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LEGISLATIVE PROPOSALS TO IMPROVE DOMESTIC RECYCLING AND COMPOSTING PROGRAMS

HEARING

BEFORE THE

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

UNITED STATES SENATE

ONE HUNDRED SEVENTEENTH CONGRESS

SECOND SESSION

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COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

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C O N T E N T S

LEGISLATIVE PROPOSALS TO IMPROVE DOMESTIC RECYCLING AND COMPOSTING PROGRAMS

WEDNESDAY, FEBRUARY 2, 2022

U.S. SENATE,
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,
Washington, DC.

The Committee, met, pursuant to notice, at 10:10 a.m. in room 106, Dirksen Senate Office Building, Hon. Thomas R. Carper (Chairman of the Committee) presiding.

Present: Senators Carper, Capito, Whitehouse, Stabenow, Kelly, Boozman, and Sullivan.

OPENING STATEMENT OF HON. THOMAS R. CARPER, U.S. SENATOR FROM THE STATE OF DELAWARE

Senator CARPER. This Committee will come to order.

I welcome a number of our witnesses that are here in person, I think three or four. Another person is joining us remotely. We welcome all four of you.

I am going to give an opening statement, and our Ranking Member, Senator Capito, will do as well. Senator Boozman, who is the co-chair of the Senate Caucus on Recycling, will be speaking as well, in an opening statement.

I was talking to Pashon, who is visiting us from Detroit, Michigan, where my Detroit Tigers are. Hopefully, pitchers and catchers are going to report in about 10 days if they can settle this strike. I hope they will, but I have passion. One of my passions, we were up here talking about football, about the Bengals. We have some Bengals fans up here, but I am a huge Detroit Tigers fan.

Pashon, a special welcome to you.

I am also passionate about recycling and composting. I have told Pashon and Rhodes, I said, I haven't recycled since this morning. Coming down on the train, the Amtrak takes recycling, and we have composting capabilities in all of our offices. So I composted right before I came over here, all the banana peels and apple cores and stuff that I wanted to compost. So these are things that I care about personally and have forever.

Senator Capito and colleagues, I think I was a 22 year old Naval flight officer in training in California, just joined my squadron, and we were stationed near Palo Alto, California, and I used to recycle every month. I would drive over to the recycling center about 2 miles from my house and recycle when it wasn't that fashionable. So I have been doing this for a while, and I am too old to quit.

Having said that, let me just get serious here, although I have been serious, but we have another big Detroit Tigers fan here, too, Senator Debbie Stabenow. She and I share this passion.

Good morning. I am pleased to call this hearing to order. Let me start by thanking the witnesses for your willingness to be here today as we discuss two draft pieces of legislation related to recycling and composting.

Rhodes Yepsen, is that the way you pronounce your name, Rhodes Yepsen? We don't have a lot of Yepsens that come here, or a lot of Rhodes, so we are especially delighted to have you here.

Pashon, I don't recall in 20 years in the Senate ever having, from Detroit or anyplace else, Debbie, having a Pashon as a witness, but we are delighted that you are both here.

Charles Levell, we are happy, Charles, to welcome you.

We have, joining us remotely, we have one more person, I believe. Is that correct? I am looking on my statement here, to see who that person is. I don't see it. Ben Harvey.

Ben, welcome Ben. We are glad you are out there and joining us remotely.

As Ranking Member Capito, Senator Boozman, our Recycling Caucus co-chair, and many of our colleagues know, the topic of today's hearing is something that, as I have just mentioned, I care deeply about. I won't bore you again with my passion and where it came from. But we all have a part to play to improve our Nation's recycling and composting efforts.

I am hopeful that today's discussion on two draft pieces of legislation will provide us with a bipartisan road map to address several of the challenges that America's recycling efforts currently face. Challenges, but also, I think, great opportunities. What Einstein used to say, in adversity, lies opportunity, so that is what we are all about here.

One of these challenges is the availability of good data. This past November, the Environmental Protection Agency released its first ever National Recycling Strategy. This Committee provided a lot, extensive; Michael Regan, the EPA Administrator, will tell you, we provided, from the Committee, significant input to the development of that National Recycling Strategy, and it reflects the bipartisan views on this subject.

The document that has been released a month or so ago by EPA offers a transformative vision for strengthening our Nation's waste management efforts, and it also highlights the need for greater standardization around data collection. To address this, Senator Boozman and I, with the help of our staffs, have developed the Recycling and Composting Accountability Act, one of the two bills that we are going to focus on today. Our bill would improve EPA's ability to gather data on our Nation's recycling systems and explore opportunities for implementing national composting strategy.

This bill is an important first step toward a national composting strategy. I hope that the experts who are here with us today, as well as other stakeholders, will support our efforts to get the ball rolling at long last.

Today, we will also focus on increasing access to recycling. Many Americans in disadvantaged communities want to recycle, and they want to compost, too, but are unable to do so because they live in

neighborhoods that lack curbside pickup, bottle return, and other necessary recycling infrastructure.

Senator Capito's Recycling Infrastructure and Accessibility Act would help address this by creating a pilot program at EPA to improve recycling services in underserved areas. This legislation has the potential to bring many communities into the recycling world, including those in urban and suburban areas while also protecting our environment. I commend Senator Capito for her work and leadership on this bill, and I want to work with her and her team to make sure the bill helps jumpstart recycling in communities with the greatest need, especially those that have historically been left behind.

Both of the two bills I have mentioned are the result of true collaboration and reflect a substantial amount of bipartisan effort dedicated to exploring our Nation's recycling and composting challenges. This fall, our Committee held several recycling roundtables, as some of you will recall, as well as a hearing on the important of transitioning to a circular economy.

The term circular economy is going to be something people will start hearing about, thinking about a whole lot in the days to come. It is a way of doing business that would mean less pollution from landfills and stronger, more efficient supply chains. We benefited from the suggestions of numerous stakeholders on how Congress could collaborate with industry to bolster recycling efforts.

Fortunately, we also discovered that with awareness and motivation, we can do a great deal to address the obvious needs and change some of the damaging behavior.

One product that stood out in recycling was aluminum, as many of you know. Few of us realize this, but 75 percent of aluminum, I am told, 75 percent of aluminum ever mined is still in use today. Think about that; 75 percent of aluminum ever mined is still in use today. That is important, because aluminum products made from recycled materials use 95 percent less energy than it would take to create from first use materials. I have got to say that again. It is important, because aluminum products made from recycling materials use 95 percent less energy that it would take to create them from first use material.

In most cases, recycled products are more energy efficient, which translates directly into reduced greenhouse gas emissions, something we all care about. That is the power of a circular economy.

As part of the Infrastructure Investment and Jobs Act, which really has its roots right here from this Committee last year, Congress provided unprecedented levels of funding for recycling infrastructure and educational programs. The two bills we are examining today represent our next steps to build on these efforts to turn the challenges of recycling and composting into opportunities to reduce planet warming emissions and create good paying jobs.

Someday, I hope to be asked by my children and grandchildren, what did you do to stop climate change and help save our planet? I want to be able to say, my generation did everything we could, everything we could. Working with Senators Capito, Boozman, and other members of this Committee and our colleagues in the Senate and the House and a lot of other stakeholders, I embrace the chance to work on a bipartisan basis to dramatically improve our

recycling and composting systems in America. By doing so, we can respect our planet, preserve the precious resources that God has bestowed upon us, and I might also add, create a lot of jobs, good paying jobs, all over the country: In West Virginia, in Arkansas, in Delaware, in Michigan, and a whole lot of other places, too.

With that, let me turn it over to our Ranking Member and partner on these issues and so many others for her opening remarks.

Also, Taylor, I understand that Taylor, not Taylor Swift, but we have some bad news from Taylor. We will miss Taylor, and we are grateful for all of her help.

OPENING STATEMENT OF HON. SHELLEY MOORE CAPITO, U.S. SENATOR FROM THE STATE OF WEST VIRGINIA

Senator CAPITO. Thank you, Mr. Chairman.

I thank the witnesses for being here with us today.

A lot of what the Chairman has said in his opening statement is mirrored in my own statements as well, because this is an issue that cuts across party, and certainly is absolutely essential in this Committee.

In 2021, this Committee and the Congressional Recycling Caucus, which Senator Boozman is the co-chair of with Chairman Carper, they were extremely active in getting a hearing on stakeholder input on recycling policy. At that hearing, we discussed the need to expand material processing and manufacturing here in America and how a lack of demand for recycled materials is inhibiting market development, and as a result, investment in recycling infrastructure.

The week before that committee hearing, Chairman Carper and I co-hosted a roundtable called Leadership in Recycling: Sustainable Practices and Innovative Technologies, where we had the opportunity to learn about some of the technological advancements in the recycling sector directly from our industry leaders.

Later in the year, the Infrastructure Investment and Jobs Act, led by this Committee, was enacted into law, establishing a new grant program for recycling education to reduce contamination and provide a feedstock of recyclable materials. This legislation also appropriated historic amounts of funding for recycling infrastructure and education.

Today, we build on that momentum with a hearing on draft legislation to address some of the data and accessibility gaps in the sector to further improve recycling across the country.

First, I will talk about my draft legislation, which is the Recycling Infrastructure and Accessibility Act. This legislation establishes, as the Chair said, a pilot program to improve recycling accessibility throughout the United States, with a particular emphasis on bringing recyclable services to underserved areas.

Recycling services, particularly curbside recycling, is not offered in many rural communities, like those of my home State of West Virginia. In fact, a study released last year showed that West Virginia has a recycling rate of just 2 percent when excluding cardboard, the lowest recycling rate in the States.

If you include cardboard, we don't do much better, with a recycling rate of 31 percent and a ranking of 40th in the Nation. According to the most recent recycling survey by the Department of

Environmental Protection in West Virginia, of the 50 county and regional solid waste authorities, only 35 provide recycling services, and five work closely with local recyclers or municipalities to make sure that residents have recycling options.

Together, these counties have 129 drop off locations and 36 curbside. Of those, 14 are municipalities that have populations—we have 14 cities that have populations that exceed 10,000, and they are required to provide curbside recycling, but this is a problem.

This is a challenge not just for our State, but also other States that are represented on this Committee, like Alaska and Wyoming, who face similar barriers. These rural areas share common challenges to accessibility: Location and proximity to material recovery facilities and the size and density of the population. This leads to low processing yields and high collection and transportation costs, leaving materials recovery facilities struggling to operate at a profit.

According to an opinion piece on WasteDive, something I read every day, that was a little tongue in cheek there, a news outlet covering the industry: "It is not uncommon for a small town to put out a request for a proposal asking waste companies to bid on recycling opportunities and to not receive any bids back due to the lack of perceived profitability."

This pilot program established would provide resources to increase collection and transportation of recyclables through investments to transfer stations, for example, providing access in those areas where a materials recovery facility may not be able to operate at a profit.

Second, Senator Carper, Senator Boozman, and I have collaborated on a draft bill, the Recycling and Composting Accountability Act. This bill requires EPA to collect and distribute data on recycling and composting across the country to provide an accurate reflection of the performance both nationwide and statewide. This is information that is critical for us to be able to evaluate how we can improve and how to best inform future recycling policies.

Recycling is a win-win solution, as the Chairman says, for our environment and our economy. In this political climate, it is critical that we remember there is a lot we agree on, and we need to be diligent in identifying and pursuing those bipartisan opportunities to improve the future. That is what we are doing here today.

It is with great sadness that I announce, as the Chairman said, that I am losing a valued staff member at the end of this week, one who is here with me today, who has been absolutely integral in not only the recycling space, but other areas on the Committee. Taylor Meredith will be leaving us. It is rare that you meet a person who brings as much intellect and enthusiasm, both in a personal way and a professional way, and Taylor is one of those. So I know she will succeed wherever she goes, and we will certainly miss her and wish her all the best.

So Taylor, thank you.

Senator CARPER. Amen.

Senator Boozman, I oftentimes refer to our Ranking Member as my wingwoman, and she refers to me sometimes as her wingman, and she has other descriptive terms as well, depending on how I am behaving. But I just want to say thank you for being my

wingman. I think we have been great partners leading the Recycling Caucus here in the Senate, and we have a bunch of folks on this Committee that are part of that and that are not on this Committee.

John, why don't you go ahead and make an opening statement?

OPENING STATEMENT OF HON. JOHN BOOZMAN, U.S. SENATOR FROM THE STATE OF ARKANSAS

Senator BOOZMAN. Well, thank you very much, Mr. Chairman, and I want to congratulate you and Senator Capito for the example that you set around here. We hear a lot about the rancor, and this and that, and we don't always agree. But I know that you two together are always trying to find common ground and find a path forward, which is so, so very important.

First, I want to thank you all very much for your attention to this important issue and for allowing us to discuss two pieces of legislation, the discussion draft of the Recycling and Composting Accountability Act that Chairman Carper and I have been working on, along with Senator Capito's Recycling Infrastructure and Accessibility Act. As the co-chair of the Senate Recycling Caucus, I understand the challenges and opportunities facing the recycling industry. It is certainly very important to me, and I know it is important to Senator Capito and Chairman Carper.

So, we do appreciate you all being here very, very much. We have a distinguished panel. When Chairman Carper and I began working on our proposal, we shared a goal of learning more about the landscape of recycling and identifying the challenges facing our Nation's recycling and composting infrastructure.

As you can imagine, the ability to recycle in Delaware and the ability to recycle in Arkansas are different. It is important to identify these regional differences so we can properly invest our resources to fix our Nation's recycling challenges. I believe there is great opportunity to make improvements in the recycling space. I look forward to continuing to work with Chairman Carper and Ranking Member Capito so we can develop meaningful, long term solutions that address the challenges facing the recycling industry today.

Thank you to the witnesses again for your participation and sharing your expertise. I look forward to hearing your thoughts on these two pieces of legislation.

Thank you, Mr. Chairman.

Senator CARPER. Thank you, Senator.

Senator Stabenow, I think you are going to introduce somebody from your home State. Please proceed, thank you.

Senator STABENOW. Well, thank you very much, Mr. Chairman and Ranking Member. This is a really important hearing, and I am so pleased that you have picked someone who is doing a fantastic job in Michigan, as well as across the country. It is my pleasure to introduce entrepreneur, activist, and educator, Michigan's own Pashon Murray.

Welcome.

Pashon was born and raised in Grand Rapids, Michigan, and after college, she helped manage one of the city's leadership and energy and environmental design projects, which culminated in the

country's first LEED certified YMCA. Today, Pashon is working to improve the carbon footprint of Detroit and beyond by finding solutions for everyday waste and eliminating trips to the landfill through composting.

She is the founder of Detroit Dirt, I love that name, Detroit Dirt, a revolutionary closed loop composting company she started in 2010 that provides compost and food waste solutions to local businesses. Through her work at Detroit Dirt, Pashon is helping to build a low carbon economy by motivating communities and industries to have a zero waste mindset. In 2017, she expanded her impact further by establishing the Detroit Dirt Foundation, a nonprofit serving the public through environmental education, research projects, and sustainable programs.

Recently, Mr. Chairman, she was recognized as a United Nations FAO food hero.

Ms. Murray, welcome. Thank you so much for the great work you are doing in Michigan as well as across the country. I am excited to welcome you to the Committee hearing.

Thank you, Mr. Chairman.

Senator CARPER. Senator Stabenow, thanks so much for introducing Pashon to all of us. Let me briefly introduce our other three remaining witnesses.

Rhodes Yepsen, Rhodes, raise your hand, please. Good to see you, my friend.

Rhodes is the Executive Director of the Biodegradable Products Institute, where he advocates for the value of compostable packaging and its role in diverting food waste from our landfills.

Welcome, Mr. Yepsen.

We are also joined by Ben Harvey. Ben is Chairman of the National Waste and Recycling Association.

Ben, I think you are out there in the atmosphere, and you are joining us, I think, remotely. We are delighted that you are doing that.

Our last witness is Charles Levell Hairston, and he goes by Levell. Levell is the General Manager for Recycling and Recovered Fibers, and he is joining us today.

And Mr. Hairston, welcome. We are delighted to see you.

I think, with that, we are going to start off with Mr. Yepsen.

You are welcome to present your testimony when you are ready. Take it away. Thank you.

STATEMENT OF RHODES YEPSEN, EXECUTIVE DIRECTOR, BIODEGRADABLE PRODUCTS INSTITUTE

Mr. YEPSEN. Chairman Carper, Ranking Member Capito, members of the Committee, thank you for the opportunity to provide feedback on these two pieces of legislation today advocating for our Nation's systems for recycling and composting. It is wonderful to see bipartisan support on these two initiatives.

As you heard, I am here on behalf of the Biodegradable Products Institute, a non-profit that advocates for the value of certified compostable packaging in diverting organic waste to composting.

These two pieces of draft legislation complement each other very well. Starting with the Recycling and Composting Accountability Act, it will provide much needed national level support by attract-

ing and quantifying the key aspects of successful recycling and composting programs. This includes the topic of access, whether that is curbside collection or drop off, the question of processing infrastructure capabilities and capacities. It addresses end markets for recycled material and finished compost, and it considers the importance of education and labeling.

As I explain in greater detail in my written testimony, no one of these aspects on its own is sufficient for determining the success of recycling or composting, because these are systems of interconnected stakeholders that form a value chain. This is precisely why I am so excited to be here today, as BPI focuses on systems based thinking for compostable packaging, rather than a product based solution, meaning the items aren't just technically compostable, but are designed to fit into food scraps collection and composting programs.

Looking at EPA's facts and figures, food is continually the No. 1 material sent to landfills and incinerators today. And the U.N. estimates that if food waste and loss were a country, it would be the third largest greenhouse gas emitter in the world, after the U.S. and China. That food is often tangled in non-recyclable food soiled packaging that makes it challenging for composters to recover. Compostable packaging enables the diversion of food scraps and associated packaging.

Groups like BioCycle Magazine have been tracking residential compost access and compost infrastructure for decades, partnering with groups like BPI on projects like FindAComposter.com to map access. The last reports from BioCycle show that over 10 million households now have access to either curbside or drop off food scraps collection composting, a number that grows each year, but is still a fraction of our population. Of the 4,700 composting facilities around the U.S., the majority accept only yard trimmings, not food scraps or other materials.

The U.S. Composting Council has done excellent work promoting end markets for finished compost, such as specifications for compost in use of Department of Transportation projects. Compost use helps restore our soils, improving water retention, pest resistance, nutrients for crops, humus for conditioning the soil. These benefits have been popularized in books and documentaries like Kiss the Ground and in research and reports by the Rodale Institute.

Unlike with recycling, composting is inherently local. Neither the raw materials, largely food scraps and yard trimmings, nor the finished compost are going to be shipped internationally like recycling. The resources will be kept regionally for use in agriculture, landscaping, and other beneficial uses.

Without the type of foundational data and reporting that the Recycling and Composting Accountability Act sets out for the EPA and without grant funding for communities like that provided in the Recycling Infrastructure and Accessibility Act, we won't realistically be able to advance a national strategy to recovering products and packaging in a meaningful way, and we won't be able to realize all the benefits associated with widespread recycling and composting.

A few small points of clarification. In the Recycling and Composting Accountability Act, we suggest amending the definition

of compostable materials to include certified compostable products beyond just paper. Compostable products and packaging will increasingly be part of the solution as companies and State governments roll out commitments to making all packaging reusable, recyclable, or compostable.

In the Recycling Infrastructure and Accessibility Act, we have two comments. The first is expanding the scope to include composting, as food soiled articles are often not readily recyclable, and again, the EPA is estimating roughly 40 percent of landfill and incinerator bound material is made up of food, yard trimmings, and wood waste, meaning we will need composting alongside recycling to make a difference. That would also help further align the two bills.

Finally, we recommend modifying the definition of underserved to be more inclusive of urban and suburban populations. We definitely respect that distance to processing facility is important, but that it is not the only determinant for whether a community offers recycling or composting, and that there may be communities that already have recycling or composting programs, but charge an extra fee for that service, setting a barrier to participation. These funds could be used more broadly.

Thank you for putting forward two excellent legislative proposals to improve domestic recycling and composting programs and for the opportunity to provide testimony and support. It has been an honor.

[The prepared statement of Mr. Yepsen follows:]

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February 2, 2022

U.S. Senate Committee on Environment and Public Works (EPW)

Hearing on "The Recycling and Composting Accountability Act" and "The Recycling Infrastructure and Accessibility Act"

Testimony of Rhodes Yepsen, Executive Director, Biodegradable Products Institute, Inc. (BPI)

Chairman Carper
Ranking Member Capito
Members of the Committee

Thank you for the opportunity to provide feedback on two bills that address our nation's systems for recycling and composting.

The Biodegradable Products Institute (BPI) is a non-profit advocating for the value of certified compostable packaging in diverting organic waste to composting. BPI operates North America's leading certification for compostable packaging, with 400+ member companies worldwide, and more than 15,000 items verified to ASTM compostability standards in our public database.

Our organization has been working on compostability topics since 1999, promoting the production, use, and appropriate end of lives for packaging that is designed to fully biodegrade in specific biologically active environments. BPI's certification is science driven and our programs support a shift to the circular economy. This includes a number of initiatives that align with the objectives of the two bills under consideration today, which I will outline blow.

The Recycling and Composting Accountability Act (RCAA)
This act covers important ground by tracking and quantifying the key aspects of successful recycling and composting programs.

Access: First, it looks at access to recycling and composting, which can be curbside collection or drop-off. BPI has been working on tracking of residential composting programs for over a decade with *BioCycle* magazine, and the latest survey showed 10 million households now have access to composting through municipal curbside or drop-off programs, a figure that rises each year.[1] Because access is not widespread, we're seeing private subscription services pop up all around the country to fill a need.[2] These reports highlight what materials are accepted, what makes programs successful, and any associated barriers.

[1] https://www.biocycle.net/residential-food-scraps-collection-access-in-the-u-s/
[2] https://www.biocycle.net/residential-food-scraps-collection-via-subscription-services/

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Processing Infrastructure: We know that access does not equate to recovery, since a majority of Americans have some form of recycling access, and yet recycling rates for most packaging remain low. Processing infrastructure, whether that's material recovery facilities (MRFs) for recycling or composting facilities for organics, is another critically piece of the solution, which means calculating the number of facilities, processing capacities and capabilities, tons diverted, contamination and reject rates, etc. Processing capacity not only helps tell the story for residential access, it also fills out the picture for commercial access, since many businesses contract directly with haulers for recycling and composting. This is another area that *BioCycle* has led the way on, in some cases with BPI support, such as with www.FindAComposter.com, which BPI took over and in 2022 will include residential collection and drop-off programs, in addition to composting facilities. *BioCycle* has detailed reports on composting infrastructure and in 2017 identified 4,713 composting facilities in the US, although the majority only accept only yard trimmings, with only about 500 accepting food scraps.[3]

End markets: Just like we need end markets for recycled materials, with postconsumer recycled content (PCR) used in new packaging, we also need end markets for finished compost, which has a number of uses including agriculture, landscaping, erosion control, green roof media, department of transportation projects, etc.[4] Compost use helps restore our soils, improving water retention and pest resistance, in addition to providing nutrients for crops and humus for conditioning the soil. These benefits have been popularized in books and documentaries like Kiss The Ground,[5] and by Rodale Institute, which reports that if regenerative agriculture practices like cover crops, no-till, and compost application were used on crop and pastureland around the world we would sequester more than our total global annual carbon dioxide (CO2) emissions.[6] That's in addition to avoiding methane, a potent greenhouse gas (GHG), by diverting food scraps and other organics from the landfill. The UN estimates if food waste and loss were a country, it would be the third largest emitter of GHGs after the US and China.[7] Talk about a low-tech climate solution!

