mountains, roadsides, municipalities around the world. We are not talking about cell phones or car bumpers or blood bags. When we think of harm, we are talking about single-use, throwaway plastics. They are ubiquitous across the globe.

But solutions are clear. First of all, we are not going to recycle our way out of this problem. But the private sector is rising to the challenge. Refill and re-use, entrepreneurs in the re-use and refill economy are succeeding. They are successfully delivering products to consumers without packaging waste. Thousands of entrepreneurs are proving successful re-use and refill business models.

At the same time, biomaterials are a promising innovation. Our team at The 5 Gyres Institute has researched what happens when bioplastic, biodegradable plastic products, are lost in real environmental settings. We wanted to understand, these biomaterials, how do they perform if they get lost in different

environments.

So we took 22 different kinds of products. We are talking about biodegradable bioplastic straws and cutlery and thin film from bags. We put them in six environment. We put them in the ocean in California, the ocean in Florida, the ocean in Maine, a forest in Maine, the Everglades, a desert in California. Six environments over 18 months, a year and a half.

Our findings are fascinating. I will show you this, this is our study. We took five kinds of straws. Here you see the different kinds of biodegradable materials, PHA, PLA, PHB, and in 16 weeks we found them, they function as a straw when they are used. If they are lost, they degrade within 16 weeks. Even this PHB straw matched the rated degradation of a paper straw.

Look at film; we had several kind of biodegradable plastic films. We found over 16 weeks the same thing, the biomaterial films are disappearing. They are degrading over time. This PHA piece of film in 16 weeks is practically gone.

The utensils, same thing. Four different kinds of utensils, the biodegradable materials, PHA and PLA, they are practically gone, even faster than the bamboo, the wooden utensil. But if you look here, the polystyrene fork, the polyethylene piece of film, the polyethylene straw, they are as new as the day we got them.

In closing, I would like to say that the problem is getting

worse, based on our work in the world's oceans and lands around the world. We urgently need smart policies. Businesses that refill and re-use are thriving and biomaterials are functional alternatives to some kinds of packaging.

I would be happy to answer any questions you might have.  
Thank you.

[The prepared statement of Mr. Eriksen follows:]

Senator Merkley. Thank you very much, Dr. Eriksen. That is a fascinating display you brought. Much appreciated.

Ms. Simon?

STATEMENT OF ERIN SIMON, VICE PRESIDENT, PLASTIC WASTE +  
BUSINESS, WORLD WILDLIFE FUND

Ms. Simon. Good morning, Mr. Chairman and Mr. Ranking Member and members of the committee.

My name is Erin Simon. I am the Vice President and head of Plastic Waste and Business here at World Wildlife Fund. I want to thank you for the opportunity to testify today on such an important topic, one that has quickly become the top environmental concern for many Americans, and that is growing plastic pollution.

Plastic can be found in nearly every corner of the planet, from our city sidewalks to the top of Mount Everest. It is estimated, as you mentioned, that there is an enormous amount of plastic pollution, 11 million metric tons, entering our oceans every year. That is about a dump truck a minute of plastic pollution.

Plastic pollution negatively impacts more than 2,000 species of wildlife in places significant to local economies, public health, and vulnerable communities. It also harms some of the world's most important ecosystems, like coral reefs and mangroves.

Unless we act now, as you mentioned, the trajectory of this will just worsen. We will double the amount of plastic we produce and triple the amount of it entering our oceans by 2040.



It is undeniable that plastic is a versatile material that keeps our food fresh and our medications safe. However, we currently rely on plastic as a single-use resources in a linear system where products and packaging are created, used, and thrown away. The plastic pollution crisis has taught us that it is no longer economically, socially, or environmentally sustainable to prioritize the production of single-use products, no matter where they are made and what they are made of. All natural resources are finite, and we are taking these materials faster than the earth can sustain.

As we look to the future of innovation, we need to amend that broken system, no matter what the material is. This means getting rid of those things we don't need, substantially increasing the re-use, recycling and composing of plastic, shifting to sustainable inputs and alternative business models, such as re-use, refill systems, and moving to alternative materials when appropriate.

Alternative materials to replace plastic could include paper, metal, glass, or bio-based materials. However, no matter the material, we must always be thoughtful and thorough when considering the use of alternatives so we avoid those negative tradeoffs. All materials have environmental and social impacts. It is critical that we take necessary steps to source and use alternatives that have stronger environmental and social

benefits when compared to the conventional plastic. It is important to note, for example, that both virgin glass and metal have intensive extraction processes. So their overall sustainability performance is largely tied to our ability to recapture these materials through re-use and recycling.

Of course, even as we look for solutions to reduce and replace, we might still need some virgin plastic. But it doesn't need to come from fossil fuels. Plastics can be made from alternative sources such as seaweed, sugar cane, and other plants. Bio-based plastics offer an opportunity to decouple from fossil resources, achieve greenhouse gas emission savings, and contribute to a resilient local economy when produced in accordance with best practices.

To realize this potential, we have to follow a no-one-size-fits-all solution for bio-based plastics. But we have to also follow a shared set of principles that can guide design choices around how they are grown and effectively recycled or composted.

It is critical that we pay attention to food security, labor practices, deforestation and land conversion, and impacts on water quality and impacts on water quality as well as the necessary recycling or composting infrastructure for the recovery of these.

Policy conversations around all material circularity continue to be essential, independent of any alternative

material solutions. We need supporting infrastructure and policy to tackle the broken system. That includes the systems to collect, re-use, recycle and compost anything that is produced.

In the United States, leading businesses are already setting ambitious around reduction, re-use and recycling. I will be on a panel later today in this room with WWF, Coca-Cola, Wal-Mart, and Mars, talking about the ambition we are seeing from many of the private sector including calls for enabling government policies like extended producer responsibility. The United States has the opportunity to be a global leader in this.

In the end, we need everybody to do their part. WWF hopes that today's conversation will pave the way for further development and implementation of robust policies in this space, policies that call attention to the considerations and advantages of reduction, re-use, and other plastic alternatives, as we seek to address the problem of plastic pollution.

A circular economy is only sustainable if we have a way forward when we are working together. It begins by reevaluating our use and disposal of plastic and moving toward a circular system that prioritizes environmental health and environmental justice. This reality may seem ambitious, but there are policies and changes and technologies we can use to move forward today and create that more efficient system for a healthy planet

for future generations.