Labeling and Education: The final component is making sure that we all know what and how to recycle and compost, because if we don't, then it doesn't matter how widespread access and infrastructure are, or how well end markets are developed. This means getting more consistent definitions and requirements about what's recyclable and compostable and what's not, and building education into K-12 curriculum. Today, due to lack of standardization it is common for the list of accepted recyclables or compostables to be different where we live and work in neighboring towns, so it's no wonder people are "wish-cycling", that there's high contamination, and we aren't achieving good recovery rates. Some states are setting requirements for labeling, but without consistency from state to state these requirements are nearly impossible for manufacturers of packaging to comply with. BPI released guidelines for manufacturers[8] and model bill language[9] for labeling and identification of compostable packaging to outline best practices and to start moving towards some common labeling.

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[3] http://www.biocycle.net/17_10_06_1/0001/BioCycle_StateOfOrganicsUS.pdf
[4] https://www.compostingcouncil.org/page/HowUseCompost
[5] https://kisstheground.com
[6] https://rodaleinstitute.org/wp-content/uploads/Rodale-Soil-Carbon-White-Paper_v11-compressed.pdf
[7] https://www.fao.org/3/i3347e/i3347e.pdf
[8] https://bpiworld.org/Labeling-Guidelines
[9] https://bpiworld.org/resources/Documents/BPI_Labeling-Identification-Policy-Compostable-Products.pdf

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One small point of clarification would be editing the definition of "compostable material" to include certified compostable products beyond just paper:

(4) COMPOSTABLE MATERIAL.—The term "compostable material" means material that is ~~**composed of biomass that can be continually and safely replenished or renewed**~~ **a feedstock for a composting process,** ~~**such as**~~ **including, but not limited to**—

(A) wood;
(B) agricultural crops;
(C) paper **and certified compostable products associated with organic waste**;
(D) other organic plant material;
(E) marine products;
(F) organic waste, including food waste and yard waste; ~~**and**~~ **or**
(G) such other material that is composed of biomass that can be continually replenished or renewed, as determined by the Administrator.

The RCAA will provide much needed national-level support to quantifying and qualifying recycling and composting on all of these fronts. Without this type of foundational data and reporting we won't realistically be able to advance a national strategy to recovering products and packaging, and won't be able to realize the climate benefits associated with widespread composting.

The Recycling Infrastructure and Accessibility Act (RIAA)

This act is an excellent complement to the Recycling and Composting Accountability Act (RCAA), providing funding to do something about the lack of access to recycling in underserved communities. It rightfully covers both curbside and drop-off programs, since one size doesn't fit all in America's variety of communities. However, we strongly suggest that the focus be expanded to include composting in addition to recycling, as food-soiled articles are often not readily recyclable. This would also further align it with the RCAA.

We know from years of EPA "Facts and Figures" data that food scraps are consistently the number one material disposed of in landfills and incinerators, and when combined with other readily compostable materials like yard trimmings and wood it makes up almost 40%.[10] That's not taking into consideration potential recovery of food-soiled packaging in the paper and plastics streams via composting, which takes the total to over 50%.

As part of the US Composting Infrastructure Coalition, BPI helped with the COMPOST Act, which would provide $2 billion in grants and loans for composting infrastructure,[11] and we are actively working with states on extended producer responsibility (EPR) bills that could help fund recycling and composting for packaging.

[10] https://www.epa.gov/sites/default/files/2021-01/documents/2018_ff_fact_sheet_dec_2020_fnl_508.pdf
[11] https://compostinfrastructure.com

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However, the COMPOST Act looks unlikely to succeed in its current form, so we are thrilled at the possibility of the definition of recycling in RCAA being expanded to include "organics recycling" so that communities also have grant funding to help compost the largest material streams in their waste bins today.

In addition, we recommend modifying the definition of "underserved" to be inclusive of urban and suburban populations. As mentioned about the RCAA, the presence of a processing facility is not the only determinant of access, and there are certainly cases where communities within a 150-mile radius of a MRF or composting facility do not offer collection or drop-off for recyclables or composting. This could be due to a processing facility not having enough capacity to serve that community, or accepting primarily commercial streams not residential. There are also many examples where households officially have access to recycling and composting services, but have to pay extra for them.

Respectfully submitted,

Rhodes Yepsen
Executive Director, BPI

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The State Of Organics

Total composting facilities

4,713

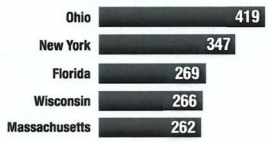
BioCycle asked states to complete an organics recycling "Snapshot Survey" to collect most recent data on composting, anaerobic digestion and quantities of organics diverted.

Nora Goldstein

FROM December 2016 to June 2017, *BioCycle* editors collected the most recent data that states had compiled about organics recycling activities. A one-page questionnaire was completed by 43 states and the District of Columbia, primarily by officials in state solid waste agencies whose responsibilities include organics recycling. Data submitted was primarily from Calendar Years 2015-2017.

The 2017 *State of Organics Recycling In The U.S.* survey requested information on both composting and anaerobic digestion infrastructure and regulations. While several solid waste agency officials who responded had data on anaerobic digestion activity in their state, the majority did not, as municipal and on-farm anaerobic digestion operations typically fall under the purview of other state agencies. As a result, *BioCycle* utilized other sources to collect much of the data on anaerobic digestion.

States with the most ...
Composting facilities



BioCycle considers the data collection process used for this 2017 report as a "State Snapshot Survey" — essentially a snapshot in time of information available from states on organics recycling activities. It became evident in the course of conducting the 2017 *State of Organics Recycling In The U.S.* that fewer states have data available on composting since *BioCycle* conducted a similar survey in 2013 as part of the 2014 *State of Composting In The U.S.* project, led by the Institute for Local Self-Reliance (see summary in "State Of Composting In The U.S.," July 2014). For example, in some states, yard trimmings composting operations are exempt from filing annual reports with the solid waste agencies, thus no aggregated data is available for that category of composting facilities at the state level. Other states don't have adequate staff to compile data that may be submitted via annual reporting requirements.

Yard trimmings composting sites

Ohio

Seven states did not respond to the "BioCycle Survey of State Organics Recycling Activity" questionnaire: Hawaii, Illinois, Indiana, New Jersey, Pennsylvania, Utah and West Virginia. However, *BioCycle* was able to utilize in-house data as well as obtain composting data for Illinois (from members of the Illinois Food Scrap Coalition), Indiana (from a mapping project done by

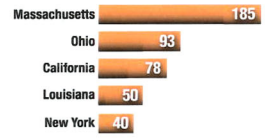
Recycling In The U.S.

the Indiana Recycling Coalition of both composting and AD infrastructure) and Pennsylvania (through a District office of the state's Department of Environmental Protection). Four states returned the questionnaires, but only had minimal data to report. These include Alabama, Arizona, Iowa and Missouri.

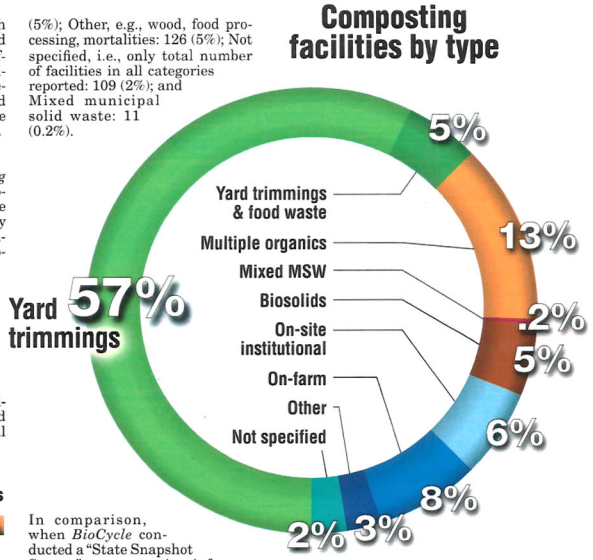
THE BIG PICTURE

The 2017 *State of Organics Recycling In The U.S.* snapshot survey found a total of 4,713 composting facilities. Table 1 summarizes this total number by facility types. Figure 1 is a representation of this data by percentage of total facilities (4,713). The state-by-state composting data is in Table 2.

Yard trimmings composting comprises the largest number of operations — 2,698 or 57 percent of all facilities in the U.S. There are 249 composting sites that process yard trimmings and food scraps only (5%), and 620 (13%) that process multiple organics, which include feedstocks such as yard trimmings, food scraps, livestock manure and industrial

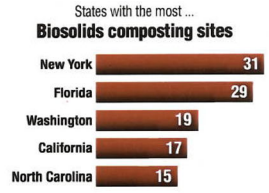


organics. Massachusetts, for example, reports 185 composting facilities processing multiple organics and did not include any sites in the yard trimmings only or yard trimmings and food scraps only categories. Percentage breakdown of the remaining facility types is as follows: On-farm: 354 (8%); On-Site Institutional: 297 (6%); Biosolids: 249 (5%); Other, e.g., wood, food processing, mortalities: 126 (5%); Not specified, i.e., only total number of facilities in all categories reported: 109 (2%); and Mixed municipal solid waste: 11 (0.2%).



In comparison, when *BioCycle* conducted a "State Snapshot Survey" on composting infrastructure in the U.S. in 2013 (to collect data for the 2014 *State of Composting in the U.S.*), a total of 4,914 composting operations in the U.S. were reported — 201 more than are reported in 2017. The following is a brief analysis.

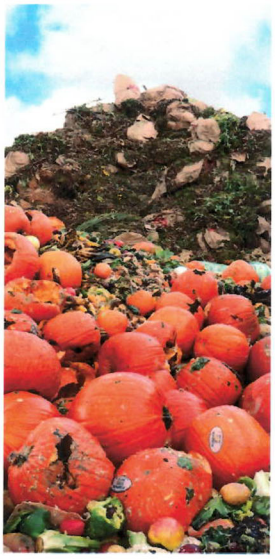
Yard Trimmings Composting: There is a decrease of 755 in the total number of yard trimmings sites (from 3,453 in 2014 to 2,698 in 2017. Some state data is significantly different between the reporting years (2013 vs. 2017), e.g., Pennsylvania: 350 vs. 158; New York: 329 vs. 133; and Massachusetts: 221 vs. 0 (an explanation is in the State Officials' Insights section). How states



categorize yard trimmings composting sites in terms of permitting is discussed as well in the State Officials' Insights section.

Food Waste Composting: In the 2013 "State Snapshot Survey," *BioCycle* requested facility information for both source separated food waste composting and mixed organics composting. The latter category was defined as facilities handling multiple organics streams beyond yard trimmings and food waste. The term "mixed organics" was confused with "mixed waste" by some states. In an attempt to clarify the terminology, in the "BioCycle Survey of State Organics Recycling Activity" questionnaire initially emailed to states in December 2016, *BioCycle* requested a breakdown of infrastructure as follows: Yard trimmings only; Yard trimming + food waste only; and Multiple organics, defined as facilities composting more than yard trimmings or yard trimmings and food waste only. The differences between the data reported (2014 "State of Composting" vs. 2017 "State of Organics Recycling") are interesting:

- 2014: Source separated food waste is 347 and mixed organics is 87.
- 2017: Yard trimming + food waste is 249 and multiple organics is 620.



BioCycle followed up with state officials about the facilities being included in the multiple organics category. The primary question was: How many of the multiple organics facilities in your state are taking food waste? In the state of Montana, the answer was none. In Massachusetts, it included a portion, but not enough data was available to provide a full explanation. California, on the other hand, reported 21 composting facilities processing yard trimmings and food waste only, and 78 processing multiple organics. In this case, it is likely that food waste is included in a number of the multiple organics composting facilities' stream. *BioCycle* will be examining this data in more detail over the next few months.

Table 3 lists the state-by-state data on anaerobic digestion facilities in the following categories, with totals provided for each category: Livestock manure only—146; Livestock manure codigested with food waste and other high strength organics (HSOs)—94; Biosolids codigested with food waste and other HSOs at wastewater treatment plants (WWTPs)—133; Food only digesters—18; Digesters processing multiple organics, e.g., food waste, yard trimmings, industrial organics—7. The Water Environment Federation (WEF), in collaboration with the American Biogas Council (ABC), tracks the number of anaerobic digesters installed at wastewater treatment plants for biosolids (which WEF references as water resource recovery facilities (WRRFs)). Newly released findings, courtesy of WEF-ABC, are 1,269 anaerobic digesters treating biosolids at WRRFs, of which 860 utilize the biogas being generated.

Table 1. Composting facilities in the U.S. (data reported, 2015-2017)

Composting Facility Types	Total of Each Type	Percent of Total
All composting facilities	4,713	
Yard trimmings	2,698	57.2
Yard trimming + food scraps	249	5.3
Multiple organics[1]	620	13.2
Mixed MSW	11	0.23
Biosolids	249	5.3
On-Site Institutional	297[2]	6.3
On-Farm	354[2]	7.5
Other[3]	126	2.7
Not specified[4]	109	2.3

[1]Taking more than yard trimmings and/or food scraps, e.g., yard trimmings, food, manure, wood shavings, industrial organics, etc; [2]Typically exempt from permitting or permit-by-rule thus often undercounted; [3]Includes sites that compost mortalities, animal by-products, community composting sites, seafood processing residuals, etc.; [4]Two states only provided a total number of composting facilities, and no break down by categories.

BioCycle obtained information for biosolids codigestion from the Water Environment & Reuse Foundation (WE&RF) and the California Association of Sanitation Agencies (CASA), along with biosolids codigestion data from several states. WE&RF, CASA and *BioCycle* concur that there are likely more than 133 treatment plants receiving off-site organic substrates for codigestion at WWTPs. Data from WEF-ABC illustrate this point: 14 percent of the 1,269 WRRFs with AD — 177 — accept additional organics from off-site generators.

COMPOSTING METHODS AND SCALE

Thirty-four states reported data on composting methods utilized by facilities in their states (Table 4). The results: Windrows—1,135; Static piles—409; Aerated static piles—170; and In-Vessel—81. The composting methods question was not asked on the "State of Composting" questionnaire, therefore no comparable data exists between the 2014 and 2017 reports.

Table 2. Composting facilities in the U.S., total, and by feedstock (data reported, 2015-2017)

State	Total Composting Facilities	Yard Trimmings Only	Yard & Food Waste	Multiple[1] Organics	MSW	Biosolids	On-Site,[2] Institutional	On-Farm[2]	Other
Alabama	n/a	0[3]	n/a	n/a	n/a	n/a	n/a[4]	n/a	n/a
Alaska	5	n/a	n/a	n/a	2	2	1	n/a	
Arizona[5]	6	2	1	2		1		n/a	n/a
Arkansas	27	16		5		4[6]	2		
California	249	39	21	78	2	17	73	19	
Colorado	33	1	2	7	0	8	5	10	
Connecticut	140	109[7]	4			1	n/a	26[8]	
Delaware	5	2	0	2	0	1			
District of Columbia	63						13		>50[9]
Florida	269	225	n/a	11	1	29	n/a	n/a	3[10]
Georgia	42	1[11]	n/a	n/a	n/a	5	14	21	1[12]
Hawaii	2					2[6]			
Idaho	5			3		2			
Illinois	58	47	10[13]			1			
Indiana	119	110[14]	9[14]						
Iowa	80								
Kansas	184	116	41					19	8[15]
Kentucky	33	23	1	2	0	4	3	n/a	
Louisiana	215	60[16]		50			5	50	50[17]
Maine	121	80	0	15		14	2	10	
Maryland	18	14	3	1	n/a	n/a			
Massachusetts	262	n/a		185	2	9	4	62	
Michigan	114	102	9	1		2[6]			
Minnesota	129	115		9			5		
Mississippi	15	10	4	1					
Missouri	11	6[5]	3[5]			2			
Montana	45	24	0	10[18]	1	1	0	2	7[19]
Nebraska	10	2[20]		2	0	5		1	
Nevada	10	1	0	6	0	1	1	1	
New Hampshire	162	150	2	6		4[6]			
New Jersey	301	295[21]		1		5			
New Mexico	41	4	2	14	0	10	1	4	6[22]
New York	347	133	12	40	1	31	97	33	
N. Carolina	64	22	19	2		15	6		
N. Dakota	81	69	0	9	0	0	1	2	
Ohio	419	292	n/a	93	0	3	11	20[23]	
Oklahoma	14	5		3		6			
Oregon	60	16	6	20	0	6	n/a	12[24]	
Pennsylvania	217	158	16			9[6]	21	13	
Rhode Island	24	21	0	1	0	1		1	
S. Carolina	23	3[25]	4	1			15		
S. Dakota	143	141	0	1	1				
Tennessee	8	4	2	1	1				
Texas	34	4		20		10[6]			
Utah	37	18[21]	4[21]			15[6]			
Vermont	14	1	0	9	0			3	1[15]
Virginia	33	8	1	4	0	3	9	8	
Washington	126	5	55	2		19	8	37	
W. Virginia									
Wisconsin	266	244	18	3	0	1			
Wyoming	29								
Total	**4,713**	**2,698**	**249**	**620**	**11**	**249**	**297**	**354**	**126**

[1]Taking more than yard trimmings and/or food scraps, e.g., yard trimmings, food, manure, wood shavings, industrial organics, etc; [2]Typically exempt from permitting or permit-by-rule thus often under counted; [3]Yard trimmings are only processed into mulch. No composting; [4]Food waste is only diverted by universities who use it on site; [5]BioCycle estimates; [6]Source: "Biosolids Composting In The United States — 2010 Update," BioCycle, Vol. 51, No. 12, 35-41; [7]Leaves only; [8]Conn. DEEP estimate; [9]Community composting sites; [10]Animal by-products; [11]Georgia EPD does not track yard trimmings composting; [12]Industrial sludges, ash, bark; [13]Source: Illinois Food Scrap Coalition; [14]Source: Indiana Recycling Coalition; [15]Mortalities; [16]Estimate of 60 yard trimmings composters by Louisiana Dept. of Agriculture & Forestry, with estimated 240 sites making mulch; [17]Food processing residuals; [18]Manure is primary feedstock. No multiple organics sites taking food waste; [19]Road kill; [20]Nebraska DEQ estimate; [21]Source: "State of Composting In The U.S.," 2014, Inst. for Local Self-Reliance; [22]Offal; [23]20 on-farm facilities do not meet exemption and are registered (permitted). Many others are exempt; [24]Oregon DEQ estimate; [25]94 yard trimmings mulch only sites.

Table 3. Anaerobic digestion facilities in the U.S., by feedstock (2015-2017)

State	Manure Only[1]	Manure + Food Codigestion[1]	Biosolids Codigestion[2,3]	Food Only	Multiple Organics
Alabama			2		
Alaska					
Arizona	2		1		
Arkansas	1		1		
California	13	6	42[4]	4	4
Colorado	1		3		
Connecticut	1[5]		1	1	
Delaware					
District of Columbia					
Florida	2		3		
Georgia	1		2		
Hawaii					
Idaho	5	1	1		
Illinois	2	1	5		
Indiana	7	2			
Iowa	1	3	2		
Kansas		1	1		
Kentucky		1[6]			
Louisiana					
Maine		1[7]	1		
Maryland	1				
Massachusetts		3[8]	2	3	
Michigan	7[9]	2[9]	2		1
Minnesota	5	2	2		
Mississippi	4				
Missouri	2	1	1		
Montana	1				
Nebraska	1		1		
Nevada			1		
New Hampshire			1		
New Jersey			3		
New Mexico					
New York	20	15	11	4	
N. Carolina	7	3			
N. Dakota					
Ohio	3[10]	1[10]	13[10]	3	
Oklahoma	1				
Oregon	4[11]	3[11]	5	2	
Pennsylvania	12	18	3		
Rhode Island					1
S. Carolina	2				
S. Dakota	1				
Tennessee					
Texas	2		3		
Utah	4				
Vermont	7	11	3		
Virginia	1[12]		2		
Washington	2[13]	7[13]		1	
W. Virginia			1		
Wisconsin	21[14]	12[14]	14	0	1
Wyoming		2			
Total	**146**	**94**	**133**	**18**	**7**

[1]BioCycle utilized livestock manure facilities data from USEPA AgSTAR, Livestock Anaerobic Digester Project Database, Aug. 2017, unless noted; [2]BioCycle utilized 2016 codigestion data compiled by the Water Environment & Reuse Foundation for all states excepting California and Ohio; [3]Water Environment Federation's www.resourcerecoverydata.org lists water resource recovery facilities with operating anaerobic digestion, on-site, or sending biosolids to AD; [4]2017 Estimate supplied by California Association of Sanitation Agencies; [5]Source: Conn. DEEP; [6]Source:Kentucky DEP; [7]Source: Maine DEP; [8]Source: Mass. DEP; [9]Source: Mich. DEQ; [10]Source: Ohio EPA; [11]Source: Oregon DEQ; [12]Source: Virginia DEQ; [13]Source: Washington DOE; [14]Source: Wisconsin DNR.

Thirty-eight states estimated the number of composting facilities by annual throughput (Table 5). Similar to the 2014 *State of Composting In The U.S.*, the vast majority of composting facilities — 2,364 — compost less than 5,000 tons/year (tpy) of feedstocks. There are 429 sites composting 5,000 to <30,000 tpy, and 194 facilities compost over 30,000 tpy of material.

The tons/year ranges were modified on the "State Snapshot Survey" sent in December 2016 for the medium-scale and large-scale operations from 5,000 to <20,000 and >20,000 respectively (2013 "Snapshot Survey") to 5,000 to <30,000 and >30,000 respectively (2016 "Snapshot Survey"). A comparison of the totals follows:

- Small-scale composters (<5,000 tpy): 2,354 (2014) vs. 2,364 (2017), a minor increase.
- Mid-scale composters: 713 (5,000 to <20,000 tpy, 2014) vs. 429 (5,000 to <30,000 tpy 2017), a decrease of 60 percent.
- Large-scale composters: 218 (>20,000 tpy, 2014) vs. 194 (>30,000

Table 4. Composting facilities, by method

State	Windrow	SP[1]	ASP[2]	I-V[3]
Alaska	0	0	4	1
Arizona	5		1	
Arkansas	8	10		
California	151	0	12	13
Colorado	23	8	1	1
Delaware	1	1	3	0
Georgia	11	10	1	5
Idaho	3		2	
Iowa	25	6	48	1
Kansas	165	21		
Kentucky	33			
Louisiana	150	15	25	25
Maine	25	80	11	3
Maryland	16		2	
Minnesota	5	0	4	2
Mississippi	3	8		
Montana	13	27	1	1
Nebraska	8			
Nevada	5		1	
New Mexico	20	19	1	1
N. Carolina	14	2	4	2
N. Dakota	23	57	0	0
Ohio				10
Oklahoma	13		1	1
Oregon	32	13	8	0
Rhode Island	22	1		1
S. Carolina	7		1	
S. Dakota	16	126	0	1
Tennessee	7	0	1	
Texas	15	1	2	
Vermont	9	0	1	0
Virginia	18	0	4	5
Washington	24	4	30	8
Wisconsin	265	0	1	
Total	**1,135**	**409**	**170**	**81**

34 states reporting.
[1]Static pile; [2]Aerated static pile; [3]In-Vessel.

tpy), therefore a slight increase in the total number.