Thank you.

[The prepared statement of Ms. Simon follows:]

Senator Merkley. Thank you very much, Ms. Simon.

We are going to turn to Humberto Kravetz. Welcome.

## STATEMENT OF HUMBERTO KRAVETZ, FOUNDER AND CEO, GSF UPCYCLING

Mr. Kravetz. Good morning, Chairman Merkley, Ranking Member Mullin, and members of the subcommittee.

My name is Humberto Kravetz, Founder and CEO of GSF Upcycling. I appreciate the opportunity to appear before the subcommittee today.

I will discuss three aspects of my company's innovations that enable true circularity in plastics. First, we can upcycle all types of used plastics back into feedstock. Second, we deliver substantial improvements in energy and environmental performance of the plastic recycling process. Third, we create a strong economic incentive for communities to keep used plastic out of the waste streams and the environment.

Our first breakthrough takes advantage of our proprietary graphene-based nanomaterials, commonly known as carbon-nanotubes. By adding our nanomaterial to tons of used plastics in a pyrolysis process, any municipal or industrial entity will now be able to upcycle the 80 percent-plus of used plastics, including mixed, dirty, and contaminated plastics that are currently too hard to recycle and otherwise end up in landfills, incinerators, or lost to the environment.

Examples of this include packaging material for about 45 percent of the global problem, as well as medical devices, automobile parts, circuit boards, and even degraded plastics

such as marine debris. We recently validated this in our demonstration plant, using fishing nets collected from local fishermen.

Our nanomaterials enable the process to occur at roughly half the temperature, 450 degrees Fahrenheit instead of 800 degrees Fahrenheit, and with a 30 to 60 percent improvement in plant performance, thus significantly reducing energy costs and associated greenhouse gases per unit of output.

Just as consequential, our process also captures 60 to 99 percent of halogens, such as bromine, fluorine, and chlorine, as well as other contaminants of major health and environmental concern. These contaminants can then be segregated for responsible disposition.

Our second breakthrough takes advantage of our proprietary mix of biological enzymes. By placing these enzymes in direct contact with used plastics, we can depolymerize the plastic back into its original building blocks. Unlike any other enzymatic method, our process takes place at room temperature, without the added heat or energy consumption, and without chemical-based solvent pre-treatment that other enzymatic processes require.

We have proven that our enzymatic process can not only handle plastics such as soda bottles, PET, but also plastics that are otherwise expensively and/or incompletely mechanically recycled, for example, Styrofoam packaging materials or

electronic plastic waste. We are currently developing similar enzymatic treatments for polypropylene and polyethylene packaging materials.

The output of both of our innovations is a high-quality feedstock that can economically compete with new feedstock from fossil fuels. In other words, plastic back into plastic. Our mid-term objective is to decouple plastic production from fossil-based sources.

Just as important, it means that upcycling of used plastic can occur at a profit, creating an economic incentive for local communities to construct affordable upcycling facilities to collect and convert all of their plastics into valuable feedstock at a net savings to their budgets, rather than at a cost.

In summary, our upcycling technology innovations are able to process all types of used plastics, including degraded plastics like marine debris, and produce a high-quality feedstock that can ready be converted into new plastic. We can perform bio-enzymatic upcycling at room temperature and can significantly reduce the head needed for pyrolysis, driving substantial reductions in energy consumption and associated air pollution and greenhouse gases. And we can capture and segregate chemical contaminants in used plastics. For example, this is where PFAS would fall into place.



By making used plastic too valuable to burn or throw away,  
we can help make plastic circularity a global reality.

I want to thank you for your time and consideration of this  
testimony. I look forward to y our questions and comments.

[The prepared statement of Mr. Kravetz follows:]

Senator Merkley. Thank you to all of our witnesses. Much appreciated.

I want to start out, Dr. Eriksen, when I was a kid, we always referred to wax paper cups. Paper cups today are mostly not coated in wax, they are coated in plastic. Is there a particular reason that, at least for cold drinks, we couldn't return to wax paper cups?

Mr. Eriksen. I see no reason why we couldn't return to some of those materials we grew up with. Same here, a wax coating on paper does function as a moisture barrier. So yes, we could. Actually they still exist today. If you look at the packaging for lettuces and cabbages in the agricultural sector, you see wax-coated cardboard utilized frequently as a water barrier.

Senator Merkley. Now I want to turn to your powerful display of what you found in the gut of a single camel, or from inside the skeleton of a single camel. I have seen similar displays from many marine species. Is it fair to say that if we are looking at the gut of, well, I have seen them for dolphins and sharks and so forth, that we often see a huge accumulation in marine birds as well, in the oceans affecting our wildlife?

Mr. Eriksen. We do see similar impacts. I have seen used plastics in other marine life, especially. Many colleagues, whenever a whale washes ashore on the west coast of the United

States, they do look in the gut. They frequently find plastic film, other objects, fishing gear sometimes.

I got my start on Midway Atoll. I went there actually surveying the history of the bases that were there. I stumbled upon hundreds of albatross skeletons, and just pulling out of them bottle caps, cigarette lighters, all kinds of random fragments of plastic, a lot of this stuff. So yes, the impacts are not just camels in the desert, but here closer to home we see tremendous impacts.

Senator Merkley. If these, it looks like mostly bags, I think you said, and you pointed out in your chart for better alternatives a variety of alternatives to plastic that biodegrade better. You set those into different types of ecosystems to see in real life, I think you said forests, deserts, and Everglades.

Mr. Eriksen. And three ocean settings.

Senator Merkley. Had those bags that you found in that camel gut, if they had been made out of these other materials, would they have biodegraded and not accumulated in the stomach in the same fashion?

Mr. Eriksen. I am confident if these were made from some of these new polymers out there, the biodegradable polymers, that I would not have this here today, that it wouldn't exist.

Senator Merkley. But isn't it the case that some

bioplastics, although they start from materials that are not fossil fuels, produce results that are very similar in the final product, as with the fossil plastics?

Mr. Eriksen. Bioplastics is a very big umbrella. There are biobased; you can actually take sugar cane and other materials and make polyethylene, polypropylene, PET. There is a whole group of biodegradable polymers, very different. It is a big umbrella; it casts a wide net of materials.

But biodegradable materials are the ones that we studied here that cannot persist in these six different environments that we tested.

Senator Merkley. Ms. Simon, so we have this big umbrella of alternative products, some of which biodegrade better than others. Has Word Wildlife investigated and found that there are kinds of advice for policy makers about what types of products might be a good substitute on the front end for single-use plastics?

Ms. Simon. Yes, absolutely, thank you. I would begin with, you have to look at a couple of things when thinking about biobased and biodegradable materials. In regard to biobased, we are sourcing it from something that grows, agricultural products. You have to assess a different set of environmental and social risks, and economic risks associated with that around land use, water.

But there are absolutely ways to assess that and mitigate that risk. It is just about understanding and addressing those up front.

Now, if that feedstock or source of renewable resource is going into that bioplastic, and it is designed to be biodegradable, it is our recommendation that it ends up in industrial composting, in formal infrastructure. Because while these can often break down, it is concerning that it will just result in more plastic ending up in nature, because people believe it will just break down.

It requires a lot of different criteria for something to break down. It has to have microorganisms, it has to have UV light, a certain level of humidity. And temperature is really important. So you want to make sure that you are designing materials for the infrastructure we have, so we can get that material back.

Circularity of materials is about driving toward another resource. If you go into an industrial composting facility, you would be able to get back resources like humus, nutrient rich soil from that composting process, versus just allowing them to be littered into nature.

Senator Merkley. So we have already gone through my five minutes. It passes very quickly. We are going to turn to Vice Chair Mullin.

Senator Mullin. Thank you, Mr. Chairman.

I have a series of questions, but I want to circle back. Did you say most of that is single-use plastics, sir?

Mr. Eriksen. Yes, that is my cut-in-half research paper that we published, is that it is all plastic bags, mostly plastic bags, not large sheets of film.

Senator Mullin. Bags aren't recyclable?

Mr. Eriksen. I am sorry, what is recyclable?

Senator Mullin. Bags are recyclable, right?

Mr. Eriksen. Technically so.

Senator Mullin. That is what I thought, because we put them in recycle bins all the time. I am just saying, we take recyclable stuff all the time.

Ms. Simon, you are shaking your head no. But that isn't one of the things that D.C. says do not put in recyclables.

Ms. Simon. Yes, they are technically recyclable, but they are not recycled. We do not have access. So most people cannot recycle plastic bags. It is problematic.

Senator Mullin. But it is not designated as single use, though. Single use is some of your health care products, your stuff that you are not allowed to use. I am not getting into the weeds here, I am just saying that I find that interesting, because I didn't know that. I thought we were recycling our bags when we put them in the blue bins all over Washington, D.C.

Ms. Simon. They are highly problematic. They get gummed up in the system.

Senator Mullin. I have no idea how you traveled back with that. I am assuming you must have not been flying commercial air, because that would be a heck of a thing to have to check.

A while ago when the Chairman was asking about the stomach and the other products that would break down faster in marine life, or in the camel's gut, Ms. Simon, you were shaking your head like, hmm, in fact, you bit your lip. So if I am reading body language right, which I used to have to do all the time, I would say that you probably disagree with that a little bit.

Ms. Simon. Kind of talking about what I was highlighting before, materials breaking down is a very specific process. It requires a certain set of temperature, relative humidity, microorganisms, oxygen. This is why biodegradable material won't break down in a landfill.

So that is the same issue in a gut, the type of bacteria --

Senator Mullin. So what I am saying is, you are not certain that the alternatives would actually break down?

Ms. Simon. That is why we recommend infrastructure versus hoping it will work out.

Senator Mullin. This brings me back to my point about alternative recycling. Because I remember when we had paper bags, and people were like, this is bad for us, we don't want to

be doing that, we need to get rid of paper bags and go to plastic. And plastic was the clean alternative. I think we all remember that.

And so what I don't want to do here is have another solution that we think is the new solution, and we actually don't know if it is accurate or not. I think we need to know, because obviously we have two people that disagree on if it will break down or if it doesn't break down. But one thing that we can agree with is we can find an alternative to how to have single-use plastics become recyclable. I think that is where we need to go back into, which Mr. Kravetz, which is kind of what your company is trying to do, right?

Mr. Kravetz. Yes. We can actually upcycle all types of plastics, including degraded plastics. The technology basically enables us to add what is missing to the mix, so we are not doing the pyrolysis, we are enabling the pyrolysis by guiding the carbon-carbon links within that scope. And in the somatic, we are breaking it down regardless, without energy or solvent treatments.

Senator Mullin. It is my understanding you are launching your first fully commercially developed GSF's carbon nanotube technology, is that right?

Mr. Kravetz. Yes.

Senator Mullin. It is coming out this month?



Mr. Kravetz. We are working with Europe's largest advanced recycling facility, one of the best ones out there, actually. What we are doing is enabling that process to have an optimized plant design that can be implemented at scale globally. Here in the States, we could bring that plant to sign and up to local communities on their plastic needs, create value for their plastic before it reaches the environment.

Senator Mullin. So what milestones are you hitting to keep this technology from coming to the United States?

Mr. Kravetz. We could start having conversations of bringing the technology to the States probably by the middle of next year. I like to be performance and data driven. So once we have that industrial scale plant up and running, then we can say, okay, what are the needs and the types of plastics we want to launch here in the States, start having those conversations. We could talk about a licensing package for local communities where they say, okay, we have this amount, this volume, these types of plastics that we want to process, and do that at scale with a plant design that is already optimized at a 30 to 40 --

Senator Mullin. All right.

Mr. Kravetz. -- volume.

Senator Mullin. I think this committee would be interested in knowing when that starts happening what barriers you are facing, so maybe we could work together.

One last thing. When I was growing up, WWF meant World Wrestling Federation. So it has totally changed my concept of what that meaning is now.

Thank you all for being here. I appreciate it. I yield back.

Senator Merkley. Thank you, Senator Mullin.

Chair Carper?

Senator Carper. Thank you. As it turns out, we have been wrestling with this for a while.

[Laughter.]

Senator Carper. I am going to ask a question in a minute of Ms. Simon on infrastructure for material. First, a question. I always look for where we agree. It is easy to find disagreement around this place. But just very briefly, each of you, what is one major point for where the three of you agree? Go ahead, Mr. Eriksen, just very briefly. Major point of agreement.