One final note on The Big Picture. As discussed in the October 2017 *BioCycle* Editorial, "Digging For Data," our analysis of the 2017 *State of Organics Recycling in the U.S.* findings highlights the importance of creating and utilizing a standard set of definitions when requesting data. For example, some states include mulch operations in their yard trimmings composting count. Responses to the multiple organics feedstock category are another example. *BioCycle* editors plan to collaborate with state organics recycling officials and stakeholder groups about standardizing definitions and helping to facilitate organics recycling data collection and reporting.

TONS DIVERTED

Thirty-five states reported data on the tons of organics recycled via composting and anaerobic digestion, primarily using 2015 and 2016 data (Table 6). Only a handful of states had quantities for all of the categories requested: yard trimmings, food waste, biosolids, livestock manure and other. The 35 states reported a total of 21.1 million tons of organics diverted. Yard trimmings comprise the greatest tonnage (14.4 million tpy), followed by Food waste (1.8 million tpy), Other (1.7 million tpy), Biosolids (1.6 million tpy), and Livestock manure (1.57 million tpy). Materials included in the other category are identified in the Table 6 footnotes.

Thirty-one states reported data on tons diverted to composting, utilizing 2014-2016 data (Table 7). Total quantity diverted to composting by these states is 14.0 million tpy.

PROGRAMS TO SUPPORT COMPOSTING, AD

Financing, technical assistance and training, and disposal bans and diversion mandates are pretty much under the purview of state legislatures and state organics recycling agencies, versus the federal government. Limited financing is available from the U.S. Department of Agriculture, e.g., the EQIP program for on-farm composting and the REAP (Rural Energy for America Program) for grants and loan guarantees to farms for livestock manure digesters. The U.S. EPA regional offices may offer grants, typically in

Table 5. Composting facilities by annual throughput (tons/year)

State	<5,000	5,000-<30,000	30,000+
Alaska	2		
Arizona	3		3
Arkansas	12	4	2
California	47	73	56
Colorado	24	7	2
Connecticut	82	46	12
Delaware	2	2	1
District of Columbia	63		
Florida	212	43	30
Georgia	3		1[1]
Idaho	0	5	0
Kansas	178	5	1
Kentucky	28	5	
Maine	111	7	1
Maryland	8	6	4
Michigan	64	26	18
Minnesota	1	8	1
Mississippi	9	2	
Montana	43	2	0
Nebraska	n/a	4	6
Nevada	2	2	3
New Hampshire	153	3	
New Mexico	35	6	0
New York	287	43	17
N. Carolina	27	16	8
N. Dakota	81	0	0
Ohio	356	45	3
Oregon	20[2]	13	9
Rhode Island	16	7	1
S. Dakota	141	2	0
Tennessee	6	1	1
Vermont	7	4	1
Virginia	26	6	2
Washington	38	18	11
Wisconsin	252	14	0
Wyoming	25	4	0
Total	**2,364**	**429**	**194**

36 states reporting.
[1]Permit pending; [2]20 permitted. Many permit-exempt facilities under 5,000 tons/year.

Table 6. Organics recycled via composting and anaerobic digestion, by feedstock type (tons/year, 2015-2016 data primarily)

State	Yard trimmings	Food Waste	Biosolids	Manure	Other
Alabama	27,757				
Alaska	n/a	65	1,300	1,800	
Arkansas	49,786	1,322	27,063		
California	4,055,000	500,000	450,000	600,000	150,000[1]
Colorado	158,368	98,879	34,971	337,983	
Connecticut	291,541	5,954	350	1,738	
Delaware	24,017	0	1,200	0	
Florida	2,674,143	221,773	239,500	264,512	192,772[2]
Georgia	1,331	468	22,352		20,444[3]
Iowa	143,113	18,533	26,445	13,379	97,063[4]
Kansas	88,998			3,152	82,137[5]
Kentucky	133,963				
Louisiana	250,000	50		40,000	50,050[6]
Maine	16,450	3,400	55,000 (wet)	31,000	6,225[7]
Maryland	640,541	80,263			174,440[8]
Massachusetts		270,000			
Michigan	1,568,500	29,800		11,100	
Minnesota	161,362	52,359			
Montana	34,156		2,090	601	570[9]
Nebraska	150,000	24,000	6,860		
Nevada	18,839	34,432	13,323		
New Mexico	28,900	4,400	9,600	11,900	4,100[10]
New York	440,000	20,000	550,000	n/a	
N. Carolina	430,000	46,613	80,000	52,270	
N. Dakota	30,040	0	0	445	
Ohio	735,666	74,807	n/a	120,017	
Oregon	520,378	55,000			378,465[11]
Rhode Island	72,825		2,600		
S. Carolina	379,694	10,157			
S. Dakota	49,831		6,337		8,775[12]
Texas	441,908				
Vermont	16,687	6,566		4,816	8,285[13]
Virginia	153,598		76,100 (wet)		49,844[14]
Washington	325,702	263,170	10,836	80,796	513,853[15]
Wisconsin	257,915	13,471			
Total by type	**14,371,009**	**1,833,582**	**1,615,927**	**1,575,509**	**1,737,023**

Grand total for all feedstock types: 21,133,050

35 states reporting.
[1]Wood; [2]Not specified; [3]Wood, mortalities, ash; [4]Wood, industrial sludge, paper, mortalities, crops; [5]81,157 tons=source separated organics, 980 tons=mortalities; [6]Seafood processing, fats, oils, grease (FOG); [7]Seafood processing; [8]Bark, chicken litter, manure, wood, etc; [9]Offal, road kill; [10]Offal, FOG, mortalities, paper; [11]Wood waste; [12]Mixed MSW; [13]Offal, oil, grease, high carbon burlap, vegetation; [14]Industrial food waste, biosolids, manure, etc; [15]Other agricultural and industrial organics, mortalities, sawdust, paper, wood, etc.

Table 7. Tons to composting, by state (data reported, 2014-2016)

State	Tons Composted
Arkansas	95,081
California	5,600,000
Colorado	257,678
Connecticut	299,234
Delaware	25,217
District of Columbia	7,389
Illinois[1]	511,171
Iowa	297,044
Kansas	174,287
Maine[2]	23,627
Maryland	825,103
Michigan	784,250
Minnesota	213,499
Mississippi	26,296
Montana	86,553
Nebraska	375,440
Nevada	164,839
New Mexico	59,000
New York	460,000
N. Carolina[3]	663,165
N. Dakota	23,535
Ohio	465,245
Oregon	481,518
Rhode Island	75,425
S. Carolina	126,470
S. Dakota	49,831
Texas	302,567
Vermont	49,934
Virginia	49,844
Washington	1,167,011
Wisconsin	300,688
Total	**14,040,941**

31 states reporting.
[1]2014 data; [2]MSW organics only; [3]Includes all materials accepted at NCDEQ Div. of Waste Mngt. Solid Waste Section composting facilities. However, includes 63,317 tons of biosolids (not all of biosolids composted in N. Carolina).

the $5,000 to $25,000 range, for food waste reduction initiatives. In terms of education and outreach about organics recycling, both the U.S. EPA and USDA have ongoing programs, e.g., EPA's Food Recovery Challenge, Wastewise, AgSTAR and EPA's anaerobic digestion webpage (epa.gov/anaerobic-digestion), and USDA's Biogas Opportunities Roadmap.

The *State of Organics Recycling In The U.S.* questionnaire asked states to provide an update on their programs and policies to support composting and anaerobic digestion (Table 8). Forty-five states and the District of Columbia responded to these questions. Response totals are summarized as follows: Grants—20; Loans—9; Tax incentives—8; Technical assistance—30; Organics diversion mandates—7; Yard trimmings disposal ban—21; Food waste disposal ban—4; Outreach and education—32; Operator training courses—19.

California leads the nation in financial assistance for composting and anaerobic digestion infrastructure via California Climate Investments, a statewide program that puts billions of the state's Cap-and-Trade auction proceeds toward reducing greenhouse gas emissions, strengthening the economy and improving public health and the environment — particularly in disadvantaged communities. Auction proceeds are deposited in the Greenhouse Gas Reduction Fund (GGRF). Competitive grant programs utilizing GGRF monies for food waste reduction and recycling are administered by the California Department of Resources Recycling and Recovery (CalRecycle) under its Organics Grant Program. The purpose of this competitive grant program is to lower overall greenhouse gas emissions by expanding existing capacity or establishing new facilities in California to reduce the amount of California-generated green materials, food materials, or alternative daily cover being sent to landfills. In FY 2016-17, $12 million was made available for composting projects, $12 million for anaerobic digestion projects and $5 million for new or expanding existing food waste prevention projects.

STATE RANKINGS

Rankings of states' composting and anaerobic digestion infrastructure are provided in Tables 9-14. *BioCycle* included New Jersey's data from the 2014 *State of Composting In The U.S.* in Tables 9 and 10 because, based on "State of Composting" data, the state comprises 6.4 percent of the national composting infrastructure. *BioCycle* spoke with several state officials in the New Jersey Department of Environmental Protection in an attempt to gather more recent composting infrastructure data. One official noted that a significant cut in the Department's staffing precludes its ability to tabulate any infrastructure data and tonnages of organics recycled.

Rankings are provided in the following categories: Total composting facilities (Table 9); Yard trimmings composting sites (Table 10); Yard trimmings + food waste composting only sites (Table 11); Multiple organics composting sites (Table 12); Biosolids composting sites (Table 13); and Livestock manure digesters (Table 14).

STATE OFFICIALS' INSIGHTS

BioCycle concludes its 2017 *State of Organics Recycling In The U.S.* with a summary of some state officials' insights and explanations about the information they were able or unable to provide in the "State Snapshot Survey." *BioCycle* editors thank all state officials who provided data (or explained why they could not) for our 2017 report, as well as various organizations and associations that helped fill in the gaps.

Arizona: Without any regulations mandating reporting, it's very hard for the Arizona Department of Environmental Quality to gather organics recycling data. This is compounded by having only one full-time employee overseeing the entire recycling program.

Georgia: Facilities that only compost yard trimmings are not required to get a permit from the Georgia Environmental Protection Department (Georgia EPD) or provide notification for permit-by-rule facilities. In addition, the operating status of most yard trimmings composting sites is unknown since they are not required to report to Georgia EPD. However, with the significant reduction in inert landfills in Georgia over the past couple of years, the EPD notes that, most likely, more yard trimmings are being mulched or composted. Further, explains a Georgia EPD official, "due to the difficulty in some of the more rural counties to carry yard trimmings to a composting or mulch facility, a Yard Trimming Landfill category was created in 2016 in the permit-by-rule section of the Solid Waste Management Rules. Yard trimming only landfills can be established in counties with a population less than 65,000. We have received only one notification for a Yard Trimming Landfill so far. We do not have any estimates on the number of counties that may apply in the future."

Louisiana: The organics recycling official at the Louisiana Department of Agriculture & Forestry reports that the state's "300 yard trimmings sites are nearly all licensed arborists trying to beneficially use the limbs, trunks and similar tree debris generated by their work. Most produce mulch; probably 20 percent also produce finished compost." Based on that data, *BioCycle* reported 60 yard trimmings composting operations in Louisiana.

Massachusetts: *BioCycle* followed up with the Massachusetts Department of Environmental Protection (MassDEP) about its categorization of composting facilities by feedstock type in its "State Snapshot Survey" response. The MassDEP official explains that MassDEP doesn't have the data to clearly identify which composting sites in the state are handling yard trimmings only (Table 2), noting that a number of the facilities listed as taking multiple organics are "probably yard trimmings only — or at least primarily.... But data is not available to know that clearly."

Minnesota: Officials from the Minnesota Pollution Control Agency (MPCA)

Table 8. State programs to support composting, AD, state by state summary

State	Grants	Loans	Tax Incentives	Technical Assistance	Diversion Mandates	Yard Trimmings Disposal Ban	Food Waste Disposal Ban	Outreach And Education	Operators Training Courses
Alabama	No	No	No	No	No	No	No	No	No
Alaska	No	No	No	No	No	No	No	No	No
Arkansas	No	Yes[1]	Yes[2]	Yes	No	Yes	No	Yes	No
California	Yes	Yes	No	Yes	Yes[3]	No	No	Yes	No
Colorado	Yes	No	Yes	Yes	No	No	No	Yes	No
Connecticut	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Delaware	No[4]	No[4]	No	Yes	Yes	Yes	No	Yes	No
District of Columbia	No	No	No	Yes	Yes	No	No	Yes	No
Florida[5]	No	No	No	Yes	No	No	No	Yes	No
Georgia	No	No	No	Yes	No	No	No	Yes	Yes[6]
Hawaii						No			
Idaho	No	No	No	Yes	No	No	No	No	Yes
Illinois						Yes			
Indiana						Yes			
Iowa	No	Yes	No	n/a	Yes	No	No	n/a	No
Kansas	No	No	No	Yes[7]	No	No	No	Yes[7]	Yes[7]
Kentucky	No	No	No	No	No	No	No	No	Yes
Louisiana	No	No	No	Yes	No	No	No	Yes	Yes
Maine	No	No	No	No	No	No	No	Yes	Yes
Maryland	No	No	No	No	No	Yes	No	Yes	No
Massachusetts	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes
Michigan	Yes	No	No	Yes	No	Yes	No	Yes	Yes
Minnesota	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No
Mississippi	Yes	No	No	Yes	No	No	No	Yes	No
Missouri	Yes	No	No	Yes	Yes	Yes	No	No	No
Montana	No	No	No	Yes	No	No	No	Yes	Yes
Nebraska	Yes	No	No	No	No	Yes	No	Yes	No
Nevada	No	No	No	No	No	No	No	No	No
New Hampshire	No	No	No	Yes	No	Yes	No	Yes	Yes
New Jersey						Yes[8]			
New Mexico	Yes	No	No	Yes	No	No	No	Yes	Yes
New York	Yes	No	No	Yes	No	No	No	Yes	No
North Carolina	Yes	No	Yes	Yes	No	Yes	No	Yes	Yes
North Dakota	No	No	No	No	No	No	No	Yes	Yes
Ohio	Yes	Yes[9]	No	Yes	No	Yes	No	Yes	Yes
Oklahoma	No	No	No	Yes	No	No	No	Yes	No
Oregon	No	No	No	No	No	No	No	No	No
Pennsylvania	Yes	No	No	No	No	Yes[8]	No	No	No
Rhode Island	No	No	No	No	No	No	Yes	No	No
South Carolina	Yes[10]	No	Yes[11]	Yes	No	Yes[12]	No	Yes	Yes[6]
South Dakota	Yes	Yes	No	Yes	No	Yes	No	Yes	No
Tennessee	Yes	No	No	Yes	No	No	No	Yes	No
Texas	No	No	No	No	No	No	No	Yes	No
Utah						No			
Vermont	Yes[13]	No	Yes[14]	Yes	Yes	Yes	Yes	Yes	Yes
Virginia	No	No	Yes	No	No	No	No	No	No
Washington	Yes	No	No	Yes	No	No	No	Yes	Yes
West Virginia						Yes			
Wisconsin	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes
Wyoming	No	No	No	Yes	No	No	No	No	No

[1]Small business loan program (not specific to composting but equipment may be eligible); [2]Recycling tax credit; [3]Mandate landfill diversion of nonresidential green waste and food waste over certain amount/generator category; [4]Grant and loan program exists, but funding depleted; [5]Recycling credits; [6]Offered occasionally; [7]Compost operator training only; [8]Leaves only; [9]Loans for anaerobic digesters only; [10]Backyard compost only; [11]No sales tax on recycling equipment; [12]Only banned from Class 3 landfills, which are generally MSW landfills only. Can be disposed in Class 1 and Class 2 landfills; [13]Not to private composters or AD directly; [14]No sales tax on compost.

explain that composting data in the state is compiled from SCORE reports submitted by Minnesota counties annually, which include information about all the waste generated in the county and the various recycling/composting/recovery programs. They noted that MPCA is working to improve its facility reporting processes, and plans are underway to implement hauler reporting as well. Finally, MPCA does not require a permit for any site that has under 120 cubic yards of material on site at any one time, thus the number of on-site composting facilities in the state "is hard to predict."

Missouri: With all the budget cuts over the last few years, the Missouri Department of Natural Resources "doesn't have any tracking on organics recycling," notes a state official. *BioCycle* utilized its own data for Missouri.

Nebraska: The Nebraska Department of Environmental Quality (NDEQ) reports that many small composting sites are exempt from permitting and therefore NDEQ "does not have the data to address accurately the amount off yard waste that is being composted." The official adds that all grass and leaves are banned from MSW landfills in Nebraska unless they have an approved gas recovery system. "Currently three of our larger landfills have an approved gas recovery system and therefore the yard waste is not diverted from these landfills," he explains.

New Hampshire: The New Hampshire Department of Environmental Services does not collect much data on composting, unless it is a permitted food waste composting facility, notes the state official, who adds that yard trimming composting is permit-exempt, therefore no data is collected.

New Mexico: An official with the New Mexico Environment Department notes the state's solid waste rules do not require on-site composting operations to register, provided they are only composting materials generated on their own site and using the compost product on their own site. "For this reason, we have only a small number of on-farm composters who are registered with the Environment Department, although there are certainly many more operating in the state," the official explains. Interestingly, the "other" category in Table 2 represents a number of small slaughterhouses and butcher shops that compost only offal. The official also notes that New Mexico does not have any permitted or registered anaerobic digestion facilities in the state, but if AD facilities are developed, they would be regulated as a "transformation facility" under the state's Solid Waste Rules.

Table 9. State ranking, total composting sites

State	Total Composting Facilities
Ohio	419
New York	347
New Jersey	301
Florida	269
Wisconsin	266
Massachusetts	262
California	249
Pennsylvania	217
Louisiana	215
Kansas	184
New Hampshire	162
S. Dakota	143
Connecticut	140
Minnesota	129
Washington	126
Maine	121
Indiana	119
Michigan	114
N. Dakota	81
Iowa	80
N. Carolina	64
District of Columbia	63
Oregon	60
Illinois	58
Montana	45
Georgia	42
New Mexico	41
Utah	37
Texas	34
Colorado	33
Kentucky	33
Virginia	33
Wyoming	29
Arkansas	27
Rhode Island	24
S. Carolina	23
Maryland	18
Mississippi	15
Oklahoma	14
Vermont	14
Missouri	11
Nebraska	10
Nevada	10
Tennessee	8
Arizona	6
Alaska	5
Delaware	5
Idaho	5
Hawaii	2

Table 10. State ranking, yard trimmings composting sites

State	Yard Trimmings Composting Sites
New Jersey	295[1]
Ohio	292
Wisconsin	244
Florida	225
Pennsylvania	158
New Hampshire	150
S. Dakota	141
New York	133
Kansas	116
Minnesota	115
Indiana	110[2]
Connecticut	109
Michigan	102
Maine	80
N. Dakota	69
Louisiana	60
Illinois	47
California	39
Montana	24
Kentucky	23
N. Carolina	22
Rhode Island	21
Utah	18[1]
Arkansas	16
Oregon	16
Maryland	14
Mississippi	10
Virginia	8
Missouri	6
Oklahoma	5
Washington	5
New Mexico	4
Tennessee	4
Texas	4
S. Carolina	3
Arizona	2
Delaware	2
Nebraska	2
Colorado	1
Georgia	1
Nevada	1
Vermont	1

[1]Source: State of Composting in the U.S. (ILSR, 2014); [2]Source: Indiana Recycling Coalition.

Table 11. State ranking, yard trimmings + food waste only composting sites

State	Yard Trimmings + Food Waste Sites
Washington	55
Kansas	41
California	21
N. Carolina	19
Wisconsin	18
Pennsylvania	16
New York	12
Illinois	10
Indiana	9
Michigan	9
Oregon	6
Connecticut	4
Mississippi	4
S. Carolina	4
Utah	4[1]
Maryland	3
Missouri	3
Colorado	2
New Hampshire	2
New Mexico	2
Tennessee	2
Arizona	1
Kentucky	1
Virginia	1

[1]Source: State of Composting in the U.S. (ILSR, 2014)

Table 12. State ranking, multiple organics composting sites[1]

State	Multiple Organics Composting Sites
Massachusetts	185
Ohio	93
California	78
Louisiana	50
New York	40
Oregon	20
Texas	20
Maine	15
New Mexico	14
Florida	11
Montana	10
Minnesota	9
N. Dakota	9
Vermont	9
Colorado	7
Nevada	6
New Hampshire	6
Arkansas	5
Virginia	4
Idaho	3
Oklahoma	3
Wisconsin	3
Arizona	2
Delaware	2
Kentucky	2
Nebraska	2
N. Carolina	2
Washington	2
Maryland	1
Michigan	1
Mississippi	1
New Jersey	1
Rhode Island	1
S. Carolina	1
S. Dakota	1
Tennessee	1

36 states reporting
[1]Taking more than yard trimmings and/or food waste, e.g., yard trimmings, food, manure, wood shavings, industrial organics, etc.

Table 13. State ranking, biosolids composting sites

State	Biosolids Composting Sites
New York	31
Florida	29
Washington	19
California	17
N. Carolina	15
Utah	15[1]
Maine	14
New Mexico	10
Texas	10[1]
Massachusetts	9
Pennsylvania	9[1]
Colorado	8
Oklahoma	6
Oregon	6
Georgia	5
Nebraska	5
New Jersey	5
Arkansas	4[1]
Kentucky	4
New Hampshire	4[1]
Ohio	3
Virginia	3
Alaska	2
Hawaii	2
Idaho	2
Michigan	2[1]
Missouri	2
Arizona	1
Connecticut	1
Delaware	1
Illinois	1
Montana	1
Nevada	1
Rhode Island	1
Wisconsin	1
N. Dakota	0

[1]Source: "Biosolids Composting In The United States — 2010 Update," BioCycle, Vol. 51, No. 12, 35-41.

Table 14. State ranking, livestock manure digesters[1]

State	Livestock Manure Digesters
New York	35
Wisconsin	33
Pennsylvania	30
California	19
Vermont	18
N. Carolina	10
Indiana	9
Michigan	9
Washington	9
Minnesota	7
Oregon	7
Idaho	6
Iowa	4
Mississippi	4
Ohio	4
Utah	4
Illinois	3
Massachusetts	3
Missouri	3
Arizona	2
Florida	2
S. Carolina	2
Texas	2
Wyoming	2
Arkansas	1
Colorado	1
Connecticut	1
Georgia	1
Kansas	1
Kentucky	1
Maine	1
Maryland	1
Montana	1
Nebraska	1
Oklahoma	1
S. Dakota	1
Virginia	1

[1]Source of data: USEPA AgSTAR and some individual states (see Table 2 for states reporting Livestock manure digester data).