I know you are probably stunned. But I am looking for a point where you three agree on something. It is important.

Mr. Eriksen. Where we both agree on something?

Senator Carper. The three of you.

Mr. Eriksen. Oh, the three of us. Well, we agree that there is a need for urgent, urgent action to solve this problem. I think we are also in agreement that the private sector is

stepping up to the challenge.

I think where we might disagree --

Senator Carper. No. I am asking where you agree. You have answered my question. Go ahead, Ms. Simon. Where do you agree?

Ms. Simon. I think we all agree we need to start with reduction.

Senator Carper. Did you say reduction?

Ms. Simon. Yes.

Senator Carper. All right, Mr. Kravetz?

Mr. Kravetz. I agree we have to face the challenge. I think companies like mine are stepping up and developing solutions that can be scalable.

Senator Carper. Good, thanks. Ms. Simon, here is a question for you, but I am going to lead into it. For the past couple of years, this committee has become, as you know, deeply engaged on a variety of issues. One of those is material circularity. This includes improving our re-use and our recycling systems to ensure that valuable materials that could be turned into new products are not just being lost to our landfills, or to pollution and incineration.

Yesterday, along with Senator Boozman, a Republican from Arkansas, I co-hosted a textile recycling roundtable, right here where you are sitting. We talked a lot about where we agreed as

folks from different backgrounds. Ms. Simon, in your testimony, you mentioned a similar situation, where some biobased plastics are compatible with existing recycling streams and others are not. What supporting infrastructure is needed for recycling streams so that all materials are compatible, and what should the Federal Government's role be in establishing and scaling this infrastructure?

Ms. Simon. I think what is really important is that we have criteria around what go into our infrastructure. Whether it is coming from biobased sources or other alternatives, that we have clear design criteria, so that when that material ends up in the facility, no matter what the technology is, it can be cleanly reprocessed in a way that can produce high value secondary materials.

So for biobased, that could be something coming from sugar cane and then going into a PET bottle, like mentioned, and then going into the recycling facility, or it could be a PAJ going into a compost facility. But all designed for that infrastructure that it is going into.

So it is design guidelines, and then following that. We need policies that set those guidelines and create a funding mechanism to make sure that there is financial sustainability for those facilities to continue recycling and composting that material.

Senator Carper. All right, thank you. Question again for the entire panel, we will start off with you, Mr. Kravetz, and go to your right. Earlier this year, our committee met right here in this room, the Environment and Public Works Committee, unanimously advanced two pieces of bipartisan recycling legislation. One of those bills, I think it is called the Recycling and Composting Accountability Act, would require the Environmental Protection Agency to collect and to make publicly available data on recycling and composting waste across the Country.

Question, starting with you, Mr. Kravetz. Would you please share the importance of increased data collection on addressing the plastics crisis and considering material alternatives?

Mr. Kravetz. Collection is key, of course, to avoid plastics from reaching the environment and the oceans. Then you need to set up all the infrastructure to move plastic and get this all set up to go to advanced recycling facilities that can handle every type of plastic, not just single waste streams. That is important to understand.

The ability to tackle all the plastics solves the problem of having to sort everything upstream.

Senator Carper. Same question, Ms. Simon, please.

Ms. Simon. We are proud to have supported the Recycling and Composting Accountability Act. We look forward to working

with the committee further on that.

We believe that transparency is key to drive change. Whether you are transparent in what you are making and how you can manage it, or in delivering on strategies. We started up a program called Resource Plastic to have companies build some transparency into what they are making, what format it is in, where it goes in the world and what happens to it. That way they can really develop the right strategies to address their plastic waste footprint.

It means we can actually directly drive improvement on the impacts by having that transparency. It will be the first key step in creating a plan for the U.S.

Senator Carper. Same question, Mr. Eriksen. Very briefly, if you will.

Mr. Eriksen. I would also agree that our recycling is essential on the front-end, designing for recyclability and compostability is essential.

Senator Carper. Good. Thanks so much. Thank you all.

Senator Merkley. Thank you, Mr. Chairman.

Now, Senator Capito, welcome.

Senator Capito. Thank you, Mr. Chairman.

Thank you all for being here today. We very much appreciate this.

I would like to ask Mr. Kravetz a question about, I

understand what you are doing would be under the term advanced recycling. Are you taking single-use plastics and making them more advanced plastic materials? How is that process, without getting too technical?

Mr. Kravetz. Thank you for the question. Advanced recycling is basically three families of technologies that take different types of plastics and bring them back to feedstock to reduce the plastic. What my company does is in the pyrolysis space enable the pyrolysis to operate economically and efficiently by adding what we think is missing in the mix, which is carbon nanotubes. That is one technology.

A second technology is the ability to depolymerize or break down any type of plastic into its building blocks so we can make new plastic again.

Senator Capito. Can we do that now?

Mr. Kravetz. Technically, it is possible, yes.

Senator Capito. Is it affordable?

Mr. Kravetz. Yes.

Senator Capito. And so I guess my big question on all of these issues, because we have two recycling bills that we are hoping to get all the way through. They are sort of, they are pretty easy. I live in rural America, and we don't have the opportunity for recyclability through our municipalities too much. It is not widespread.

How do we get this topic down to the everyday user of plastic? I know the big industrial users are probably the ones that we are looking at here. But how do you relate this very sort of technical issue to everyday people, whether they are an ag community or a rural community?

I will start with you, Dr. Eriksen.

Mr. Eriksen. How we communicate this problem, the challenges to rural America?

Senator Capito. Simply, yes.

Mr. Eriksen. I think you can explain to people some of the human health concerns, and the research is coming out very quickly showing the impacts of micro nanoplastics. I think telling people about the impacts on wildlife and the impact on our pocketbook, what the true costs are to try to capture some of these plastics and bring them back to the waste stream.

I think when you talk about human health, the wildlife impacts, but also the bottom line, what it costs them and their communities.

Senator Capito. Ms. Simon?

Ms. Simon. Yes, just building on that, in that communication we help to educate them, we empower them with easy actions. Today it requires some sort of decoder ring to figure out what goes in your recycling bin. And it needs to be easier for them to be able to do it. So we need to design in more



standardization to make it so that it is not up to the consumer to figure out to recycle or compost their materials.