New York State: The New York State Department of Environmental Conservation (NYDEC) has the following regulatory categories for yard trimmings and/or source separated organic waste (SSOW) operations based on the quantity and types of feedstocks:

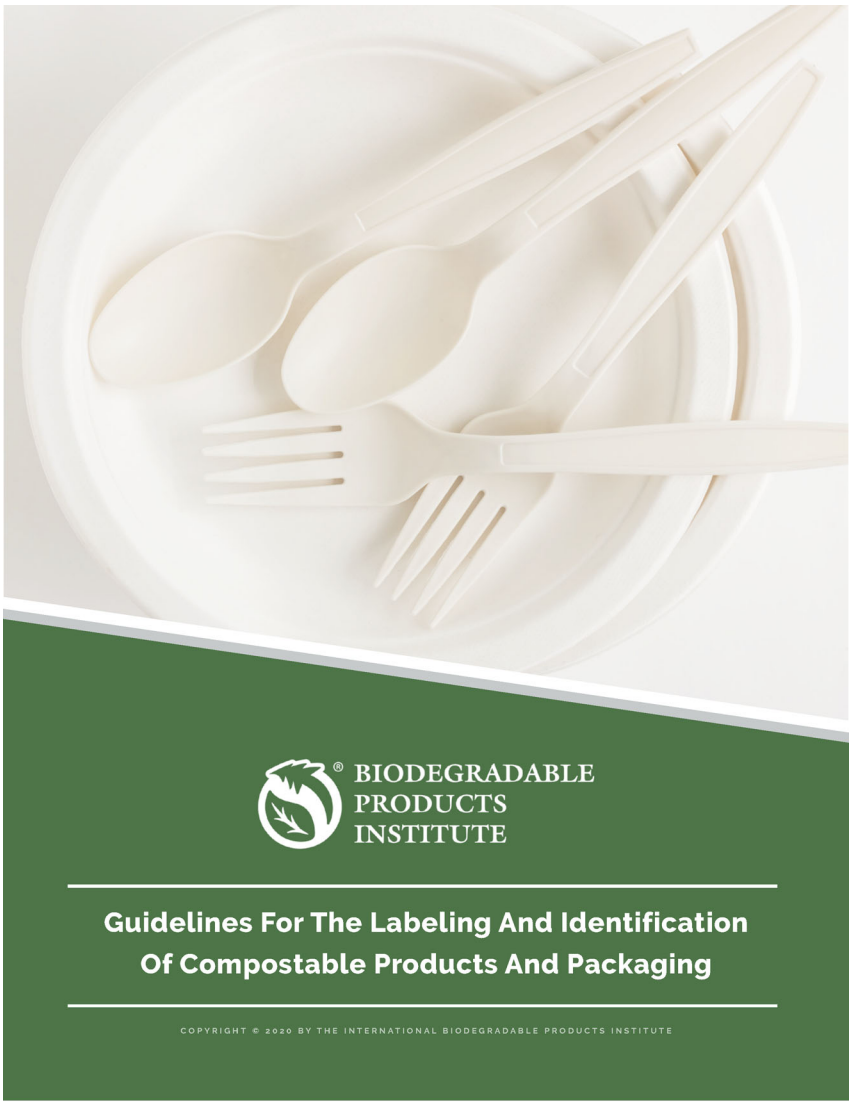
- Registered SSOW: <1,000 cubic yards (cy) SSOW/year
- Permitted SSOW: >1,000 cy SSOW/year
- Exempt Yard Waste: <3,000 cy yard waste/year
- Registered Yard Waste: 3,000–10,000 cy yard waste/year
- Permitted Yard Waste: >10,000 cy yard waste/year

Explains the NYDEC official: "You can get a registration or permit as a SSOW composting facility; New York State has 40 facilities that are registered/permitted to take food waste, which is their primary feedstock. They may also accept yard waste if it is under 3,000 cubic yards as that is considered an exempt activity. We include those in the multiple organics category. On the other hand, we have 12 facilities that are registered/permitted to accept SSOW and yard trimmings."

Wisconsin: The Wisconsin Department of Natural Resources does not regulate on-farm composting operations or composting operations that have less than 50 cubic yards of material on-site at one time. That covers most school and university composting operations.

Wyoming: Insights on organics recycling infrastructure in the state were provided by the official with the Wyoming Department of Natural Resources (DNR): "Unfortunately, the DNR doesn't track much. All but one of the state's municipal solid waste facilities are operated by local governments. Many compost green waste (grass clippings, leaves, garden plants, etc.), but it's pretty small scale. A couple larger communities (Casper and Cheyenne, for example) operate fairly large composting yards, but they are not required to report to the DNR. Also, the DNR does not have separate rules for composting or AD facilities. A single chapter of the rules (Chapter 6) regulate all solid waste transfer, treatment, and storage facilities. Permit requirements are tailored to the type of waste managed using accepted standard practices for the waste management activities as a guide to how waste should be managed." ■

Nora Goldstein is Editor of BioCycle.



BIODEGRADABLE PRODUCTS INSTITUTE

Guidelines For The Labeling And Identification Of Compostable Products And Packaging

OBJECTIVE

To establish consistent, category-specific identification guidelines that make it easy for consumers, composters and others to identify compostable products and packaging, with the goals of reducing contamination, facilitating food scrap composting programs, and decreasing landfill methane production.

Overview

Compostable products and packaging exist to help facilitate the diversion of food scraps from landfills. Unfortunately, the threat of contamination from "look alike" non-compostable packaging has led some composters to discontinue accepting even certified compostable items.

In order for compostable products and packaging to perform their intended function, they should be readily and easily identifiable by end-users, consumers, composters and others so they can be differentiated from their non-compostable counterparts. The guidelines put forth in this document reflect the belief that a consistent identification strategy employed by product manufacturers and brand owners is a key driver in achieving differentiation and will assist in the acceptance of food scraps and compostable products and packaging on a larger scale.

Intended Audiences

This document has a number of intended audiences, all with an interest in organics diversion and the principles of circular economies.

The primary audiences include **Product and Packaging Manufacturers and Brand Owners.** This document will help these audiences to evaluate their current labeling and identification strategies and to put plans in place for short and long-term changes designed to bring consistency to how compostable products and packaging are labeled and identified.

In addition, this document may be of value to other stakeholders:

- **Composters** are essential to the success of waste diversion systems utilizing compostable products and packaging in the effort to divert organics from landfills. This document is the first iteration of an ongoing collaborative effort between composters, governments, brand owners, and the compostable products industry to reduce contamination and, ultimately, lead to higher quality feedstocks for composters.

- **State and Local Governments** may use this document to inform conversations around labeling and identification requirements for compostable products and packaging, particularly as it relates to product and category-specific manufacturing capabilities that vary with factors like shape, size, and material type.

Stakeholder Engagement

BPI invited and incorporated feedback on these guidelines from a wide array of groups including: the United States Composting Council (including state chapters), the California Compost Coalition, the Compost Manufacturing Alliance, independent composters, the City of Seattle, Zero Waste Washington, the Foodservice Packaging Institute, Sustainable Packaging Coalition, foodservice operators and brand owners. BPI looks forward to ongoing work with these stakeholders and others as the recommendations for labeling and identification are considered and put into practice.

PART ONE

This section outlines the variety of considerations that should be taken into account when determining how to properly label and identify compostable products and packaging.

Legal and Regulatory Considerations

The Federal Trade Commission (FTC) in the United States, the Competition Bureau (CB) in Canada and various state/provincial and local governments across both countries have created various guidelines and laws for marketers of compostable products and packaging to follow when making

claims of compostability. The following are examples of requirements or suggestions that generally become relevant whenever a product or package is marketed as "compostable":

1. Provide reliable and scientific evidence of compostability, such as meeting ASTM D6400 or ASTM D6868 compostability standard specification.
2. Use disclaimer language for products and packaging to qualify compostable claims if the product cannot be composted at home safely or in a timely way, such as "Commercially Compostable Only."
3. Use disclaimer language to indicate that commercial compost facilities are not available to a substantial majority of consumers such as, "Facilities May Not Exist In Your Area."
4. Use a Resin Identification Code (RIC) for bioplastic containers over 8 ounces in size. For bioplastics, the RIC is #7.

Use of the term "Biodegradable"

It is illegal in California, Maryland, and Washington to use the term "biodegradable" in marketing claims related to plastic products. This is because "biodegradable" is often used to describe items that do not meet ASTM standards for compostability, and are contaminants for composters.

Washington State Labeling Legislation

The Washington State legislature passed HB 1569 to address labeling and identification for compostable products and packaging. The law went into effect on July 1, 2020 and either requires or suggests items 5 - 8 in addition to existing federal requirements. It also references "industry standards for being distinguishable upon quick inspection" that did not exist prior to the creation of this document.

5. Use of the word "compostable".
6. Use of a third-party certification logo to verify that an item meets ASTM standards for compostability.
7. Use of identification that makes the product or packaging distinguishable upon quick inspection in both public sorting areas and in processing facilities.
8. Use of distinctive color schemes, green or brown color striping, or other adopted symbols, colors, marks, or design patterns that help differentiate compostable items from non-compostable materials.

Third-Party Certification Requirements

While use of a certification mark is optional for other certification providers, products certified by the Biodegradable Products Institute must include the BPI Certification Mark.

Technical Considerations

Today, manufacturers of compostable products and packaging have three primary techniques for labeling and identification:

1. Printing is a reliable method of delivering specific information on a product or package, whether through visual elements like a stripe, or with words and symbols. Printing, however, may not be possible -- or may be a significant challenge -- on many of the products covered by these guidelines.

2. Material coloring and tinting are options for achieving visual differentiation. These techniques, however, are not sufficient on their own to clearly identify compostable products and packaging.

3. Embossing, debossing or otherwise etching compostable items may make it possible to deliver the information required. This messaging strategy is most effective when the wording is prominently featured on the products and packaging and is legible by consumers and composters. The category specific chart and graphical examples in Part Two of this document recommend a "Prominent Emboss" approach of the word "compostable".

In the future, innovation will bring new solutions, expanding the possibilities beyond printing, coloring and embossing. This document will be updated as these solutions move closer to reality.

Spatial Considerations

Along with technical challenges, lack of space is often cited by manufacturers and brand owners as a challenge when considering language and logo usage on compostable products and packaging. Some of the spatial challenges for existing regulatory requirements are detailed below.

1. Including the word "compostable" alone (especially on smaller items) does not meet the FTC's Guides for the Use of Environmental Marketing Claims

2. Including "Commercially compostable only. Facilities may not exist in your area." does meet FTC guidelines, but is lengthy and may be a challenge -- but not impossible -- to emboss.

3. Including a third-party certification logo alone (without any qualifying language) does not meet FTC guidelines, and the logo alone may not be recognized by all consumers.

When adequate space is a challenge, the overall recommendation of these guidelines is to include as much of the required content as possible on all products where labeling is an option. When

spatial constraints make it truly impossible to fit all required content on the products themselves, the recommendation is to include all required content on packaging and marketing collateral.

Composter Considerations

Composters require high-quality feedstock to manufacture high-quality compost. In order to achieve this, visually inspect the feedstock to assure there is little to no contamination. Making sure that compostable products and packaging are readily and easily identifiable makes it possible for them to distinguish compostable from non-compostable items.

Connection to Food Scraps

Only common elements of the food service waste stream are covered by this document, and are eligible for BPI certification. Compostable versions of foodservice products and packaging make it easier to divert organics at scale because they can be included with food scraps in the same bin.

Brand Owner Considerations

Brand owners often customize products and packaging to communicate their own brand and message. This can include specific branding standards, such as logos, colors, and images. Manufacturers are strongly encouraged to share these guidelines with their brand owner partners and to work together to incorporate them wherever and whenever possible.

Consumer and End-User Considerations

In residential and commercial environments, consumers and end-users are generally tasked with determining which bin to put their products and packaging in after use. In this way, they are the first line of defense in the effort to provide composters with a contaminant-free stream of organic material.

The labeling and identification recommendations in this document are driven by a desire to make it as easy as possible for consumers and end-users to distinguish between compostable and non-compostable products and packaging. To facilitate the quick decision making that is often required at the point of disposal, manufacturers acknowledge that more work needs to be done with various stakeholders on consumer and end-user education to augment improvements in labeling and identification techniques for compostable products and packaging.

Manufacturing Limitations, Market Preferences, and Financial Considerations

There are a number of factors driving the feasibility and timeframes associated with the labeling and identification strategies recommended in Part Two of this document.

First, many of the strategies that are called for are not in practice today and will require significant time and investment to implement. The recommendation to manufacturers and brand owners is to follow a phased approach, starting with categories where manufacturing and technology limitations are not present.

Second, certain market preferences are determining factors for how many compostable items are produced. For example, adding color to clear items will fundamentally change the value proposition (e.g., ability to see the food inside), and there may be scenarios where conventional packaging will be used instead of compostable packaging if design elements like striping or tinting are required.

Third, the investments required to implement some of the recommended strategies will significantly change the economics for manufacturers and brand owners, and some of those costs are likely to be passed on to their downstream customers. Compostable products and packaging are already sold at significant premiums relative to their conventional counterparts, and it is possible that the labeling and identification approaches proposed here will increase those premiums. This could lead to reduced market acceptance of these items.

PART TWO

This section makes specific recommendations for the labeling and identification of compostable products and packaging, recognizing that products and materials may have different options. These recommendations address the considerations outlined in Part One and incorporate the results of a manufacturer survey designed to identify current and potential identification methods in use and/or in development across the compostable products and packaging industry.

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Part Two of the document is divided up into two sections:

1. A comprehensive chart displaying the full set of labeling and identification techniques available, by category and material type.

2. A set of mocked up illustrations designed to make the recommendations in the chart easier to visualize, accompanied by estimates of availability based on Manufacturing Limitations and Market Preferences.

Recommendations Chart

The chart on page 9 shows possible labeling and identification techniques available for specific categories and material types. When multiple labeling and identification options are presented, they are listed in order of availability and/or industry preference. The footnotes in the chart correspond to text and color recommendations that vary depending on the primary method of labeling.

For example, the options for the Bioplastic Clamshell category are displayed as follows: Emboss* 1,2 | Color 3 | Print 1,2,3. The first option recommends a Prominent Emboss approach on this product, with significant embossment, debossment, or etching of the word "compostable", and including all other required messaging elements indicated by the footnotes. Tinting of the product in conjunction with prominent embossment is a subsequent option, followed by printing.

While the categories and material types displayed in the chart represent the majority of the products and packaging categories likely to be disposed of in organics bins, it is not an exhaustive list. One notable omission from the chart are products made from plant-based fibers only like napkins, tissues, paper towels, and wipes. These items are generally recognized as compostable, are largely exempt from BPI's labeling requirements and are specifically excluded from Washington's regulations.

When multiple options are presented below, they are listed in order of current industry-wide availability and/or industry preference.

	Bioplastics	Bioplastic Coated Paper/ Paperboard	Uncoated Paper / Paperboard and Wood	Molded Fiber
Beverage Cups	Print[1,2,3] | Emboss*[1,2] | Color[3]	Print[1,2,3]		
Food Containers - Round	Print[1,2,3] | Emboss*[1,2] | Color[3]	Print[1,2,3]		
Food Containers - Square	Emboss*[1,2] | Color[3] | Print[1,2,3]	Print[1,2,3]		
Food Containers - Clamshell	Emboss*[1,2] | Color[3] | Print[1,2,3]	Print[1,2,3]		Emboss*[1,2] | Color[3] | Print[1,2,3]
Portion Cups	Print[1,2,3] | Emboss*[1,2] | Color[3]		N/A	Emboss*[1,2] | Color[3] | Print[1,2,3]
Lids for Cups	Emboss*[1,2] | Color[3] | Print[1,2,3]			Emboss*[1,2] | Color[3] | Print[1,2,3]
Lids for Containers	Emboss*[1,2] | Color[3] | Print[1,2,3]			Emboss*[1,2] | Color[3] | Print[1,2,3]
Cup Sleeves			Print[1,2,3]	
Plates	Emboss*[1,2] | Color[3] | Print[1,2,3]	Print[1,2,3]	N/A	Emboss*[1,2] | Color[3] | Print[1,2,3]
Bowls	Emboss*[1,2] | Color[3] | Print[1,2,3]	Print[1,2,3]		Emboss*[1,2] | Color[3] | Print[1,2,3]
Meat Trays	Emboss*[1,2] | Color[3] | Print[1,2,3]	Print[1,2,3]		
Wraps & Sheets		Print[1,2,3]	Print[1,2,3]	
Bags (i.e. carryout, produce, kitchen liners)	Print[1,2,3] & Color[3]		N/A	
Cutlery	Emboss[1,2] | Color[3]		N/A	
Straws	Color[3,4]	Print[1,2,3] | Color[3]		
Straw Wrappers			Print[1,2,3]	
Stirrers, Picks, Chopsticks & Splash Sticks	Print[1,2,3]		Color[3,4]	
Coffee Pods	Color[3,4] | Emboss[1,2] | Print[1,2,3]			
Sachets & Pouches	Print[1,2,3]	Print[1,2,3]		
Flexible Packaging (i.e. chip/snack bags, wrappers)	Print[1,2,3]			
Other (i.e. sushi grass)	Color[3,4]			

No common products made in this material.

N/A *Products have been exempted from either BPI's requirements or WA's labeling law.*

For ALL products where printing or embossing is possible, the word "COMPOSTABLE" should be included.
1 The text "Commercially compostable only. Facilities may not exist in your area." should be included.
2 BPI Certification Mark for BPI Certified Products should be included. Other certification marks may also be included.
3 Inks for printing or coloring (including tinting) should be green or brown.
4 The use of material color (including tinting) could be used on its own for products where other options are not technically possible. However, it would require others outside the compostable products industry to agree voluntarily, or through regulatory measures, that the color would not be used with non-compostable products.
** Indicates where "Prominent Emboss" should be used.*

Mocked Up Illustrations

Beginning on page 11, mocked up illustrations of major product categories and material types are displayed. These drawings are examples of what finished products might look like when the recommendations for labeling and identification by category and material type are put into practice. The brand names used are fictional placeholders designed to make the illustrations look more realistic.

To the right of or below every example is a set of two "sliding scales" with additional information on the labeling and identification technique(s) illustrated. Many of the recommendations in these guidelines will require new investments to achieve, and will also require downstream partners, end-users and consumers to adjust to new versions of products and packaging.

Manufacturing: An Inside Look

In order to adopt many of the recommendations outlined here, manufacturers will need to make changes that involve time, money and human resources. For example:

- Adding or changing embossing requires that new molds be made and installed for every shape and size of a given product.
- Adding color will require identifying FDA approved inks and colorants, recertifying with BPI, and creating new print plates for every shape and size of a given product.
- For items that are not printable today, advancements in technology will be required before scalable printing will be possible.

1. The "Manufacturing Limitations" sliding scale is designed to give the reader a sense of current availability and estimated future availability based on the investments required to achieve the recommended labeling and identification method.

2. The "Market Acceptance" sliding scale is designed to give the reader a sense for how the recommendations may be viewed by customers in food service and retail marketplaces today. For example, transparent packaging is often used with fresh foods recognizing that consumers "eat with their eyes" and may want to see the food to confirm freshness. Switching to a tinted package may help with labeling and identification for composters, but this may not be acceptable for brand owners and their consumers. Additionally, incorporating green or brown colors to signal that a product or package is compostable may be beneficial for identification purposes, but brand owners may be reluctant to use these colors if they conflict with their own existing branding guidelines.

Note: In the drawings that follow, the use of the marks Fresh Start, Right Pack, Right Snacks and Fresh Brews are fictitious and not intended to represent existing brands.

COLD BEVERAGE CUP & LID
BIOPLASTIC

PRINT

Widespread printing capabilities exist.

EMBOSS

"Prominent Emboss" features significant "Compostable" call out in available marking area.

EMBOSS

"Prominent Emboss" features significant "Compostable" call out in available marking area.

TINT

Market acceptance could be a challenge for the tinting of traditionally clear products.

HOT BEVERAGE CUP
BIOPLASTIC COATED PAPER

PRINT

Widespread printing capabilities exist.

LID
BIOPLASTIC

EMBOSS

"Prominent Emboss" features significant "Compostable" call out in available marking area.

Full Material Color

MATERIAL COLOR

Most valuable if only compostable products are produced in colors like green and brown.

CLAMSHELL BIOPLASTIC

EMBOSS

"Prominent Emboss" features significant "Compostable" call out in available marking area.

TINT

Market acceptance could be a challenge for the tinting of traditionally clear products.

PRINT

Printing this item will require advancements in technology that are likely to shift economics for manufacturers.

CLAMSHELL
BIOPLASTIC COATED PAPER OR MOLDED FIBER

Molded Fiber

EMBOSS

"Prominent Emboss" features significant "Compostable" call out in available marking area.

Bioplastic Coated Paper
Or Molded Fiber

PRINT

Printing this item will require advancements in technology that are likely to shift economics for manufacturers.

PLATE
BIOPLASTIC

EMBOSS

"Prominent Emboss" features significant "Compostable" call out in available marking area.

MATERIAL COLOR

Most valuable if only compostable products are produced in colors like green and brown.

PRINT

Printing this item will require advancements in technology that are likely to shift economics for manufacturers.

PLATE
BIOPLASTIC COATED PAPER OR MOLDED FIBER

Molded Fiber

EMBOSS

"Prominent Emboss" features significant "Compostable" call out in available marking area.

Bioplastic Coated Paper
Or Molded Fiber

PRINT

Printing this item will require advancements in technology that are likely to shift economics for manufacturers.

BOWL
BIOPLASTIC

EMBOSS

"Prominent Emboss" features significant "Compostable" call out in available marking area.

MATERIAL COLOR

Most valuable if only compostable products are produced in colors like green and brown.

PRINT

Printing this item will require advancements in technology that are likely to shift economics for manufacturers.

BOWL
BIOPLASTIC COATED PAPER OR MOLDED FIBER

Molded Fiber

EMBOSS

"Prominent Emboss" features significant "Compostable" call out in available marking area.

Bioplastic Coated Paper
Or Molded Fiber

PRINT

Printing this item will require advancements in technology that are likely to shift economics for manufacturers.

PORTION CUP & LID
BIOPLASTIC

PRINT

Printing is operationally possible but not a regular offering today.

EMBOSS

"Prominent Emboss" features significant "Compostable" call out in available marking area.

EMBOSS

"Prominent Emboss" features significant "Compostable" call out in available marking area.

Tinted Bioplastic

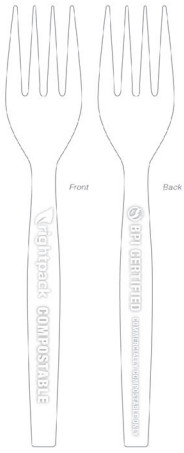
TINT

Market acceptance could be a challenge for the tinting of traditionally clear products.

CUTLERY
BIOPLASTIC

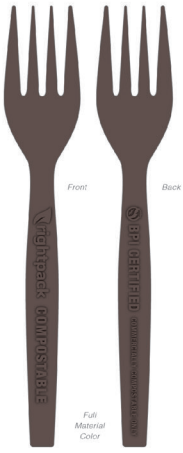
MATERIAL COLOR

Most valuable if only compostable products are produced in colors like green and brown.



EMBOSS

"Prominent Emboss" features significant "Compostable" call out in available marking area.



MATERIAL COLOR

Most valuable if only compostable products are produced in colors like green and brown.

SOUP CUP
BIOPLASTIC COATED PAPER

PRINT

Widespread printing capabilities exist.

LID
BIOPLASTIC

EMBOSS

"Prominent Emboss" features significant "Compostable" call out in available marking area.

Full Material Color

MATERIAL COLOR

Most valuable if only compostable products are produced in colors like green and brown.

ROUND DELI CONTAINER & LID
BIOPLASTIC

PRINT

Printing is operationally possible but not a regular offering today.

EMBOSS

"Prominent Emboss" features significant "Compostable" call out in available marking area.

EMBOSS

"Prominent Emboss" features significant "Compostable" call out in available marking area.

TINT

Market acceptance could be a challenge for the tinting of traditionally clear products.

SQUARE DELI CONTAINER & LID
BIOPLASTIC

EMBOSS

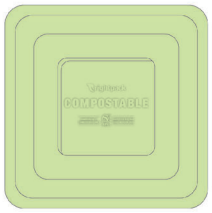
"Prominent Emboss" features significant "Compostable" call out in available marking area.

TINT

Market acceptance could be a challenge for the tinting of traditionally clear products.

EMBOSS

"Prominent Emboss" features significant "Compostable" call out in available marking area.



TINT

Market acceptance could be a challenge for the tinting of traditionally clear products.

SMALL SNACK PACKAGE
BIOPLASTIC

PRINT

Widespread printing capabilities exist.

SACHETS & POUCHES
BIOPLASTIC & COATED PAPER

PRINT

Widespread printing capabilities exist.

COFFEE PODS
BIOPLASTIC

PRINT

Widespread printing capabilities exist.

BAG
BIOPLASTIC

PRINT

Widespread printing capabilities exist.

CONTAINER LIDS
BIOPLASTIC

EMBOSS

"Prominent Emboss" features significant "Compostable" call out in available marking area.

TINT

Market acceptance could be a challenge for the tinting of traditionally clear products.

STRAW WRAPPER PAPER

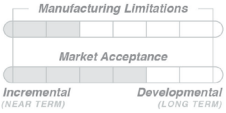
PRINT

Widespread printing capabilities exist.

STRAW BIOPLASTIC & COATED PAPER

MATERIAL COLOR

Most valuable if only compostable products are produced in colors like green and brown.



STIRRERS BIOPLASTIC

MATERIAL COLOR

Most valuable if only compostable products are produced in colors like green and brown.

HOT CUP SLEEVE UNCOATED PAPER & PAPERBOARD

PRINT

Widespread printing capabilities exist.

BIODEGRADABLE PRODUCTS INSTITUTE

Guiding Principles

Labeling and Identification Policy for Compostable Products

The Biodegradable Products Institute (BPI) is North America's leading certifier of compostable materials, products, and packaging, with 300+ member companies worldwide. BPI supports a shift to the circular economy by promoting the production, use, and appropriate end of life management for materials and products that are designed to fully biodegrade in specific biologically active environments.

BPI is supportive of regulatory efforts that accurately define compostability, and bring consistency to labeling in an effort to make compostable products more readily and easily identifiable. Along with voluntary commitments, these regulations are critical to building trust in compostable products along the value chain, from the manufacturer, to the user, to the composter. The following are the core elements for a comprehensive model bill:

1. Compostability should be defined by third-party (ASTM, EN, ISO, etc) standard specifications, and labeling principles should apply to all items defined as compostable regardless of material type (i.e., should not just call out "plastic").

2. Claims of compostability should be limited to products that are designed to be associated with food scraps and other organic wastes accepted by composters. This includes but is not limited to: Food scrap and yard trimmings collection bags and produce bags;
    a. Foodservice packaging (e.g., cups, lids, straws, cutlery, takeout containers);
    b. Flexible food packaging (e.g., snack bags, bar wrappers, stand-up pouches);
    c. Coffee filters, tea bags, coffee pods;
    d. Napkins, paper towels;
    e. Common contaminants (e.g. fruit stickers).

    Example Bill Language: *"The product must be designed to be associated with organic wastes, like food scraps and yard trimmings, that are collected for composting."*

3. Regulations should prohibit misleading terms like "biodegradable" from being used on products and packaging.

    Example Bill Language: *"Except as specified in this regulation, a person shall not sell a product that is labeled with the term "biodegradable," "degradable," or "decomposable," or any form of those terms, or in any way imply that the product will break down, fragment, biodegrade, or decompose in a landfill or other environment."*

4. Labeling and identification regulations should drive ease of identification by requiring the word "compostable", a third-party certification mark, and use of green or brown color where possible.

   Example Bill Language: *"Is labeled and designed in a manner that clearly distinguishes the product from a noncompostable or nonbiodegradable product upon quick inspection by consumers and solid waste processing facilities, where possible including the word "compostable," an approved third-party certification mark, and the use of green or brown colors."*

5. Labeling and identification regulations should reference industry standards for labeling and identification.

   Example Bill Language: *"The department may adopt regulations for product labeling to ensure that products labeled "compostable" or "home compostable" are clearly distinguishable from noncompostable products upon quick inspection by consumers and solid waste processing facilities. The department, in adopting regulations pursuant to this subdivision, may consider the product labeling requirements of other states, stakeholder input, and industry-standard guidelines to maximize consistency with those requirements and guidelines and that input when possible."*

6. Soil biodegradation claims should be restricted to agricultural products, as opposed to compostability claims on consumer products, and should be defined as items meeting the standard specification EN 17033 for soil biodegradable mulch film.

7. Marine biodegradation claims should be restricted to items used in the marine environment where loss cannot be avoided (e.g. fishing nets, buoys, etc.), as opposed to consumer products.

8. Compostable products displaying an approved third party certification mark should be exempt from resin ID code requirements, including chasing arrows, a triangle, and the number 7. Compostability is not dictated by resin type, and exemption from resin ID codes will more clearly indicate that compostable items belong in a food scraps bin, not a recycling bin.

Food wastage footprint
Impacts on natural resources

Summary Report

ISBN 978-92-5-107752-8

About this document

The Food Wastage Footprint model (FWF) is a project of the Natural Resources Management and Environment Department. Phase I of the project has been commissioned to BIO-Intelligence Service, France. This Summary Report presents the preliminary results of the FWF modeling, as related to the impacts of food loss and waste on climate, land, water and biodiversity. The full technical report of the FWF model is available upon request from FAO. Phase II of the FWF project is expanding the model to include modules on full-cost accounting of environmental and social externalities of food wastage, with also comparison with food wastage reduction investment costs and footprint scenarios for 2050.

Acknowledgements

Phase I of the FWF was implemented by BIO-IS staff including: Olivier Jan, Clément Tostivint, Anne Turbé, Clémentine O'Connor and Perrine Lavelle. This project benefited from the contributions of many FAO experts, including: Alessandro Flammini, Nadia El-Hage Scialabba, Jippe Hoogeveen, Mathilde Iweins, Francesco Tubiello, Livia Peiser and Caterina Batello. This FWF project is undertaken with the generous financial support of Germany.

Queries regarding the FWF project must be addressed to: Nadia.Scialabba@fao.org

Food wastage footprint
Impacts on natural resources

Summary Report

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Executive summary

FAO estimates that each year, approximately one-third of all food produced for human consumption in the world is lost or wasted. This food wastage represents a missed opportunity to improve global food security, but also to mitigate environmental impacts and resources use from food chains. Although there is today a wide recognition of the major environmental implications of food production, no study has yet analysed the impacts of global food wastage from an environmental perspective.

This FAO study provides a global account of the environmental footprint of food wastage (i.e. both food loss and food waste) along the food supply chain, focusing on impacts on climate, water, land and biodiversity. A model has been developed to answer two key questions: what is the magnitude of food wastage impacts on the environment; and what are the main sources of these impacts, in terms of regions, commodities, and phases of the food supply chain involved – with a view to identify "environmental hotspots" related to food wastage.

The scope of this study is global: the world has been divided in seven regions, and a wide range of agricultural products – representing eight major food commodity groups – has been considered. Impact of food wastage has been assessed along the complete supply chain, from the field to the end-of-life of food.

The global volume of food wastage is estimated to be 1.6 Gtonnes of "primary product equivalents", while the total wastage for the edible part of food is 1.3 Gtonnes. This amount can be weighed against total agricultural production (for food and non-food uses), which is about 6 Gtonnes.

Without accounting for GHG emissions from land use change, the carbon footprint of food produced and not eaten is estimated to 3.3 Gtonnes of CO_2 equivalent: as such, food wastage ranks as the third top emitter after USA and China. Globally, the blue water footprint (i.e. the consumption of surface and groundwater resources) of food wastage is about 250 km^3, which is equivalent to the annual water discharge of the Volga river, or three times the volume of lake Geneva. Finally, produced but uneaten food vainly occupies almost 1.4 billion hectares of land; this represents close to 30 percent of the world's agricultural land area. While it is difficult to estimate impacts on biodiversity at a global level, food wastage unduly compounds the negative externalities that monocropping and agriculture expansion into wild areas create on biodiversity loss, including mammals, birds, fish and amphibians.

The loss of land, water and biodiversity, as well as the negative impacts of climate change, represent huge costs to society that are yet to be quantified. The direct economic cost of food wastage of agricultural products (excluding fish and seafood), based on producer prices only, is about USD 750 billion, equivalent to the GDP of Switzerland.

With such figures, it seems clear that a reduction of food wastage at global, regional, and national scales would have a substantial positive effect on natural and societal resources. Food wastage reduction would not only avoid pressure on scarce natural resources but also decrease the need to raise food production by 60 percent in order to meet the 2050 population demand.

This study highlights global environmental hotspots related to food wastage at regional and sub-sectoral levels, for consideration by decision-makers wishing to engage into waste reduction:

- Wastage of cereals in Asia emerges as a significant problem for the environment, with major impacts on carbon, blue water and arable land. Rice represents a significant share of these impacts, given the high carbon-intensity of rice production methods (e.g. paddies are major emitters of methane), combined with high quantities of rice wastage.
- Wastage of meat, even though wastage volumes in all regions are comparatively low, generates a substantial impact on the environment in terms of land occupation and carbon footprint, especially in high income regions (that waste about 67 percent of meat) and Latin America.
- Fruit wastage emerges as a blue water hotspot in Asia, Latin America, and Europe because of food wastage volumes.
- Vegetables wastage in industrialised Asia, Europe, and South and South East Asia constitutes a high carbon footprint, mainly due to large wastage volumes.

By highlighting the magnitude of the environmental footprint of food wastage, the results of this study – by regions, commodities or phases of the food supply chain – allow prioritising actions and defining opportunities for various actors' contributions to resolving this global challenge.

Introduction

This study provides a worldwide account of the environmental footprint of food wastage along the food supply chain, focusing on impacts on climate, water, land and biodiversity, as well as an economic quantification based on producer prices.

The Food Wastage Footprint (FWF) model was developed to answer two key questions: what are the impacts of food wastage on natural resources? where do these impacts come from? This required analyzing the wastage footprint by regions, commodities or phases of the food supply chain in order to identify "environmental hotspots" and thus, point towards action areas to reduce food wastage.

Context and definitions

Context

In 2011, FAO published a first report assessing global food losses and food waste (FAO 2011). This study estimated that each year, one-third of all food produced for human consumption in the world is lost or wasted. Grown but uneaten food has significant environmental and economical costs. Obviously, this food wastage represents a missed opportunity to improve global food security and to mitigate environmental impacts generated by agriculture. In addition, by 2050, food production will need to be 60 percent higher than in 2005/2007 (Alexandratos & Bruinsma 2012), if production is to meet demand of the increasing world population. Making better use of food already available with the current level of production would help meet future demand with a lower increase in agricultural production.

To date, no study has analyzed the impacts of global food wastage from an environmental perspective. It is now recognized that food production, processing, marketing, consumption and disposal have important environmental externalities because of energy and natural resources usage and associated greenhouse gas (GHG) emissions. Broadly speaking, the environmental impacts of food mostly occur during the production phase. However, beyond this general trend, large discrepancies in food consumption and waste-generation patterns exist around the world. In a context of increasing commercial flows, there are significant differences in the intensity of wastage impacts among agricultural commodities, depending on their region of origin and the environmental issue considered. Therefore, it is necessary to assess the environmental impact of this food wastage at a regional level and by commodity type in order to capture specificities and finally draw the global picture.

Definitions

Food loss refers to a decrease in mass (dry matter) or nutritional value (quality) of food that was originally intended for human consumption. These losses are mainly caused by inefficiencies in the food supply chains, such as poor infrastructure and logistics, lack of technology, insufficient skills, knowledge and management

capacity of supply chain actors, and lack of access to markets. In addition, natural disasters play a role.
Food waste refers to food appropriate for human consumption being discarded, whether or not after it is kept beyond its expiry date or left to spoil. Often this is because food has spoiled but it can be for other reasons such as oversupply due to markets, or individual consumer shopping/eating habits.
Food wastage refers to any food lost by deterioration or waste. Thus, the term "wastage" encompasses both food loss and food waste.

Scope and methodology

This study builds on previous FAO work that estimated food wastage volumes (FAO 2011)[1], and goes a step further by evaluating the impact of such losses on the environment. The scope of the study is global, including seven world regions and a wide range of agricultural products, representing eight food commodity groups. Both the regions and commodities are further divided in sub-groups, as shown in Table 1 and 2.

Table 1: World regions selected for the FWF project

Region name	Short name	Sub-region
1 – Europe	Europe	Europe
2 – North America & Oceania	NA&Oce	Australia, Canada, New Zealand, USA
3 – Industrialized Asia	Ind. Asia	China, Japan, Republic of Korea
4 – Sub-Saharan Africa	SSA	Eastern Africa, Middle Africa, Southern Africa, Western Africa
5 – North Africa, Western Asia & Central Asia	NA,WA&CA	Central Asia, Mongolia, Northern Africa, Western Asia
6 – South and Southeast Asia	S&SE Asia	Southeastern Asia, Southern Asia
7 – Latin America	LA	Caribbean, Central America, South America

Table 2: Agricultural commodity groups selected for the FWF project

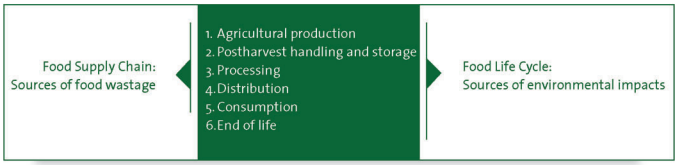
Region name	Short name	Sub-region
1 – Cereals (excluding beer)	Cereals	Wheat, Rye, Oats, Barley, Other cereals, Maize, Rice, Millet, Sorghum
2 – Starchy roots	SR	Starchy roots
3 – Oilcrops & Pulses	O&P	Oilcrops, Pulses
4 – Fruits (excluding wine)	Fruits	Apples, Bananas, Citrus, Grapes, Other fruits
5 – Meat	Meat	Bovine meat, Mutton & Goat meat, Pig meat, Poultry meat
6 – Fish & Seafood	F&S	Fish, Seafood
7 – Milk (excluding butter) & Eggs	M&E	Milk, Egg
8 – Vegetables	Veg.	Vegetables

1 Most notably, technical definitions such as grouping of the world regions and food commodity groups (slightly adjusted) are taken from the FAO (2011) study.

The environmental assessment for all commodities is based on a life cycle approach that encompasses the entire "food cycle", including agricultural production, post-harvest handling and storage, food processing, distribution, consumption and end-of-life (i.e. disposal).

Food wastage along the food supply chain (FSC) has a variety of causes, such as spillage or breakage, degradation during handling or transportation, and waste occurring during the distribution phase. The later a product is lost or wasted along the supply chain, the higher the environmental cost, as impacts arising for instance during processing, transport or cooking, will be added to the initial production impact. In this study, this mechanism is taken into account in the quantification of climate impacts.

Figure 1: Sources of food wastage and sources of environmental impacts in the food life cycle



The environmental footprint of food wastage is assessed through four different model components: carbon footprint; water footprint; land occupation/degradation impact; and potential biodiversity impact – complemented by an economic quantification component.

The general approach is similar for the quantification of carbon, water and land impacts, as well as for the economic component. It is based on multiplications of activity data (i.e. food wastage volumes) and specific factors (i.e. carbon, water, and land impact factor or producer prices). The biodiversity component is assessed through a combined semi-quantitative/qualitative approach, due to methodological and data difficulties.

Food wastage volumes

Method

In this study, the Food Balance Sheets (FBSs)[2] serve as the core basis to gather data on global mass flows of food for each sub-region and agricultural sub-commodity. Assembled by FAO, FBSs give the total amount of food available for human consumption in a country/region during one year. Wastage percentages[3] were applied to FBS data for 2007, in order to quantify food wastage volumes in each region, for each commodity and at each phase of the supply chain.

The study has also calculated two types of food wastage volumes: volumes for the edible and the non-edible parts of food; and food wastage for only the edible part of food. Since environmental impacts relate to the entire product and not just its edible part, most studies provide impact factors for the entire product and not for its edible part only (i.e. impact per kg of "entire" product). Consequently, food wastage volumes for "edible + non-edible parts" were used in the footprint calculations and are presented in all figures (except Figure 2). This also facilitates cross-components analysis.

Results overview

The global volume of food wastage in 2007 is estimated at 1.6 Gtonnes of "primary product equivalents". The total food wastage for the edible part of food only is 1.3 Gtonnes. This amount can be weighed against the sum of the domestic agricultural production of all countries taken from FBSs, which is about 6 Gtonnes (this value includes also agricultural production for other uses than food). The amount of food wastage (edible and non-edible), the amount of food wastage for the edible part of food only, and agricultural production are presented for each commodity in Figure 2.

It must be noted that there is currently an on-going debate for defining fish wastage because, for example, what is discarded is not necessarily lost and by-catch is not accurately reported, which blurs calculations. Therefore, food wastage volumes obtained for the fish and seafood commodity group must be considered with caution.

2 FAOSTAT, Food Balance Sheets. Available at: http://faostat.fao.org
3 Wastage percentages taken from the FAO (2011) study.

Figure 2: Total agricultural production (FBS) vs. food wastage volumes

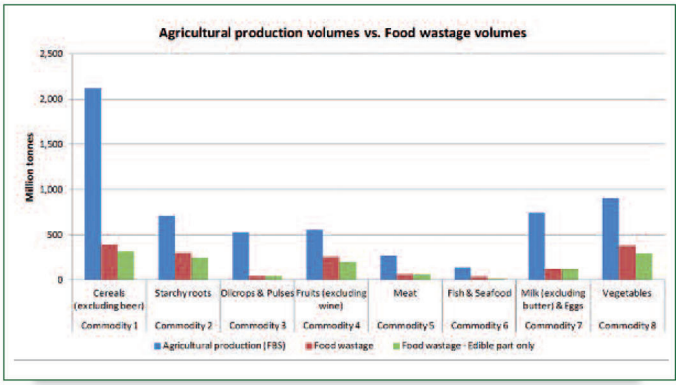


Figure 3 illustrates the amounts of food wastage along the food supply chain. Agricultural production, at 33 percent, is responsible for the greatest amount of total food wastage volumes. Upstream wastage volumes, including production, post-harvest handling and storage, represent 54 percent of total wastage, while downstream wastage volumes, including processing, distribution and consumption, is 46 percent. Thus, on average, food wastage is balanced between the upstream and downstream of the supply chain.

An analysis of the food supply chain phases by regions (Figure 4) reveals that:

- upstream, losses occurring at agricultural production phase appear homogenous across regions, representing about one-third of each region's food wastage;
- downstream, wastage occurring at consumption level is much more variable, with wastage in middle- and high-income regions at 31–39 percent, but much lower in low-income regions, at 4–16 percent.

Figure 3: Food wastage volumes, at world level by phase of the food supply chain

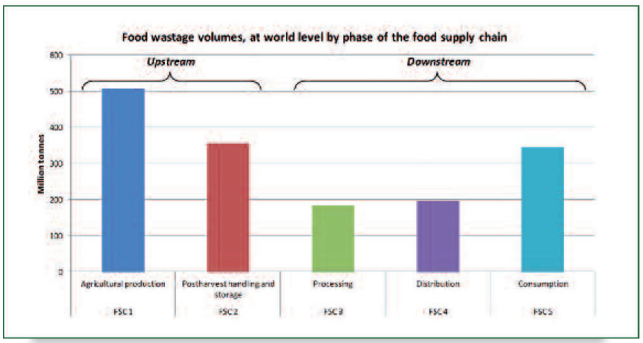
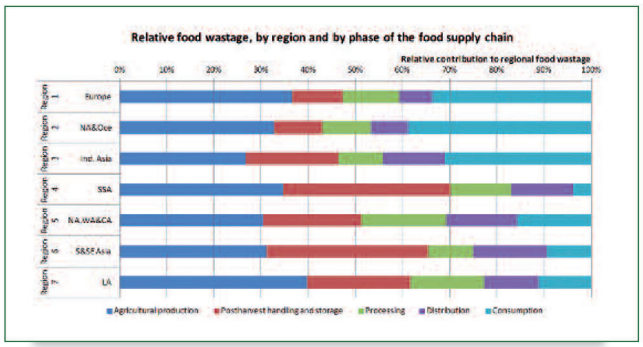


Figure 4: Relative food wastage, by region and by phase of the food supply chain



Figures 3 and 4 illustrate some fundamental characteristics of food wastage. Food wastage arises at all stages of the food supply chains for a variety of reasons that are very much dependent on the local conditions within each country.

At global level, a pattern is visible. In high-income regions, volumes of lost and wasted food are higher in downstream phases of the food chain, but just the opposite in low-income regions where more food is lost and wasted in upstream phases.

In developing countries, there are indeed significant post-harvest losses in the early stages of the supply chain, mostly because of the financial and structural limitations in harvest techniques, storage and transport infrastructures, combined with climatic conditions favourable to food spoilage.

In the most affluent societies, there is a combination of consumer behaviour and lack of communication in the supply chain. For example, with consumers there can be insufficient purchase planning or exaggerated concern over "best-before dates". As for actors in the supply chain, quality standards too restrictive, according to size or aesthetics, are responsible for a large amount of the food wasted at the end of the chain.

Hotspots – contribution to total food wastage

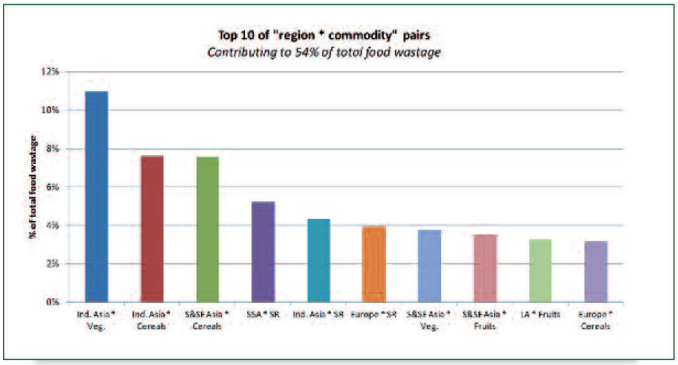
The FWF model is based on seven world regions and eight commodity groups, which multiplies out to 56 "region*commodity" pairs. The 56 pairs can be ranked according to their contributions to total food wastage volumes and used to identify hotspots, that is to say a limited number of region/commodity crossings that are major drivers of food wastage.

Figure 5 shows the ten "region*commodity" pairs (out of 56) with the highest contribution to food wastage volumes. Asia (including Ind. Asia and S&SE Asia) appears six times in the top 10 and dominates this ranking with vegetables and cereals. SSA also appears, because of its starchy root crops, as do Europe, because of starchy roots and cereals, and Latin America because of fruits. In the top 10, it seems quite natural to see, on the one hand, commodities that stood-out in the results overview per commodity and, on the other hand, regions that stood-out in the results overview per region[4].