Senator Capito. So if we are looking at landfills, for instance, which have all kinds of different wastes going in, is there a movement now, and I will get to you again, Mr. Kravetz, on that first question, is there availability working with the landfill owners to be able to successfully separate out and make that an economic model as well?

Ms. Simon. Coming from landfills?

Senator Capito. Yes.

Ms. Simon. I have not done that research to understand what would happen if we recaptured material from landfills. But I will say there is probably a lot of high value material in our landfills today considering how resource-constrained we are. It would probably be interesting to research that. But I don't have that data for you, I am sorry.

Senator Capito. Okay. Mr. Kravetz, I will give you that question, that one I just asked, and then the one before. How do you translate this down to the regular consumer in terms of the importance of this?

Mr. Kravetz. I do agree with what has been said before, in educating the consumers. I do think, and the premise of my company is that plastic is valuable and recycling companies, advanced recycling companies will have to pay for plastic. So

making plastic reusable material avoids or changes the concept of being waste. So if you consider plastic waste, okay, so we are throwing it away. But if it has some value and it is reusable, then the mindset might change, that we can actually start recycling.

Then of course, you need to build the infrastructure and start recycling, prove it at scale.

Senator Capito. Right.

Mr. Kravetz. But the shift in thinking of this as waste or used recyclable plastic I think is key.

Senator Capito. If we look at what we have done with paper, paper is looked at as recyclable, I think. When you see newspapers, or any kind of paper, it used to be, when that started in the 1970s, you would see a little print on the bottom of your stationery, this paper is recyclable. That was unusual.

Now, I don't think we assume everything has been recycled, but a lot of it has been. Do you envision a time when plastic, with advanced recycling, could get to that point?

Mr. Kravetz. Yes, for sure. That is what is going on. I have been in this for a few years now, have been going to different events throughout the world. And now the whole value chain is talking. This is massive collaboration between plastic manufacturers, transformers, brands, and the advanced recycling companies.

So I think we are getting there. Now the technologies have to scale, companies like mine that have developed disruptive technologies and taking charge of all the plastics that can be recycled, not just single stream. I think we will make a difference.

Senator Capito. Thank you. Thank you all.

Senator Merkley. Senator Whitehouse?

Senator Whitehouse. Thanks, Chairman. Just for the record, I don't think plastic bags are recyclable in D.C. They are not in Rhode Island. Plus, the recycling rate completely stinks. There are some plastics that go into the bin that are zero percent recycled. There are others, I think the top is 20 percent, and the average is single digit, like 8 or 9 percent of what you actually put in the bin to recycle getting recycled.

So it is very, very much a failed system, almost to the point where we put consumers into the role of being unwitting actors in a play in which recycling takes place except at the end of the day it is faux recycling, it doesn't actually take place.

When you look at the other side of the market, if you look at single-use plastics, we are lucky to hit 2 percent recycled content in how single-use plastics, disposable plastics, are manufactured. So clearly, both on the manufacturing side at 2 percent and on the alleged recycling side at 8 or 9 percent,

these are catastrophic failures, when you consider all the effort that is put into maintaining, I will put air quotes around it, recycling.

I think if it is going to change, the economic signals have to change. At the moment it is cheaper to buy brand new virgin plastic and make your plastic bags and make your spoons and make your containers than it is to use recycling, hence 2 percent. If that economic signal shifts, then suddenly recycling works, because if there is one rule of capitalism, it is that profit is imperative. It is really uphill sledding for a company to make economic decisions that are against its best interest.

So I think we need to, frankly, put a recycling fee on virgin plastic that is destined for single use. That will balance the market and that will also provide a good price signal to help companies like yours, Mr. Kravetz, to be able to have a better business model. Because now people are really looking.

If you don't send that price signal, then public pressure becomes really important. Thank you, Chairman Merkley, for holding this hearing. Thank you, Chairman Carper, for your leadership in this space. Because public pressure matters.

I would single out Unilever, the enormous European-based company, for what I think at this point is the best corporate pledge so far that kicking in in 2025, they are going to take a

kilo of plastic waste out of the environment for every kilo of plastic they put into the environment through their business. That does obviously give them a big incentive to reduce the amount of plastic they put out into the system, and to look for alternatives. It also creates a market on the other side, because they are going to have to buy plastic back. They are not going to send Unilever employees around the world to scoop up plastic themselves. They are going to create supply chains to get waste plastic off of the shores of countries where plastic is shin-deep in the wrack line of the coast, because of so much coming ashore from the ocean.

I remember landing in Bamako, Mali with John McCain. We were driving from the airport into downtown Bamako, and we went by a big field. I turned to John and said, I have never seen so many crows in my life in a field. Do you think those are crows or ravens or what are they? Because there were thousands and thousands of things flapping out in the field.

It wasn't birds at all, it was plastic bags. Mali's standard means for carrying things around is a black plastic bag. And this field was just filled with them, to the point where I thought an enormous flock of crows or ravens in the thousands had come in.

When Unilever's pledge goes live, it suddenly makes sense for somebody to go out there and pick up all that plastic and

take it into Unilever's supply chain. So I think it is really important that we add to this technical conversation an economic conversation about aligning the economic incentives. Otherwise, charity isn't going to help. Incentives make the difference.

Let me ask Ms. Simon to comment briefly on that. Then I will yield back.

Ms. Simon. I agree, we need to create financial incentives in the system that will not only drive, level the playing field for companies that are already out there trying to redesign and rethink the materials they are using, reducing, starting with reduction, to be able to do that and move into re-use systems and into monomaterials that are easy to recycle and formats that are easier to recycle.

That incentive will also, when they are paying for that through whatever policy mechanism, whether that is DRS or EPR, it allows, it pays for the infrastructure and the technology in the infrastructure to return secondary materials that are high quality. That becomes the new supply chain for them. They can then pull that material and put it into their products and recycled content instead of having to go back and buy more virgin.

Senator Whitehouse. Thank you, Chairman.

Senator Merkley. Thank you very much.

Senator Mullin wanted to ask a follow-up question on that.

Senator Mullin. Not really a follow-up question, but this whole debate about plastic bags being recyclable or not, according to ZeroWaste.DC.gov, plastics are recyclable. In fact, they tell you exactly where to drop them off. They tell you, their website says, "Have you ever been unsure about which items can be recycled or which items are considered too hazardous to put in the trash bin? With new where it goes tools, we can help take the guesswork out. Specifically, drop off plastic bags, wrap and film, drop off these items for recyclable, all bags, wraps, film, should be clean and empty. To find the nearest drop-off location near you, please visit plastic film recycling website."