It appears that vegetables in Ind. Asia are a key wastage hotspot. This is mostly due to wastage occurring during agricultural production, post-harvest handling and storage, and consumption phases. Although food wastage percentages at each of these phases are actually lower than in other high-income regions, the high contribution attributed to Ind. Asia is because this region dominates world vegetables production and consumption, with more than 50 percent of both.

4 These results are presented in the FWF technical report.

Figure 5: Top 10 of "region*commodity" pairs for food wastage

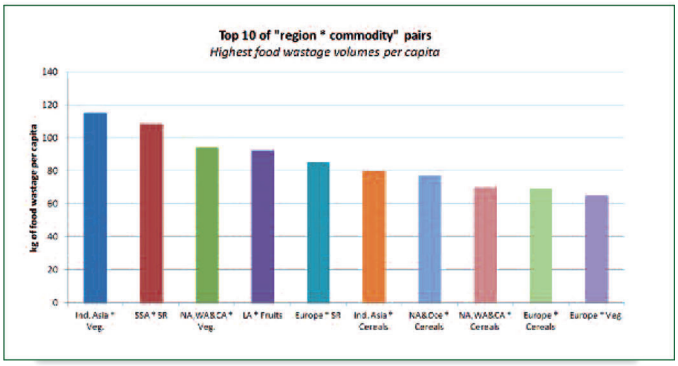


In terms of volume, cereal wastage is quite similar in Ind. Asia and S&SE Asia. However, in-depth analysis shows that more cereals are wasted at the consumption phase in Ind. Asia (similar to other middle- and high-income regions), than in S&SE Asia.

Although SSA is not a major contributor to food wastage at the global level, its wastage of starchy roots appears in the top 10 because of high wastage volumes in the agricultural and post-harvest phases. This is due to a combination of high production of starchy roots in this region (mostly cassava) and relatively high wastage percentages for these two phases, compared to other regions predominated by developing countries. Cassava is highly perishable. Deterioration of the roots starts two to three days after harvest and their consumption value decreases rapidly (Bokanga 1999).

Hotspots can also be pinpointed by calculating per capita ratios for each of the 56 "region*commodity" pairs. This calculation identifies a different top ten, as shown in Figure 6, although seven of the top ten shown in Figure 5 still appear in Figure 6. However, the S&SE Asia is no longer visible in this top 10 and, in fact, has the lowest food wastage volumes per capita. Conversely, the NA,WA&CA is prominent in this calculation, due the fact that cereals and vegetables are major contributors to food wastage in this region, which has a ratio of food wastage per capita higher than the world average.

Figure 6: Top 10 of "region*commodity" pairs for food wastage volumes per capita



Carbon footprint

Method

A product's carbon footprint is the total amount of greenhouse gases (GHGs) it emits throughout its life cycle, expressed in kilograms of CO_2 equivalents. This includes the GHG emissions during the agricultural phase, including those from on-farm energy use and non-energy-related emissions (such as CH_4 and N_2O) from soils and livestock.

Emissions due to land use change (LUC) are not accounted for in this study, but assessing and integrating them in the calculations is definitely a topic for future improvement of the present work. LUC could not be included in the FWF model, since only a fraction of Life Cycle Assessment (LCA) data sources take them into account, and such calculations are heterogeneous and continuously challenged. However, if LUC were taken into account in the FWF model, the evaluation of the global GHG emissions for food production phase would be at least 25 percent higher (Hörtenhuber et al. 2012) and potentially 40 percent higher (Tubiello et al. 2013)

Results overview

The global carbon footprint, excluding land use change, has been estimated at 3.3 Gtonnes of CO_2 equivalent in 2007. As show in Figure 7, if integrated into a country ranking of top emitters, food wastage would appear third, after USA and China, according to the latest data available (WRI 2012). This amount is more than twice the total GHG emissions of all USA road transportation in 2010 (1.5 Gtonnes of CO_2 eq.)[5].

Figure 7: Top 20 of GHG emitting countries vs. food wastage

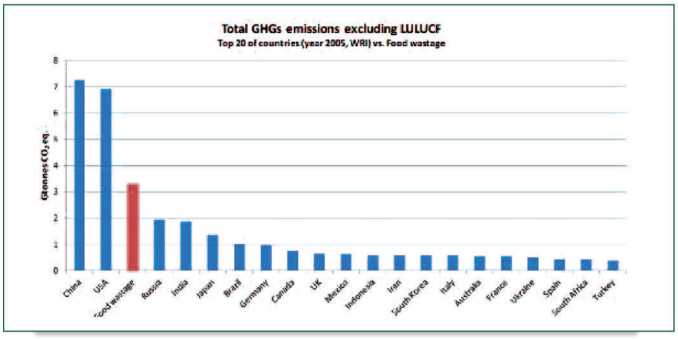
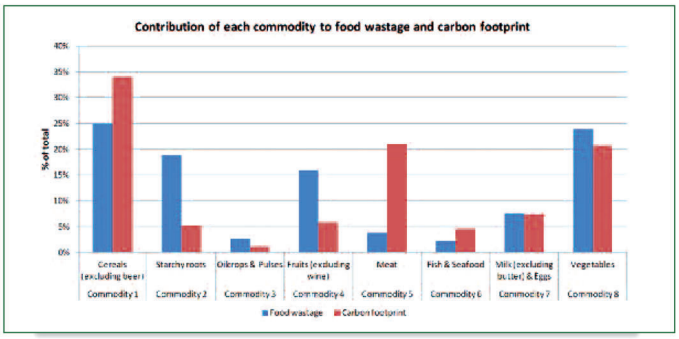


Figure 8 illustrates food wastage for each commodity, along with its carbon footprint. The major contributors to the carbon footprint of food wastage are cereals (34 percent of total), followed by meat (21 percent) and vegetables (21 percent). Products of animal origin account altogether for about 33 percent of total carbon footprint, whereas their contribution to food wastage volumes is only 15 percent. The ratio between red and blue bars of Figure 8 gives an indication of the average "carbon intensity" of each commodity group (i.e. GHG emissions per kg of product).

5 GHG data from UNFCCC, available at http://unfccc.int

Figure 8: Contribution of each commodity to food wastage and carbon footprint



All foodstuffs share a common characteristic: emissions of biogenic GHG such as methane (CH_4) and nitrous oxide (N_2O) play an important role in their carbon footprints. CH_4 and N_2O are very powerful GHGs, CH_4 having a weighting factor of 25 times CO_2 and N_2O 298 (IPCC 2007). The following discussion looks at the GHG characteristics of the commodities in the scope of the present study. Information presented here is taken from the LCA studies that were selected for the calculations.

Cereals

The production and application of nitrogen fertilizer are major contributors to the overall climate impact of cereals. In addition, the use of diesel for agricultural operations, such as ploughing, harvesting and drying the produce, results in CO_2 emissions. Differences in the emission factors for various types of cereals mostly depend on the yield level.

Pulses

Pulses, such as peas and beans, are efficient sources of protein, as compared with animal protein, because pulses need fewer inputs per kg of protein produced. In addition, the ability of grain legumes to fix nitrogen from air means that only a small amount, if any, nitrogen fertilizer is applied in the cultivation, which lowers the emission factors of these products.

Fruits, vegetables and starchy roots

In general, the production of fruits and field-grown vegetables generates relatively low GHG emissions. As for grains, emissions are mainly due to the use of diesel and nitrogen fertilizers, as well as yield level. Potatoes and other roots are particularly efficient in the cultivation, because of very high yield per unit area. Thus, emissions of GHG per kg of product are low. Regarding vegetables grown in heated greenhouses, the type of heat production is the most important parameter for such products' carbon footprint.

Meat and dairy products

When it comes to GHG emissions from animal products, a distinction should be made between monogastric animals and ruminants. For monogastric animals (pigs and poultry), feed provision is the first contributor to emissions, followed by manure management, due to methane emissions. These emissions are dominated by N_2O from soil turnover of nitrogen and carbon emissions from production of mineral fertilizers. Energy used to maintain appropriate conditions in animal housing can be of significance for some animals, such as chickens.

CH_4 is often the major source of emissions for ruminants (cattle, sheep and goats). It mostly originates from enteric fermentation that occurs during feed digestion, although some CH_4 emissions also come from manure management. The second most important source of emissions, nitrous oxide, is related to feed provision. This includes emissions caused by production of fertilizers, soil emissions of nitrous oxide and energy used in arable farming.

Fisheries

The climate impact of fisheries is dominated by carbon dioxide emissions from onboard diesel combustion, which is directly related to the amount of fuel used. The second major factor is the leakage of refrigerants from on-board cooling equipment, if the refrigerants used have a high climate impact.

Aquaculture

The production of fish farm inputs (particularly feed) often dominates the climate impact of aquaculture products. It is to be noted that some fish, such as carp and tilapia, are omnivores, and can feed on crop products or residues. Other species, including popular species such as salmon, trout and cod, are predators and require some marine-based feed. In industrialized production systems, this calls for fishmeal and fish oil which increase the GHG emissions of carnivorous fish.

Figure 9: Contribution of each region to food wastage and carbon footprint

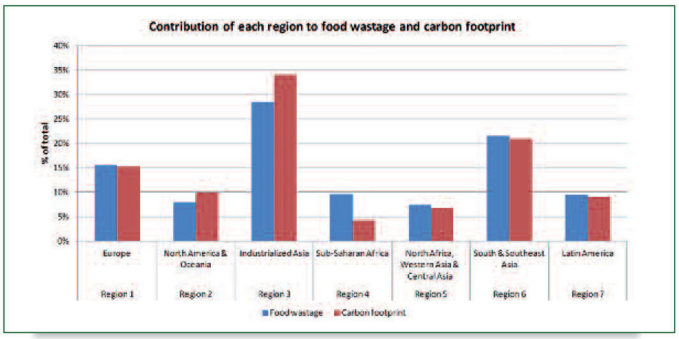


Figure 9 shows the average carbon intensity of each region. Variations are due to different mixes of commodities that are lost or wasted in each region. Regional carbon intensity is higher in North America than in Europe because the share of meat in food wastage is higher (9 percent and 5 percent of regional food wastage, respectively). Carbon intensity is very low in SSA because the share of starchy roots (a commodity with low carbon intensity) in this region is more than 50 percent. The carbon intensity in Ind. Asia is high, due to the carbon footprint of wasted cereals, most notably rice. Rice is also an important contributor to S&SE Asia's carbon intensity.

Figure 10 shows that the highest carbon footprint of wastage occurs at the consumption phase (37 percent of total), whereas consumption only accounts for 22 percent of total food wastage. This is because when food wastage occurs along the FSC, impacts of all the phases that the product has gone through (e.g. processing, transport), are added to the initial agricultural impact and the final end-of-life impact. This means, for instance, that the carbon footprint of the wastage occurring at the consumption phase comes from energy used for cooking, but it also includes the energy used when the food was grown, stored, processed and distributed, and then the end-of-life of the discarded food, such as landfill, must be factored in.

Figure 10: Contribution of each phase of the food supply chain to food wastage and carbon footprint

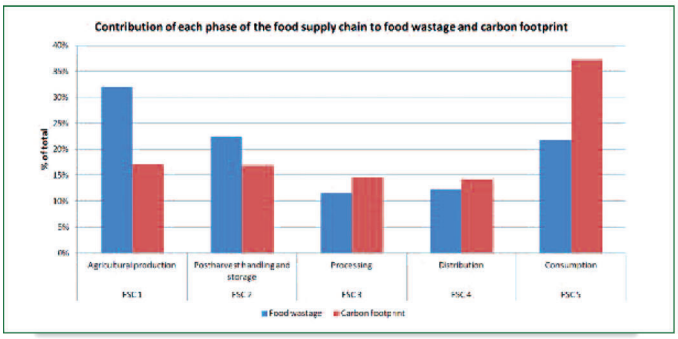


Figure 11: Carbon footprint of food wastage, by phase of the food supply chain with respective contribution of embedded life-cycle phases

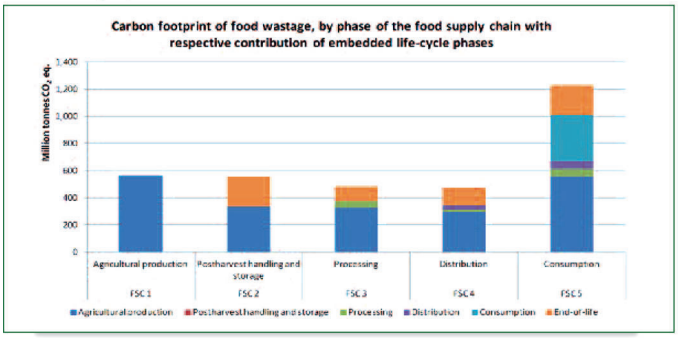


Figure 11 presents the carbon footprint of each phase of the FSC with the respective contribution of embedded life-cycle phases. As shown earlier, GHG emissions from the agricultural phase are always the major contributors to the carbon footprint of each FSC phase. At the consumption phase, the GHG emissions coming from consumption itself (i.e. energy for cooking) play a significant role. Emissions related to end-of-life are noticeable for all phases, except for the agricultural phase which has only negligible emissions[6].

The regional profiles of commodities presented in Figure 12 may vary from one region to another, but they also show some common trends:

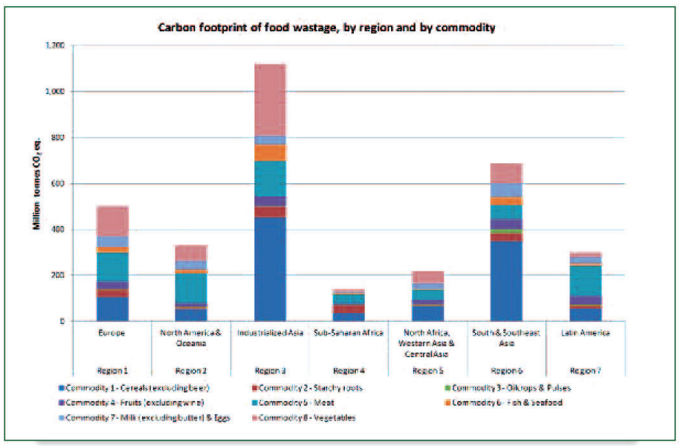
- Contribution of lost and wasted oilcrops and pulses, as well as fish and seafood, to the carbon footprint is low in all regions (1 to 6 percent of the carbon footprint of the region).
- Contribution of lost and wasted starchy root to the carbon footprint is quite low in all regions (less than 7 percent), with the notable exception of Sub-Saharan Africa (24 percent).
- Three commodities, namely cereals, meat and vegetables, contribute significantly to the carbon footprint of each region. Taken together, they account for more than 60 percent of the carbon footprint in every region. However, their respective shares are variable. For instance, the carbon footprint of cereals is as high as 51 percent and 40 percent of total in S&SE Asia and Ind. Asia, respectively. The footprint of meat is high in LA (44 percent) and NA&Oce (40 percent).

The average carbon footprint of food wastage is about 500 kg CO_2 eq. per capita and per year (Figure 13). Europe, NA&Oce and Ind. Asia have the highest per capita carbon footprint of food wastage (approximately 700 to 900 kg CO_2 eq. per capita and per year), while SSA has the smallest footprint per capita (about 180 kg CO_2 eq.). With a view to illustrate the magnitude of these results, it can be mentioned that in 2007, per capita carbon footprint (excluding land use, land use change and forestry – LULUCF) was about 23 tonnes CO_2 eq. in the USA, 10.7 in Japan and 8.4 in France[7].

6 Food wastage during the agricultural production phase is usually dealt with on-farm, through uncontrolled open burning or agriculture products simply left in the field. Climate change impacts of such practices are deemed negligible since the CO_2 emitted by the combustion of agricultural products is of biogenic origin. In addition, agricultural products left in the field are not degraded in anaerobic conditions and do not produce CH_4 as in landfills.

7 GHG data from UNFCCC, available at http://unfccc.int

Figure 12: Carbon footprint of food wastage, by region and by commodity



Hotspots – contribution of "region*commodity" pairs to total carbon footprint

As with the analysis performed for food wastage volumes, the "region*commodity" pairs can be ranked according to their contributions to total carbon footprint. Asia – Ind. Asia and S&SE Asia – appears five times in the top 10 and dominates this ranking with vegetables and cereals. Meat is present in four regions, Ind. Asia, Europe, NA&Oce and LA.

The carbon footprint is calculated as a multiplication of a food wastage amount and an impact factor. Figure 14 enables determination of which part of the multiplication is the main driver of the carbon footprint for the identified hotspots.

Figure 13: Carbon footprint of food wastage, by region – per capita results

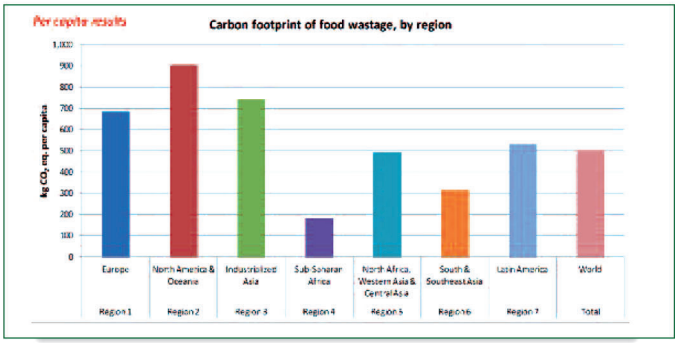
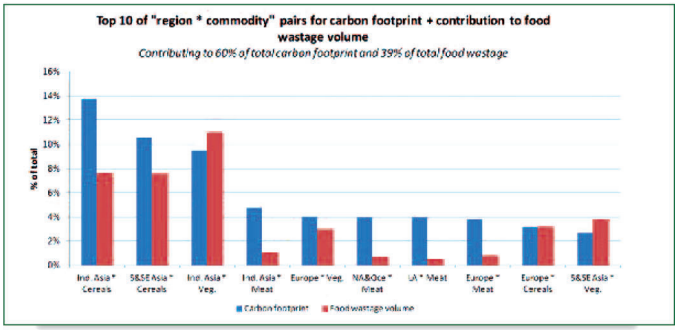


Figure 14: Top 10 of "region*commodity" pairs for carbon footprint presented along with contribution to food wastage volume



In Figure 14, the top 10 of "region*commodity" pairs for carbon footprint are presented along with their respective contribution to food wastage volume. This figure indicates whether the carbon footprint of the hotspot is mainly due to high food wastage volumes, or to high impact factors. Indeed, if the contribution to total carbon footprint of a given "region*commodity" is high, but its contribution to total food wastage volumes is low, then the driver of the carbon footprint is the carbon intensity of the commodity (i.e. the impact factors used in the FWF model). In the case of vegetables, the driver seems to be mostly the wastage volume whereas, for meat, the driver is the carbon intensity of the commodity. As regards cereals, both aspects play a role in the carbon footprint.

Looking more precisely at each hotspot, some particular patterns can be observed. The top two hotspots are cereals in Ind. Asia and S&SE Asia. They account for 13.7 and 10.6 percent of total GHG emissions of food wastage, while their contribution to food wastage volume is 7.6 percent each. In addition, it can be observed that cereals in Europe account for 3.2 percent of the total carbon footprint and 3.2 percent of total food wastage. Thus, it appears that wastage of cereals in Europe is less carbon-intensive.

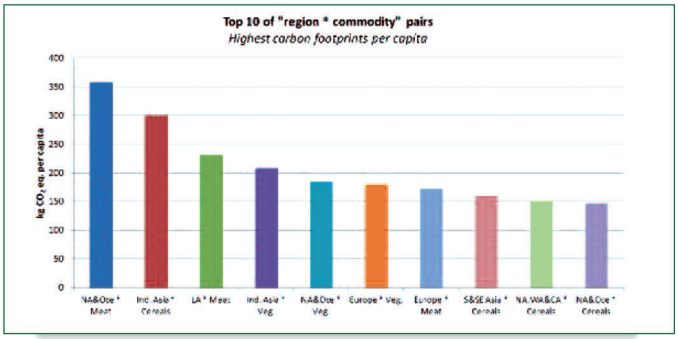
This can be explained by the fact that Asia and Europe mainly grow different cereals. In Asia, rice dominates cereals wastage with 53 percent in Ind. Asia and 72 percent in S&SE Asia, whereas in Europe, wheat dominates with 71 percent of wastage. Furthermore, average impact factors for rice in Ind. Asia and S&SE Asia are 5 and 3.4 kg CO_2 eq/kg, respectively. For wheat in Europe, the impact factor is lower, that is 2 kg CO_2 eq/kg. Note also that about 70 percent of GHG emissions of rice wastage in Ind. Asia and S&SE Asia come from the agricultural phase. Indeed, rice is a CH_4-emitting crop because of the decomposition of organic matter in flooded paddy fields. These higher impact factors for rice explain why wastage of cereals is more carbon-intensive in Asia.

For vegetables, an opposite pattern is observed: vegetable cropping is more carbon-intensive in Europe than in Asia, which is likely due to the fact that Europe grows a higher share of its vegetables in heated greenhouses. It should be noted that, due to lack of data, some assumptions had to be made regarding the share of vegetables grown in greenhouses across the various regions. Therefore, interpretations on this particular point have been made very cautiously.

Hotspots – per capita analysis

Hotspots can also be pinpointed by calculating per capita ratios for each of the 56 "region*commodity" pairs. A new top 10 based on this calculation, shown in Figure 15, is dominated by middle- and high-income regions (7 times). Cereals and vegetables are still present but meat is more visible.

Figure 15: Top 10 of "region*commodity" pairs for carbon footprint per capita



Water footprint

Method

Accounting for water use can take two forms: withdrawal or consumption. Water withdrawal refers to water diverted or withdrawn from a surface water or groundwater source. Consumptive water use refers to water that that is no longer available for the immediate water environment because, for instance, it has been transpired by plants, incorporated into products or consumed by people or livestock. The water footprint approach addresses the issue of water consumption.

Recent work on the global water footprint of human activities or specific country studies demonstrates the major role played by agriculture. It indicates that consumption of agricultural products is responsible for 92 percent of the water footprint of humanity (Hoekstra & Mekonnen 2012). For that reason, the modelling work is focused on the agricultural production phase[8].

8 Although it can be pointed-out that water is also used for food processing (e.g. food cleaning, sanitizing, peeling, cooling), a large part of this water is released afterwards, thus limiting the water footprint of this stage.

The Global standard on water footprint assessment developed by the Water Footprint Network (WFN) has been used for water footprint assessment (Hoekstra et al. 2011). It defines the water footprint of a product as the total volume of fresh water that is used directly or indirectly to produce the product. Under the WFN definition, a water footprint consists of three sub-components that measure different sorts of water appropriation: blue water, green water and grey water.

Blue water in agriculture is the consumptive use of irrigation water taken from ground or surface water. Green water is the rainwater directly used and evaporated by non-irrigated agriculture, pastures and forests. Finally, grey water footprint does not reflect actual water consumption – it measures a theoretical volume of water that is required to dilute pollutants. This latter footprint was not calculated in the present study.

The environmental impact associated with green water use is relatively minor because it does not alter hydrological systems. However, blue water use in irrigated agriculture has the potential for causing severe environmental problems, such as water depletion, salinization, water-logging or soil degradation (Aldaya et al. 2010). This is why the present study focuses primarily on the blue water footprint.