My point is, on all this is they are recyclable. It is ridiculous that we don't know what is actually recyclable and what is first use and what is not first use. But yet we have all these solutions. Maybe we should start with what is recyclable and what is not, start at that point and then we can take a lot of the guessing out of it.

Like I said before, plastic was supposed to be the new green when we got rid of paper bags. So let's not be too knee-jerk reaction here and do more damage instead of actually finding out a solution that is good for all of us moving forward.

Senator Whitehouse. I should have been clearer. I meant

through the bin, the blue bin at the end of the driveway.

Senator Merkley. We are going to continue some exploration of these issues. No one here has mentioned some of the exploration of using products made from, for example, those folks working with mushrooms to be able to reduce products, people working with seaweed.

Dr. Eriksen and Ms. Simon, are either of you familiar with those alternatives for single-use plastics? Is there promise there?

Mr. Eriksen. Yes, there is tremendous promise. Something Senator Whitehouse said about capturing some of the negative externalities on the back end, some plastics just get lost to the environment. I call them, the bags, the escape artists. They get out and they have true costs. While they are typically recyclable, there is such a cost to collecting them, sorting them, transporting them, landfilling them, trying to recycle them, there are many that get lost to the environment and cause harm.

There are so many solutions on the front end that are mitigating those problems, capturing those negative externalities, like some of these biomaterials that we did study.

And we did study these because we wanted to see what happens if they really get lost in different environments, in



ocean environments and land-based environments. Some of them really perform very well. Some, like the PHAs and PHBs, degrade as fast as wood and paper. But during their utility, they have the functionality as plastics, the water vapor barrier and packaging products.

So there is promise in some of the new biomaterials. Again, I should say that bioplastics, the large umbrella, you have the biobased, there are biodegradable ones, the new materials very promising.

Senator Merkley. Ms. Simon?

Ms. Simon. I think seaweed is especially interesting, because it has some net environmental benefits to it. So there has been a lot of exploration into sourcing seaweed for feed fuel and materials. Today there are converters of it, but there is nothing at scale that matches products. But it is something that is being explored.

Mushrooms, too, there has been a lot of transport packaging from Steelcase, even explored in electronics companies because of its cushioning properties, where they can use that and match expanded polystyrene. I think for any of these sources you are looking at, can you sustainably source it in a way that is beneficial to the environment and communities, and there are methods to assess that.

Then you are looking at, are they technically viable to

meet the performance criteria of the different products. Not every feedstock, not every crop can make every single plastic. So you are looking at a variety of different agricultural needs there. Then again, you want to make sure that any of those materials can be recovered in a system, so we can get them back and use them again, whether that is through re-use, recycling or compost.

Senator Merkley. Ms. Simon, you mentioned metal as an alternative. One of the things that came up recently that surprised me was that often aluminum cans are coated on the inside with a layer of plastic. Is that accurate, so when you buy beer and soda or even water in aluminum bottles, is it coated on the inside on the inside with plastic?

Ms. Simon. It depends on what is being packaged in it, and if it is highly acidic and corrosive. So sometimes they have to line it if it a highly acidic or corrosive liquid or product.

Senator Merkley. Water is not?

Ms. Simon. Water should not have a lining.

Senator Merkley. How about beer?

Ms. Simon. I am not quite sure on that, but I do not believe beer has a coating in it.

Senator Merkley. Can you get us more information about what aluminum is coated, and which isn't?

Ms. Simon. I can. I don't have it with me, but I can,

yes.

Senator Merkley. Great. Also, then what happens to that plastic when the aluminum is recycled that is coated?

Ms. Simon. It is just melting in the process.

Senator Merkley. So it basically becomes vapors that basically get exhausted and affected the local community?

Ms. Simon. It can be if there is not good air and quality management coming out of those recycling facilities.

Senator Merkley. I want to turn back to the bioplastics. When you talked about them breaking down, in my head, when I see something made out of bamboo or some other wood product, I am kind of like, okay, well, nature has been dealing with wood for a billion years, so I am pretty comfortable it is not going to break down into stuff that has various chemicals in it that will affect the environment.

But I am concerned about whether the bioplastics that break down in these different experiments, they may become very tiny, but do they become kind of microplastics that might still affect the ecology differently than if they were made from cellulose?

Mr. Eriksen. Good question. That very much depends on the additives, it depends on the properties you want. Often, they will do laminates. Right here you will see some where they were laminating different biomaterials to increase the water vapor barrier. With those, as those begin to degrade, if the

biomaterial degrades, if there is a metal layer or a polyethylene layer, that is going to degrade also and produce microplastics. If there are additives that are UV inhibitors, for example, or other chemicals, those toxins may also leach off as the biomaterial degrades.

So it really depends on what kinds of additives you are putting into it. In some cases, though, there are no additives. For example, this one straw that is here, and this bit of film, you can use the pure material in some packaging applications. And when they degrade, there are no toxic legacy materials left behind.

Senator Merkley. Which should be our goal.

Mr. Eriksen. Yes.

Senator Merkley. Mr. Chairman, Senator Carper.

Senator Carper. Thanks again for just a terrific hearing, and to all of you for joining us. This is timely and important.

Erin Simon, I am going to pick on you again, with no malice intended. But if you probably ask most of my colleagues here in the Senate about Green Guides, they wouldn't know what to say. Our staff on this committee, they would know. But I think most of my colleagues, including me at one time, would not have any idea what they were talking about.

But as you know, about every 10 years the Federal Trade Commission updates its Guides for the Use of Environmental

Marketing Claims. It is also known as Green Guides. Green Guides provide guidance for producers to label their products, they can label them as recyclable, they can label them as compostable, or they can label them as environmentally friendly.

Unfortunately, the Green Guides have not been updated, I am told, since 2012. That is like 11 years. A lot has changed in 11 years. The market for new packaging alternatives is rapidly evolving as well. This has led to manufacturers making claims that are sometimes misleading about whether an alternative package is recyclable, or whether it is compostable, or neither.

This is why earlier this year some of my colleagues and I, colleagues on this committee, actually, wrote to the Federal Trade Commission, and we encouraged them to update these Green Guides. It has been long enough, in fact, it has been too long.

Ms. Simon, how can updating the Green Guides help reduce consumer confusion on what types of products are recyclable, what are compostable and what are more sustainable?

Ms. Simon. We too were happy to see that the Green Guides were being updated and WWF was a part of that process. Much of my testimony echoes what we wrote in the Green Guides. We need to evaluate where materials are coming from and have verification and accountability for where they end up.

The Green Guides can really start by ensuring that materials that are claimed to be recyclable, compostable, or

more sustainable actually are. This means allowing only specific formats of materials which a majority of the Country has access to recycling can be called recyclable, not just technically recyclable, but access to.

With compostable, we need a definition that ensures consumers know where to put those compostable items and that compost rooms are either industrial, where someone picks them up from your house, or home compostable, where according to ASTM standards, where those products will break down in anyone's back yard.

Senator Carper. Thank you. Thank you for that.

I like to quote Winston Churchill. Winston Churchill was a great hero during World War II, he carried the British people on his back to victory over the Germans, with our help. Gosh, less than a year after he was, he was just a hero, the voters of Great Britain threw him out. They put somebody else in as Prime Minister. Winston Churchill was leaving 10 Downing Street, moving out, and the press was there, and one of them asked, "For you, Mr. Churchill, is this the end?" And famously, he said, "It is not the end, it is not the beginning of the end." He said, "This is the end of the beginning."

Lenny Kravitz, probably a relative of yours, quite a well-known entertainer in his own right, once paraphrased Churchill. I don't know if he was a one-hit wonder or not, I think he had a

couple, but one of his more popular songs is the lyric that it ain't over until it is over. This debate and conversation on this topic is going to be going on for a while. I am delighted that we are doing it, and delighted that you are doing it with us.

That leads me into my question on Federal legislative action. I think I speak for my colleagues and me, we have enjoyed hearing about each of your respective efforts to consider materials' hardness to plastic within your respective fields and industries. While we know that there is a whole suite of policy options available to us, will each of you share the top legislative action that you believe Congress should take within the next year to help our Country address the plastics crisis? We will turn to a relative descendant of Lenny Kravitz to respond first to that question.

Mr. Kravetz. Thank you for the question. I think the criteria, first and foremost, has to be performance based. So not looking at specific technology on its own merits, but comparing it to other types of technologies. That is when innovative companies like mine can actually rise to the challenge of meeting those standards. That is one thing.

Maybe the second thing is on the materials, where we are talking about replacing one material with another one, we do have to look at the total carbon footprint that each material

has. There are materials that are better than plastics, others that are not. So let's not fall into a blame game, and let's try to figure out, with performance-based technologies and full carbon footprint of competitive materials, which ones are best for what situation.

Senator Carper. All right, thank you.

Ms. Simon, same question. What would be the top legislative action that you feel Congress should take within the next year or so to help our Nation address the plastics crisis?

Ms. Simon. I believe that extended producer responsibility can really connect the creation of these materials, no matter what they are, to their end of life through transparency, design standardization and financial models. It can really help us to reimagine the linear economy, so that everyone can have access to those recycling systems, and we can make sure that we are getting those materials back and increasing economic growth.

In fact, later today I will be in this same room talking with some corporate partners, and they will be advocating for extended producer responsibility also.

Senator Carper. Thanks. Dr. Eriksen?

Mr. Eriksen. I wrote something similar, EPR. I think an EPR bill would allow the companies who are making materials that become waste participate financially in the recovery and management of those materials. Also a bottle bill, a national



bill. I think that would go a long way to getting back the material from the environment.

Senator Carper. All right, good, thank you.

Abraham Lincoln was once asked, what is the role of government. He replied famously, "The role of government is to do for the people what they cannot do for themselves." On this committee, we are oftentimes looking for how do we harness market forces in order to achieve something good for the people of this Country, maybe the good of the world.

We talked about incentives and so forth during the course of this hearing, but I am always looking for ways to harness market forces. If anybody has a thought, a closing thought on market forces, I would welcome that. Dr. Eriksen?

Mr. Eriksen. Having been on this issue for about two decades, I have met so many young entrepreneurs and innovators that are on the front end or creating businesses in the re-use and refill economy in biomaterials. I think those market forces can reduce the amount of waste that is in the waste stream, especially the harm that we see coming from single-use plastics. So those two market drivers, those business models, are powerful.

Senator Carper. Good, thank you.

Ms. Simon?

Ms. Simon. I would agree with that. I would build on that

innovation is not going to just happen in the materials and the technologies, it is going to be in the systems to manage them. We have seen the shared economy really grow, low water and energy cleaning technologies for re-use systems expanding.

So I believe there is a lot of desire to solve this with unique and innovative solutions. I think between new technologies to recycling, new technologies and systems for re-use, we have a good opportunity to get there. And there is a lot of science that says that that will happen if we pull all the levers that we have.

Senator Carper. Okay, thanks.

Ms. Simon. Thank you.

Mr. Kravetz. I think that the concept of changing waste plastic into usable plastic is key, incentive for consumers to change this is key. Industry wide, there is a lot more collaboration going on. Anywhere from design for recycling to changing the concept that something can be recycled but it is not recyclable, or something could be recyclable, but it is not really recycled.

So that is going to make a difference. The incentives have to be on actually giving value to the plastic, so that it doesn't end up in the environment in the first place and build on technologies that can scale and change this paradigm of plastic waste versus used plastic.

Senator Carper. Thank you.

Mr. Chairman, this has been timely and I think well-attended. We appreciate very much all the work that you do and sharing your thoughts with us this morning.

Senator Merkley. Thank you, Chairman Carper. You quoted Churchill and Lincoln, but what reverberates in my mind is a quote from that esteemed public leader Senator Carper, which is, do more of what works and less of what doesn't. That sums up kind of a strategy.

I wanted to return for a moment to this conversation about plastic bags and whether they are single use or not. Nationally, less than 10 percent of plastic bags are recycled. Very few places in the Country can you put plastic bags into a bin. And if it does, the wind blows them out. But they don't take them.

What is happening is stores in some places say, you can bring them back to us, and we will find a way for them to be sent somewhere where they will be turned into new plastic bags possibly or possibly plastic lumber, is what I am seeing.