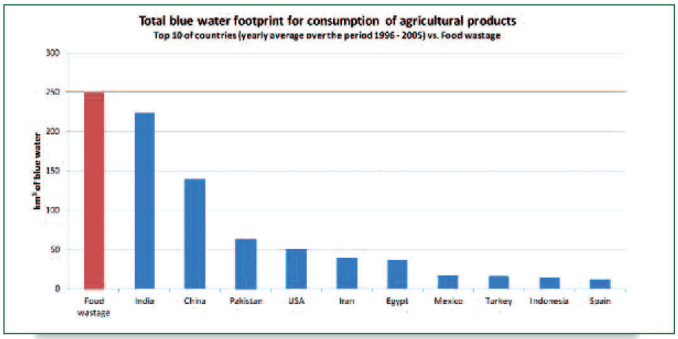
Due to lack of data, the water footprint for fish and seafood was not taken into account in this study. Several authors point-out that no water consumption can be associated with wild seafood and marine fisheries (Zimmer & Renault 2003). It can also be considered that brackish and marine aquaculture are not water-consumptive, because there is no demand or competition for marine or brackish water (Brummett 2006; Welcomme 2006). As regards freshwater aquaculture, it can consume small quantities of water through water evaporation of natural streams and bodies and, sometimes, through the agricultural primary products used to feed the fish.

Results overview

Globally, the blue water footprint for the agricultural production of total food wastage in 2007 is about 250 km^3, which is more than 38 times the blue water footprint of USA households, or 3.6 times the blue water footprint of total USA consumption (Mekonnen & Hoekstra 2011). In terms of volume, it represents almost three times the volume of Lake Geneva, or the annual water discharge of the Volga River.

The magnitude of the blue water footprint of food wastage can also be represented by integrating it into a country ranking of largest blue water consumers. The blue water footprint of food wastage calculated in this study focuses on the footprint of agricultural production. Therefore, the national water footprint accounts (Mekonnen & Hoekstra 2011) presented in Figure 16 are for the blue water footprint of the national consumption of agricultural products.

Figure 16: Top 10 of national blue water footprint accounts for consumption of agricultural products vs. food wastage

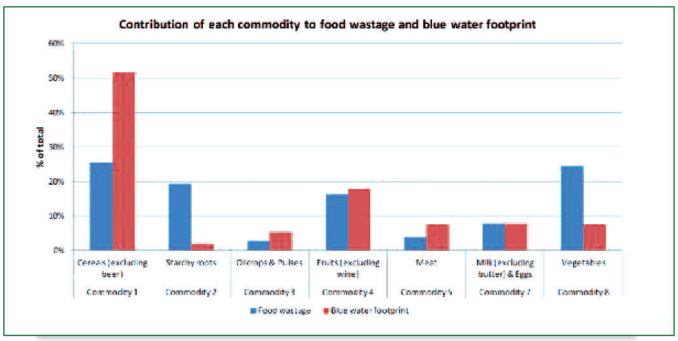


The national blue water footprint accounts for the consumption of agricultural products indicate that the global water footprint of food wastage is higher than that of any country, whether a temperate country with relatively large water use or a large country, such as India or China.

Figure 17 shows that the major contributors to the blue water footprint of food wastage are cereals (52 percent of total) and fruits (18 percent), whereas their contributions to total food wastage[9] are 26 percent and 16 percent, respectively. Conversely, starchy roots account for 2 percent of the water footprint, whereas this commodity represents 19 percent of total food wastage.

9 Excluding fish and seafood in order to allow a comparison on the same grounds.

Figure 17: Contribution of each commodity to food wastage and blue water footprint



The ratio between red and blue bars of Figure 17 indicates the average "blue water intensity" of each commodity group, expressed in m^3 of blue water per kg of product. Information on the water intensity characteristics of the individual commodities included in this study is presented below.

Crops

Comparing the water footprints of products must be done very cautiously. Global average water footprints can differ greatly from region-specific water footprints. Thus, relative performance of products may differ depending on the geographical scale.

Due mainly to the differences in crop yields, water footprints of a given crop vary across countries and regions. For instance, Europe has relatively small water footprints per tonne of cereal crops, while in most parts of Africa, the water footprints of cereal crops are quite large. This can mainly be explained by the higher average yield in Europe, compared to that observed in Africa.

The average water footprint per tonne of primary crop differs significantly among crops. Crops with a high yield or that have a larger fraction of their biomass harvested generally have a smaller water footprint per tonne (e.g. starchy roots, fruits or vegetables) than crops with a low yield or small fraction of crop biomass harvested (e.g. cereals, oilcrops). Note also that the water footprint can vary significantly across products within a commodity.

Animals

In general, animal products have a larger water footprint per tonne of product than crops. From a freshwater resource perspective, it appears more efficient to obtain calories, protein and fat through crop products than animal products. Most of the water footprint comes from the animal feed – the animals' drinking water only accounts for a minor share. Three key parameters affect the water footprint of animals: feed conversion efficiency of the animal, feed composition and feed origin. The nature of the production system – whether grazing, mixed or industrial – is important because it has an effect on all three parameters.

The feed conversion efficiency, that is the amount of feed required to produce one unit of animal product, strongly affects the water footprint. For instance, cattle's relatively low conversion efficiency leads to a large water footprint. Feed composition is also a driver of the footprint, most notably the ratio of concentrates versus roughages and the constituents of the concentrates. In spite of favourable feed conversion efficiencies, chicken and pig have relatively large fractions of cereals and oil meal in their feed, which results in relatively large water footprints. The origin of the feed is also a factor influencing the water footprint of a specific animal product because of the differences in climate and agricultural practice in the regions from which the various feed components are obtained.

Figure 18: Contribution of each region to food wastage and blue water footprint

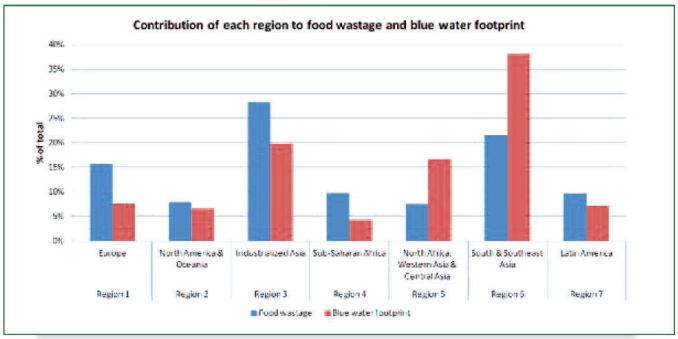
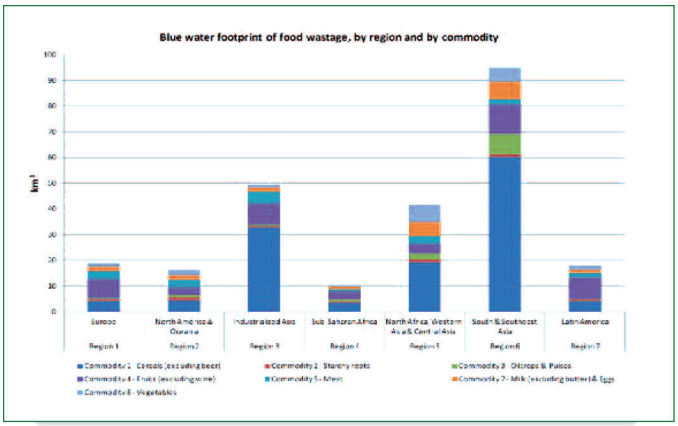


Figure 18 reflects the average blue water intensity of each region. Observed variations come from the different mixes of commodities that are lost or wasted in each region, combined with specific impact factors. Some of the interesting patterns, which are further illustrated in Figure 19, are the following:

- Regional blue water intensity is much higher in NA,WA&CA and S&SE Asia than in other regions. In these two regions, a large share of the footprint is due to cereals which account for about 50 and 60 percent, respectively.
  - In NA,WA&CA, it is mostly because of wastage of: wheat and maize in the Northern Africa sub-region; and wheat and rice in the Western Asia sub-region. The impact factor for these products are higher than average in these sub-regions.
  - In S&SE Asia, it is mostly because of wheat and rice wastage in the Southeast Asia sub-region, in particular in India. The impact factor for wheat is higher than average in this sub-region.
- Regional blue water intensity is very low in SSA because the share of starchy roots (a commodity with low blue water intensity) in this region's food wastage is very high, at more than 50 percent.

Figure 19: Blue water footprint of food wastage, by region and by commodity

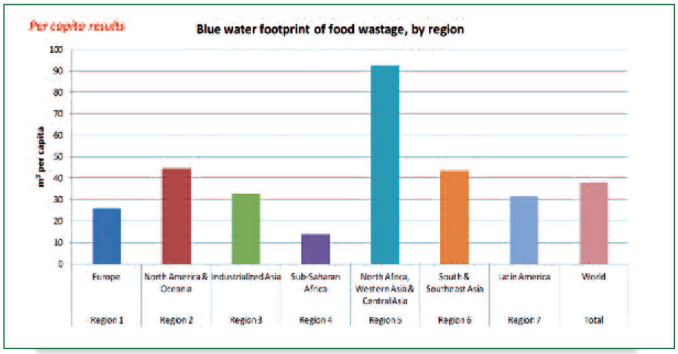


A different picture emerges from the per capita results. Most notably, S&SE Asia, the region with the highest absolute water footprint, is actually close to world average when looking at the per capita results. The average blue water footprint of food wastage is about 38 m^3 per capita and per year. NA,WA&CA stands-out as the region with the highest per capita footprint, which is more than 90 m^3 per capita and per year. Indeed, this region represents 17 percent of the total water footprint of food wastage but only 7 percent of the total population. SSA is the region with the smallest footprint per capita, at 14 m^3 per capita and per year. This region represents only 4 percent of the total water footprint of food wastage, but as much as 12 percent of the total population.

In order to illustrate the order of magnitude of these results, it can be mentioned that in 2007, the world average for per capita blue water footprint for household water consumption was only about 7 m^3 per capita and per year, and the highest value was for Canada at 29 m^3 per capita and per year (Mekonnen & Hoekstra 2011).

The average blue water footprint of food wastage, when considering food crops only and not taking animal products into account, is about 30 m^3 per capita and per year, a value that is close to the estimate reported by another recent study (Kummu et al. 2012).

Figure 20: Blue water footprint of food wastage, by region – per capita results



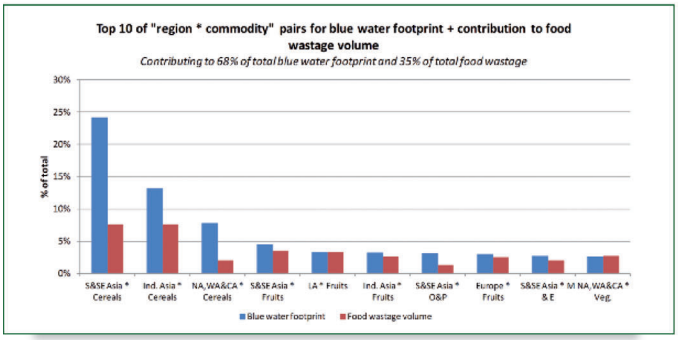
Hotspots – contribution of "region*commodity" pairs to total blue water footprint

The "region*commodity" pairs also can be ranked according to their contributions to total blue water footprint, using analysis similar to the one used for food wastage volumes.
Figure 21 shows the ten pairs with the highest contribution to blue water footprint. Cereals dominate this ranking with the three first places accounting for 45 percent of total footprint. Fruits are quite visible in the top 10, appearing four times. But the contribution of fruit (at 14 percent) remains secondary to cereals.

Blue water footprint is calculated by multiplying a food wastage amount by an impact factor. It can be interesting to determine which part of the multiplication is the main driver of the blue water footprint for the identified hotspots. Figure 21 has been built for that purpose.

The Top 10 of "region*commodity" pairs for blue water footprint is presented in Figure 21, along with their respective contributions to food wastage volume. The main driver for cereals seems to be the water footprint intensity of the commodity, whereas for fruits, it seems to be more connected to the wastage volumes.

Figure 21: Top 10 of "region*commodity" pairs for blue water footprint presented along with contribution to food wastage volume



More specifically, in S&SE Asia, the water footprint of cereals primarily comes from the Southern Asia sub-region (because of India) and in Ind. Asia (because of China). In both sub-regions, major contributing cereals are wheat and rice. Regarding NA,WA&CA, it appears that the key sub-regions are Northern Africa and Western Asia, because of wheat and maize and wheat and rice, respectively. While the estimate for fruits is fairly robust at global level, interpretation of disaggregated results is complicated by some methodological constraints. Indeed, it appears that the main contributor to the footprint of this commodity is the sub-commodity "other fruits" which includes a wide range of product but is not further broken down in the FBS and, thus, does not allow further disagreggation in the FWF model.

Hotspots – per capita analysis

Another way to pinpoint hotspots is to calculate per capita ratios for each of the 56 "region*commodity" pairs. This identifies a new top 10, which is presented in Figure 22. The ranking is modified but six pairs of the first top 10 are still present. NA,WA&CA, which has the highest overall blue water footprint per capita, dominates this ranking. In addition, two new commodities from this region have appeared in the ranking (M&E[10] and fruits). It can also be mentioned that NA&Oce is now visible because of cereals and fruits. This region is not responsible for a large share of the food wastage of cereals and fruits (3.4 percent and 6.8 percent, respectively) but with only 5.6 percent of the total population, this makes a significant per capita ratio.

Taking water scarcity into consideration

Data available on the Global Agro-Ecological Zones (GAEZ)[11] portal of FAO and the International Institute for Applied Systems Analysis (IIASA) were adapted to the FWF model in order to complement water footprint figures with aspects of water scarcity. Water scarcity has three dimensions: physical (when the demand is higher than the available supply), infrastructural (when the water demand cannot be satisfied because of ineffective infrastructures) and institutional (when secure and equitable supply of water to users is not ensured by public authorities). In terms of physical water scarcity, a withdrawal rate above 20 percent of renewable water resources is considered to represent substantial pressure on water resources – and above 40 percent, is considered critical.

GAEZ identifies areas of land that have a low, moderate, high or very high water scarcity in each country of the world. The country-level areas for each level of water scarcity have been summed-up according to region, providing a view of the regions that have the largest share of land areas with high or very high water scarcity. Figure 23 places this water scarcity profile alongside food wastage in order to reveal potential linkage between the two aspects.

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10 Milk and egg

11 Over the past 30 years, IIASA and the FAO have been developing the Agro-Ecological Zones (AEZ) methodology for assessing agricultural resources and potential. The GAEZ v3.0 portal is available at http://www.gaez.iiasa.ac.at

Figure 22: Top 10 of "region*commodity" pairs for blue water footprint per capita

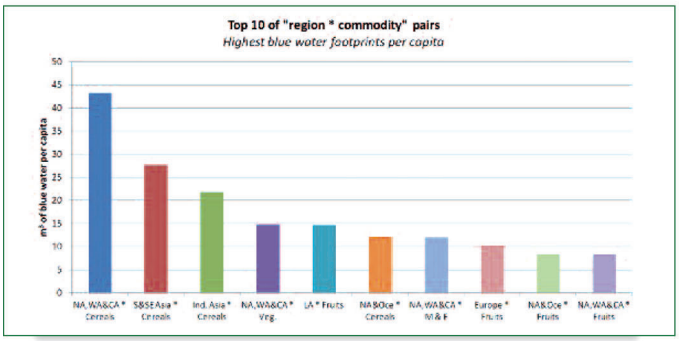
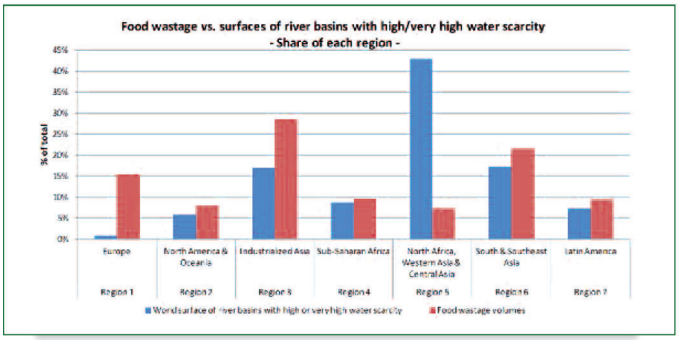


Figure 23: Food wastage vs. surfaces of river basins with high/very high water scarcity



Knowing that agriculture is the largest water consumer, one can consider that comparing regional food wastage (red bars) and water scarcity (blue bars) somewhat provides a rough indicator of the "useless" or "ineffective" pressure food wastage puts on the water resource. In this perspective, it seems that the Ind. Asia and S&SE Asia regions raise concerns, as they significantly contribute to water scarcity through food wastage. However, making a relevant connection between water scarcity and volumes of food wastage is not so obvious. Indeed, most of NA,WA&CA has arid or semi-arid climates so, logically, this region has the largest share of water-scarce surfaces. On the other hand, NA,WA&CA accounts for a relatively minor share of food wastage in relation to the issue of water scarcity, but it can be questioned if this gives a fair account of the actual pressure of food wastage on the water resource in such scarce conditions.

Land use

Method

In this study, land occupation describes the surface of land, including cropland and grassland, necessary to produce foodstuff. More specifically, it evaluates the surfaces occupied by food produced but uneaten because of wastage.

This land occupation indicator has some advantages, since it has relatively low uncertainty and is expressed in a surface area unit (e.g. ha) which is easy to understand. Land (and particularly agricultural land) can be seen as a limited natural resource with a number of competing uses (e.g. agriculture, buildings, roads). Assessing land occupation provides a view on the depletion of this resource (Mattila et al. 2011).

However, this single indicator is not sufficient to describe all the land-related environmental impacts. Indeed, it does not address the issue of land use change which would account for the impact of deforestation, urbanization and soil sealing. It also does not indicate if the land occupation is actually beneficial or negative for the environment, particularly regarding impacts on soil quality. Indeed, occupation of land, such as for agricultural use, can lead to a temporary or permanent lowering of the productive capacity of land. The United Nations recognizes this phenomenon, called land degradation, as a global developmental and environmental issue. In this context, the land occupation figures calculated in this study have been complemented with data from the FAO Land Degradation Assessment in Drylands (LADA) model (FAO LADA 2011) in order to give a preliminary view of the linkage between aspects of land occupation of food wastage and land degradation.

In this case, the land use factor for capture fisheries is not included, as such products obviously do not require agricultural land. Regarding aquaculture (both marine and inland), it should be noted that in some productions systems, fish can be fed with feed made from agricultural products. However, no detailed data could be found on the land occupation factor related to aquaculture.

Results overview

At world level, the total amount of food wastage in 2007 occupied almost 1.4 billion hectares, equal to about 28 percent of the world's agricultural land area. This figure can be compared to the surface of the largest countries, where land surface occupied by food produced and not consumed is second to the total land area occupied by the Russian Federation.

Figure 24: Top 20 of world's biggest countries vs. food wastage

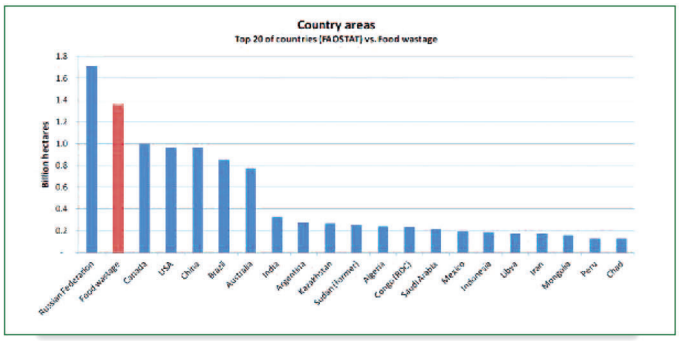
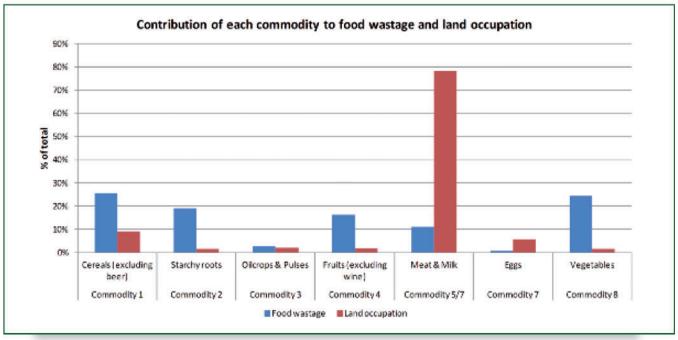


Figure 25 shows that the major contributors to land occupation of food wastage are meat and milk, with 78 percent of the total surface, whereas their contribution to total food wastage is 11 percent[12]. The ratio between red and blue bars of Figure 25 indicates the average "land intensity" of each commodity group, that is hectare of land per tonne of product. In practical terms, it illustrates that land intensity is inversely proportional to the yield.

12 Excluding fish and seafood in order to allow a comparison on the same grounds.

Figure 25: Contribution of each commodity to food wastage and land occupation



The discussion below looks at the land occupation/yield characteristics of the commodities analyzed in this study.

Crops

It should be stressed that comparing yields of crop products must be done with great caution. World average yields can vary greatly from region-specific yields. Thus, a given product can have a higher yield than another one at world level but the opposite can be observed locally.

The yield of a given crop varies across countries and regions. This is mainly due to differences in agricultural practices (e.g. inputs intensity, water and land management) and agroclimatic conditions. For instance, Europe and USA have relatively high yields of wheat compared with other regions. Overall, higher yields are generally observed for commodities where a large fraction of crop biomass is harvested (e.g. starchy roots, fruits or vegetables), compared with crops where a small fraction of crop biomass is harvested (e.g. cereals, oilcrops).

Animals

With regards livestock production, land occupation assessment requires specific accountings of the agricultural surfaces occupied for producing animal feed and/or surfaces used for grazing, per tonne of animal product. The land intensity of an animal product is primarily determined by the feed conversion efficiency of the animal, the composition of the feeding ration and the origin of the constituents of the ration.

For ruminants, the feeding ration can be composed of roughages (e.g. pasture) and/or concentrates (e.g. grains, soymeal) and other supplements. Schematically, the share of roughages and grassland productivity will influence the non-arable land occupation intensity. Conversely, the share of concentrated feed, its constituents such as maize or soy, and the yields in the originating regions of these crops, will influence the arable-land occupation intensity.

Land occupation intensity of products from monogastric animals can also be divided in arable and non-arable land. Although monogastric animals do not feed on grass, they indirectly require non-arable land surfaces because milk or components of milk from ruminants (which require grassland) can be ingredients of their feeding rations.