But essentially, at this moment, it is inefficient to recycle plastic bags. They don't get recycled. So they end up going into, well, into the landfills, or they get blown away and end up in the ecosystem, as we see from this.

I keep coming back to that display and thinking about all

the other pictures I have seen of plastic building up in the guts of turtles, seals, dolphins, whales, et cetera. Now you have added camels, which I hadn't seen before, on land. Have we ever seen, Dr. Eriksen, a problem where essentially animals are digesting wood and ending up with the same sort of problem in their gut?

Mr. Eriksen. These animals forage on wood, they forage on acacia trees and leaves, and they digest those just fine. Many hoof stock animals or ruminants are eating plant material and cellulose and digesting it when they can, or passing it when they can't.

So those natural materials have been consumed by life for millions of years. This is a new material that doesn't work in that situation.

Senator Merkley. Thank you. To my point, you never see a picture of a gut cut open and it is full of wood, because animals have evolved in a world where we have plant-based material, and they either eat it and digest it or they don't eat it. So it is not an issue.

So one of the things that we do know is often, globs of plastic look like they may possibly be more edible items, for example, sea turtles that that they are jellyfish and so forth. One of the advantages of trying to find cellulose based products is, on the front end they are not made from fossil gas. Our

fossil gas systems, our methane gas systems, they have a huge impact on climate just in the distribution of the gas before the plastic is ever made in the first place.

Then, under the existing systems of chemical recycling, they use a tremendous amount of heat. Mr. Kravetz, you may have a different system. We will get back to you in a couple of years and see what we have learned about the application of that technology.

But essentially, the pyrolysis strategy produces another round of carbon and basically chemical fumes that are highly cancer-causing. Then they are basically burned, and you have another round of carbon production and pollution. So you have three rounds of carbon production and pollution in basically utilizing plastic in the first place, which is why we are holding this hearing about alternatives to plastic.

I was struck that last week, Britain said its utensils are now going to be non-plastic utensils. Are either of you familiar with that, and are they allowing bioplastics, or are they turning to wood?

Mr. Eriksen. I am not familiar with that.

Senator Merkley. I know on my last trip overseas, visiting my daughter, the utensils I saw were all wood. But I am not sure how they are actually being implemented. I think that mainland Europe has already moved in this direction as well.

I did look up what it would cost if we were to utilize wood here. Right now, a wood utensil costs about 2 cents, is what I found. But again, this idea on the front end, if we can avoid fossil gas, if we can produce a product that if it does end up discarded it doesn't cause the problems in the ecosystem that plastic products cause, it is a big advantage.

To this debate between, if you will, a bag made of paper that is cellulose or one made of plastic, I would always vote for the bag made of paper, because cellulose does not produce the problems. Plant material has been part of the world, as you put it, from the beginning.

So, any other insights any of you would like to add on the upfront strategy of replacing single-use plastics with alternative materials? Ms. Simon?

Ms. Simon. I would just say that if we are going to move to an alternative material, like forest-based cellulose, that we should be doing so in a thoughtful manner, sourcing it either from recycled content and/or Forest Stewardship Council certified forests, so we know that those working forests are managed to be renewable for future generations.

Senator Merkley. One of the products I have seen most commonly used in this regard is bamboo, because bamboo can grow very quickly, can be done in kind of a plantation style production, as opposed to harvesting natural forests for wood.

I think the responsible thinking about that life cycle is what you are pointing to.

Ms. Simon. Bamboo can be considered a part of the Forest Stewardship Council, too, you just have to address any land conversion to the bamboo plantation in the first place. But there are ways to mitigate those risks.

Senator Merkley. Yes. And as we know, every strategy has impacts and the point is to evaluate all of them collectively in order to understand the broader picture of minimal impact. We wrestled with this in renewable energy, a solar panel takes up land space, a wind turbine can kill birds, and it disturbs the view shed, and it requires electric lines to connect it.

There is nothing that doesn't have an impact. Our goal is to find the minimum sustainable strategy, that is the undertaking.

Mr. Eriksen, is there anything else you would like to add?

Mr. Eriksen. I look through a lens of harm, where is the harm in the environment and to human health. It always comes back to single-use plastic materials and some of the chemistry associated with those, the additives.

That is why I often talk about the upstream, as you have. On the front end, the reusable materials, the refill, the re-use, and some of these biobased or biodegradable materials, just to capture those costs. And yes, it is more expensive on the

front end. But I think if you do the total lifecycle assessment, the true cost of managing all this waste and harm it causes that is often hard to put a price tag on, it often warrants the front end mitigations that we have talked about.

Senator Merkley. We have had a lot of testimony in this committee about plastic breaking down into microplastics, how it ends up in our bodies and now in every aspect of our bodies, and it often has endocrine disruptors, chemicals in it that affect public health. Have we ever heard of cellulose breaking down into micro-cellulose and affecting human health?

Mr. Eriksen. No.

Senator Merkley. Thank you.

Back to my point that we have a product that is creating huge human health issues and is creating huge ecological issues and to the degree we can replace it on the front end with something that doesn't create those health issues we are in a much better place.

I do look forward to more detailed information in this committee about other alternatives that are being produced on the front end. I mentioned that we have innovators who are using different plant materials, such as mushrooms or seaweed.

My colleague, Senator Mullin, has a company in Oklahoma called Utopia Plastics. It is using a plant material to make straws that harden when they are in water, so they don't



collapse like a paper straw. I have no idea if it is biodegradable or not.

But the point is many small businesses are experimenting with approaches. Our goal in public policy is to understand what approaches, when viewed in their entirety, are having the last impact and make the most sense. So they continue to be a topic of exploration for the committee.

Thank you very much for bringing your knowledge and experience to bear.

With that, I think there are some closing comments I need to make.

In closing, I ask unanimous consent to submit for the record a variety of materials that include letters from stakeholders and other materials that relate to today's hearing. Is there an objection?

Hearing none, those materials will be put into the record.

[The referenced information follows:]

Senator Merkley. Senators will be allowed to submit written questions for the record through the close of business on Thursday, November 9th. We will compile those questions and we will send them to all of you. If you can reply to us by November 30th, that would be helpful for us to wrap up the record of the hearing.

With that, the committee is adjourned. Thank you.

[Whereupon, at 11:21 a.m., the hearing was adjourned.]