Figure 26: Land occupation of food wastage, at world level by commodity arable land vs. non-arable land

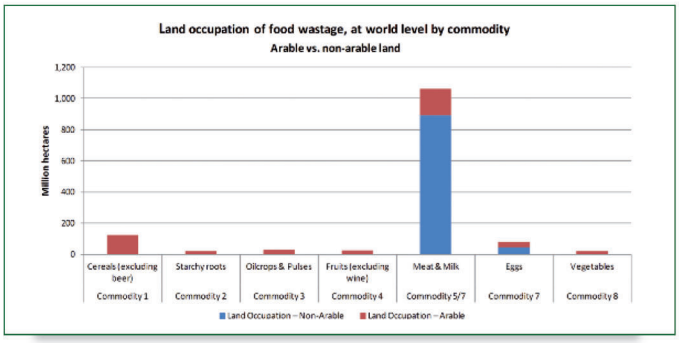


Figure 27: Contribution of each region to food wastage and land occupation

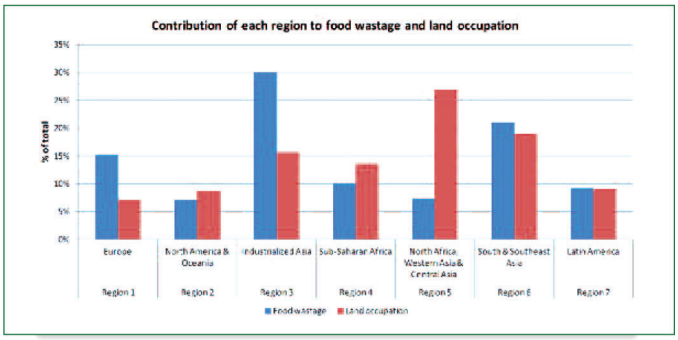


Figure 26 shows that the majority of the surfaces occupied to produce meat and milk are non-arable, meaning pastures and meadows. Meat and milk occupy 95 percent of non-arable land, the remaining 5 percent coming from eggs. Moreover, lost and wasted meat and milk occupy about 40 percent of the arable land (i.e. cropland). This is because of feed crops grown on arable land that are indirectly wasted when meat or milk is wasted. Food crops taken as a whole represent about 20 percent of total land occupied by food wastage. Lost and wasted food crops only use arable land and cover 52 percent of total arable land occupied by food wastage.

Regarding the role of each region in the surfaces occupied by food wastage, Figure 27 shows that the major contributor is NA,WA&CA, which accounts for 27 percent of the area occupied by food wastage globally. Low-income regions account for about two-thirds of total land occupation, while their contribution to total food wastage is about 50 percent.

Figure 27 reflects the average "land occupation intensity" of each region. Observed variations come from the different mixes of commodities that are lost or wasted in each region, combined with specific shares of arable and non-arable land. Patterns worth noting include the following (see also Figure 29).

- Land occupation intensity is much higher in NA,WA&CA than in other regions. In this region, 85 percent of the land occupation of food wastage is non-arable land for meat and milk, in particular for bovine, ovine and caprine animals. In this region, the non-arable land impact factor is very high, because the production systems mostly rely on grassland for feeding animals. In addition, these grasslands have low yields, resulting in low livestock productivity. Consequently, large areas are required to feed animals.
- Europe and Ind. Asia have the lowest land occupation intensity. The share of non-arable land for meat and milk is still the largest contributor to land occupation but, in parallel, the share of arable land for meat and milk is higher than in other regions. In these regions, the non-arable land impact factors are lower because production systems generally rely less on grassland and because grasslands are more productive. Feeding rations include higher shares of concentrates, resulting in more arable-land occupation but less non-arable land occupation. This results in lower total land occupation intensity.
- The difference between Ind. Asia and S&SE Asia is mostly due to differences in cattle production systems. The higher grassland productivity and higher share of concentrates in feeding rations in Ind. Asia result in higher productivity.

Figure 28: Land occupation of food wastage, at world level by region – Arable land vs. non-arable land

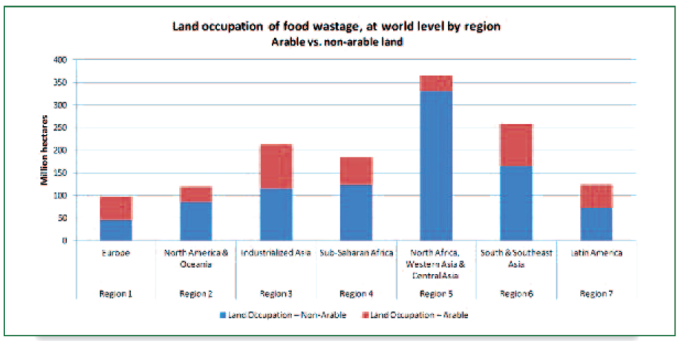


Figure 28 shows that in NA,WA&CA, more than 90 percent of the land occupation happens on non-arable land. In other regions, the share of non-arable land fluctuates between 47 percent for Europe and 71 percent for NA&Oce. In all regions, meat and milk are the largest contributors to non-arable land occupation. These commodities are also key drivers of arable land occupation. Consequently, the share of arable and non-arable land in each region is mostly driven by the share between grass and concentrate in the feeding rations. Regions that have higher shares of arable land tend to have lower total land occupation intensity because it is generally related to systems that are more productive.

The major features of the regional profiles of commodities presented in Figure 29 are as follows:

- Surfaces of non-arable land occupied to produce lost/wasted milk and meat contribute as much as 46–85 percent of the total land occupation of food wastage in each region.
- Lost/wasted milk and meat account for large surfaces of arable land. Arable land used by these commodities contributes to more than 10 percent of total land occupation of food wastage in all regions except NA,WA&CA and S&SE Asia, where production systems rely more on grasslands, which are low productive.
- Among food crops, the largest contributors to land occupation of food wastage are cereals. Arable land used to grow uneaten cereals contribute to 4–15 percent of total land occupation of food wastage in each region.
- In spite of significant food wastage volumes, starchy roots, vegetables and legumes are not very visible in the profiles because of their generally high yields.

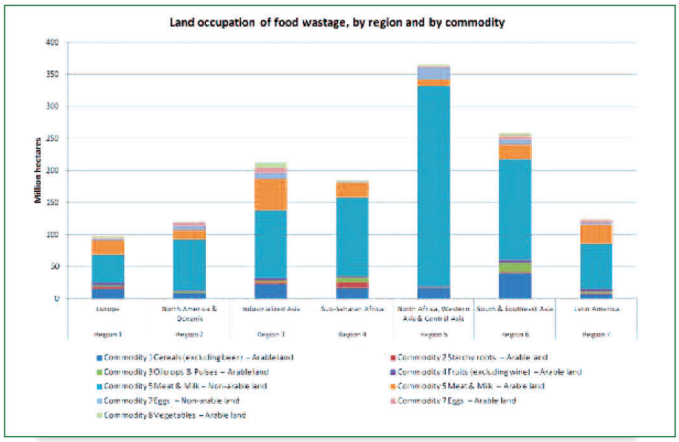
Hotspots – contribution of "region*commodity" pairs to total land occupation

For this component, a distinction is made between hotspots related to arable land occupation and hotspots related to non-arable land occupation. In Figure 30 and 31, top "region*commodity" pairs are presented along with their respective contribution to food wastage volume[13].

It can be noted that for meat and milk, the driver seems to be mostly the land occupation intensity of the commodity, for both arable and non-arable land. The observed variability in the impact factors of meat and milk across regions is due to differences in production systems, mainly factors such as the composition of the feeding ration and the amount of land required to produce the constituents of the ration.

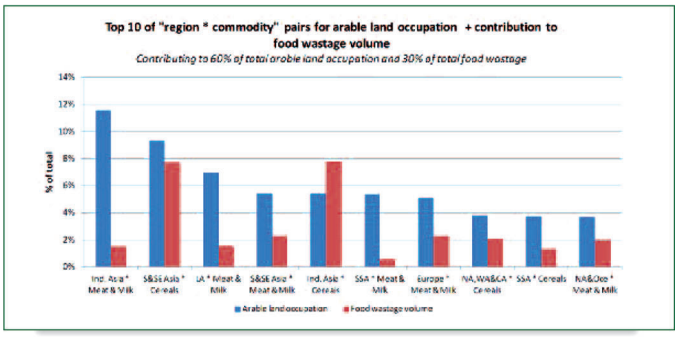
13 Figure 31 is only a top 5, because the number of potential "hotspot" pairs is reduced (only meat, milk and eggs have an arable-land occupation). This top 5 contributes to 83 percent of total non-arable land occupation.

Figure 29: Land occupation of food wastage, by region and by commodity



With cereals, wastage volumes play a role in arable land occupation but impact factors can accentuate or limit the effect of volume. For instance, cereals in S&SE Asia and Ind. Asia make the same contribution to total food wastage volumes but make different contributions to arable land occupation. The average land occupation factors for cereals in these two regions are different mainly because rice, relative to other cereals, has higher wastage in S&SE Asia, where rice yields are lower than in Ind. Asia. This results in a higher average impact factor for cereals in S&SE Asia.

Figure 30: Top 10 of "region*commodity" pairs for arable land occupation presented along with contribution to food wastage volume



Hotspots – per capita analysis

Another way to pinpoint hotspots is to calculate per capita ratios for each of the "region*commodity" pairs. Figure 32 presents the top 10 for total land occupation, with animal products clearly dominating the ranking. The major per capita hotspots are in NA,WA&CA, which has the highest total land occupation per capita.

Linkage with land degradation

Land degradation is defined by the FAO/LADA project as the reduction of land capacity to provide ecosystem goods (e.g. food, water, construction material) and services (e.g. maintaining hydrological cycles, regulating climate, cleaning water and air), over a period of time for its beneficiaries.

Figure 31: Top 5 of "region*commodity" pairs for non-arable land occupation presented along with contribution to food wastage volume

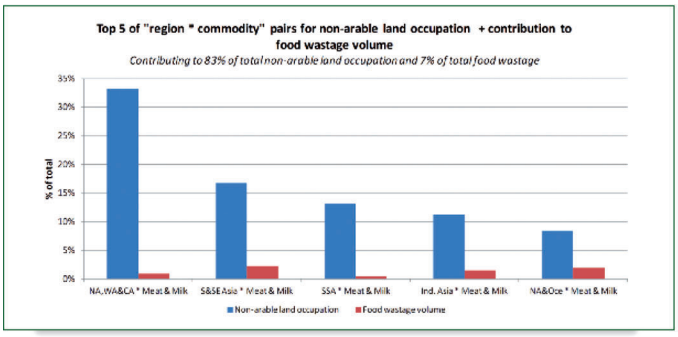
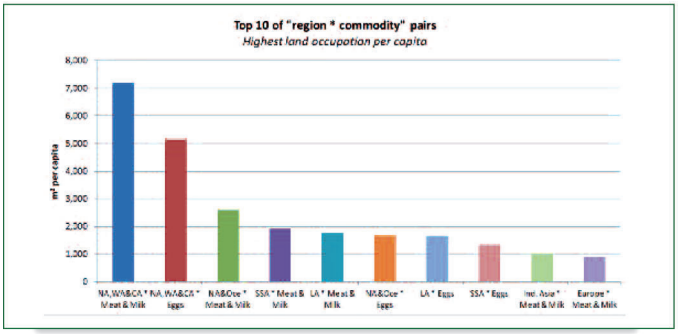


Figure 32: Top 10 of "region*commodity" pairs for land occupation per capita



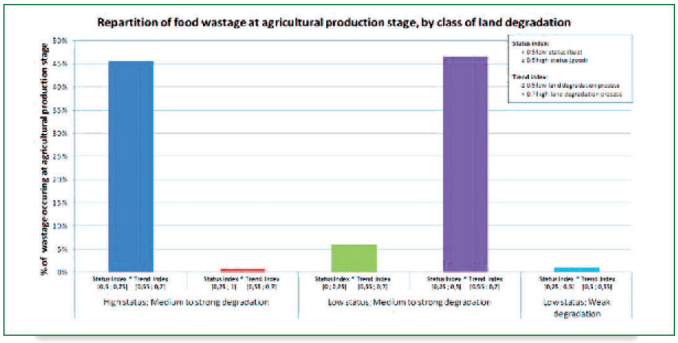
Degradation or decline in ecosystem services corresponds with a change in state of these services due to pressures and resulting in various degradation processes, that is, the land degradation trend. However, before quantifying these changes, the baseline of the actual status of each ecosystem needs to be determined, that is, the land degradation status. Trend and status can be further combined in classes of land degradation, that is to say particular "trend*status" pairs.

Land on which the agricultural production of food eventually lost/wasted occurred falls into three classes of land degradation (as defined in FAO LADA, 2011):

- ✔ Class 1: high (good) land status + medium to strong land degradation
- ✔ Class 2: low (bad) land status + medium to strong land degradation
- ✔ Class 3: low (bad) land status + weak land degradation

Figure 33 offers a view of the land degradation class/status/trend of the surfaces occupied to grow food lost at the agricultural production phase.

Figure 33: Repartition of food wastage at agricultural production stage, by class of land degradation



Almost 99 percent of food wastage at agricultural production stage appears to be produced in regions whose soils are experiencing, on average, medium to strong land degradation, thus adding pressure unduly. In addition, more than 50 percent of food wastage at the agricultural production stage appears to be produced in regions whose soils are, on average, currently at a low status in terms of soil degradation.

Biodiversity

Method

Biodiversity comprises the diversity of life on Earth, across genes, species and ecosystems. In this study, the impact of food wastage on biodiversity is focused on the agricultural production phase. Clearly, damages caused to natural habitats during the production phase are considerably greater than biodiversity impacts due to the disposal of unused parts of food. Biodiversity impacts are discussed where production occurs. Therefore, food wastage responsibility related to international trade is deliberately excluded from the assessment, as this important aspect requires detailed global supply chain models not contemplated in this study.

Biodiversity impacts related to agricultural production are assessed both at ecosystem level, through the extent of deforestation due to agriculture, and at species level, through the extent of Red Listed species of mammals, birds and amphibians threatened by agriculture. The biodiversity impacts related to fisheries are assessed at community level, by considering trends in mean trophic levels of species in a Large Marine Ecosystem (LME) since 1950. The Marine Trophic Index (MTI) measures the decline in abundance and diversity of fish high in the food chain, thus reflecting the complex interaction between fisheries and marine ecosystems (Pauly & Watson 2005). These three biodiversity indicators were chosen as they were the most meaningful and available ones to assess the impacts of food production at global level. Other indicators, such as trends in genetic diversity or trends in invasive species, are not fully developed or could not easily be linked to food production.

The quantitative assessment that follows is focused on terrestrial and marine biodiversity at regional or sub-regional level, but not at commodity level. This means that food wastage volumes could not be directly related to impacts on biodiversity, as for the other categories of environmental impacts. However, this study offers a qualitative review of evidence about the impacts of the different food commodities on biodiversity. This evidence base is then used to help interpret the relation between the quantitative biodiversity indicators and the regional information on food wastage per commodity. It should also be noted that in the quantitative assessment, the importance of the production system type (e.g. intensity level, traditional vs. industrial) could not be accounted directly, due to data availability issues. Moreover, the estimates of extent of deforestation from agriculture are maximum values, assuming all land deforested between 1990 and 2010 was due to conversion to agriculture. In reality, the extent of deforestation due to food production is probably smaller, as some of this agricultural land may not go to food production (e.g. biofuels) and as not all new agricultural land actually comes from forest areas. In addition these

estimates do not consider a number of other factors that can affect the magnitude of biodiversity impacts, such as the initial state of the forest (i.e. whether it was already degraded or not), or whether several conversions occurred in the 20-year period taken into consideration.

The review of evidence highlights that the greatest threats posed by crop expansion are likely to occur in the tropics, which support the highest species richness and endemism, while providing the greatest scope for increasing global agricultural production. In the developed world, there is generally poor conservation of biodiversity because industrial agriculture and urban expansion have led to declines in farmland diversity, ecosystems' pollution and habitat loss. Current trends towards agricultural land abandonment may lead to further biodiversity declines through reductions in habitat heterogeneity.

Animal husbandry has widespread impacts on biodiversity, mostly due to the conversion of natural areas to pastures and the production of forage, but also due to grazing and loss of livestock genetic diversity. Livestock production is concentrated in areas of cheap food supply, while becoming more industrialised. Generally, biodiversity decreases along a gradient of grazing intensities, where low-input rangelands have the highest biodiversity value, while rangelands with high stocking rates have the lowest biodiversity value. In the developing world, livestock production can play an important role in deforestation. In the developed world, livestock farming with low grazing intensity is often essential in maintaining semi-natural habitats of high ecological value, which are gradually being lost to high-input and more productive pastures.

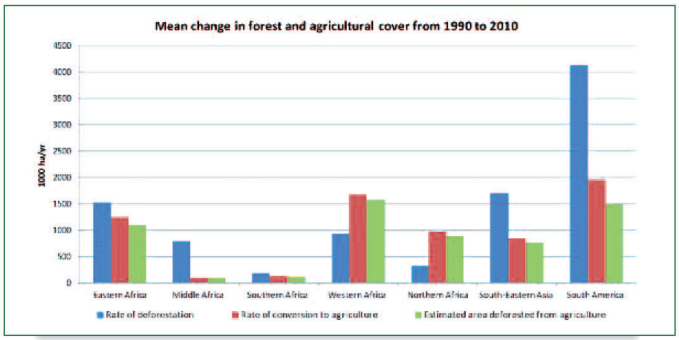
Fish and seafood production are also a considerable source of biodiversity decline. Marine fisheries have severely depleted and damaged fishery resources and fundamentally altered marine ecosystems. In fact, the number of overexploited, depleted or recovering marine fish stocks increased in 2008 to 32 percent, the highest in history. In addition, about half of the marine fish stocks are estimated as fully exploited, and for the ten species that have the highest share in catches, most of the stocks are overexploited (FAO 2010). This is largely due to modern industrial fishing, which causes significant collateral damage by destroying sea floor habitats and by-catch of unwanted species that is discarded as waste at sea. Aquaculture may also pose significant threats to biodiversity, but at the same time, it can have some locally positive impacts. For example, effluents in oligotrophic marine waters increase local biodiversity. The main causes of biodiversity decline due to aquaculture involve the escape of alien species, increasing use of hormones and antibiotics and discharge of other pollutants in the aquaculture process, genetic alterations of wild fish stocks and transmission of diseases.

Results overview

Farming, including conversion of wild lands and intensification, is a major threat for biodiversity worldwide. However, most of the impacts of food production on biodiversity occur in low-income regions, such as Sub-Saharan Africa and Latin America. Deforestation due to agricultural expansion seems to occur today mainly in tropical and sub-tropical areas of the African continent, Western and Southeastern Asia and Southern America (Figure 34). This is in line with existing findings showing that, between 1980 and

2000 across the tropics, more than 55 percent of new agricultural land came at the expense of intact forests and another 28 percent came from disturbed forests (Gibbs et al. 2010). While bioenergy crops have witnessed a rapid expansion over the past 10 years, especially in the tropics, deforestation remains largely due to the production of food commodities (Phalan et al. 2013). Maize, sorghum and cassava show somewhat lower rates of expansion than bioenergy crops but concern larger extents of land (Phalan et al. 2013), and thus are significant cause of land conversion.

Figure 34: Maximum area of forest converted to agriculture from 1990 to 2010, in regions where deforestation occurred



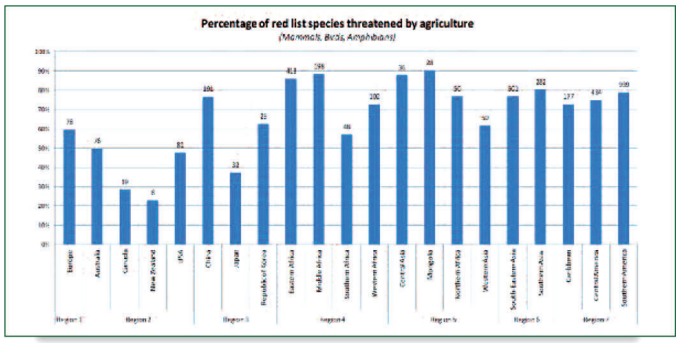
Threats to biodiversity are considerably higher in developing countries than in developed countries: on average, crops are responsible for 44 percent of species threats in developed countries, compared with 72 percent in developing countries. The threat is lower for livestock production, with developed countries responsible, on average, for 21 percent of the threats, compared with 34 percent for developing countries. The main biodiversity impacts are also located in tropical and sub-tropical regions, including Central and Southern Asia, Central and South America, and Africa.

Overall, this study shows that agriculture is responsible for 66 percent of threats to species (Figure 35), but there is considerable regional variability, since agriculture causes only 23 percent of threats to species in New Zealand, but up to 90 percent of threats in Mongolia. The production of food crops has approximately twice as much impact on mammals, birds and amphibian biodiversity than livestock production:

70 percent vs. 33 percent of threats to species, respectively (Figure 36). This difference is striking and partly reflects the fact that rangelands, especially low-input and low density ones, promote habitat diversity, making them relatively biodiversity-friendly.

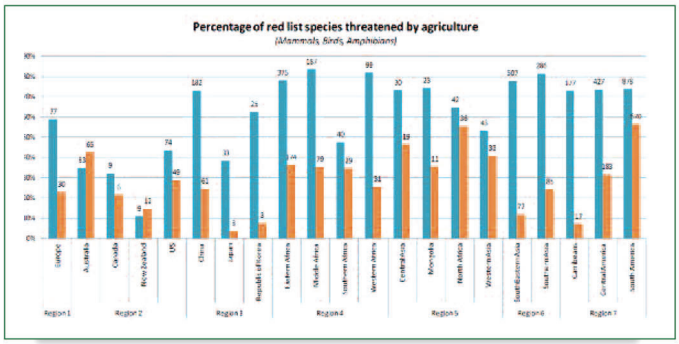
Overall, mammals, birds and amphibians show similar responses to food production activities. However, bird species appear especially vulnerable to food production activities in tropical and sub-tropical regions, probably because of the relatively high number of forest-dependent species in this group. Mammals tend to be less vulnerable than the other two taxonomic groups.

Figure 35: Percentage of Red List species of Birds, Mammals and Amphibians that are threatened by agriculture (both crops and livestock). The number of threatened species is indicated above the bars



The Marine Tropic Index measures the degree to which countries are "fishing down the food chain," with fish catches increasingly consisting of smaller fish that are lower in the food chain. The average mean trophic level has been declining in most LMEs since 1950 (Figures 37 and 38), but this decline occurs at very different rates in different seas and regions. Middle- and high-income regions which have a diversity of seas (i.e. Europe, NA&Oce, Ind. Asia) have approximately two thirds of their seas showing declining trends in MTI since 1950. This is likely due to the importance of commercial fishing and its impacts on the food webs. For example, in the Humboldt current (i.e. NA&Oce), MTI plummeted as soon as fisheries of anchoveta, a low trophic level species, took-off in 1955. In contrast, developing regions with few seas (i.e. SSA, NA,WA&CA, S&SE Asia) show relatively stable or positive trends in MTI since 1950.

Figure 36: Percentage of Red List species of Birds, Mammals and Amphibians that are threatened by crop production (blue bars) and livestock farming (orange bars). The number of threatened species is indicated above the bars



This probably reflects the fact that fishing mostly occurs at artisanal or subsistence levels in these areas. Developed regions (i.e. Europe, NA&Oce, LA) also show a number of stable or increasing trends in MTI values, that may in some cases reflect the uptake of more sustainable fishing practices, but also mask some biodiversity declines. For instance, in the Agulhas current (LA), the sharp increase in mean trophic level since the 1970s reflects the collapse of the fisheries for pilchard and anchovies, which are two low trophic level species[14].

These biodiversity impacts can then be linked to food wastage through the production phase for each commodity and region to detect hotspots of biodiversity impacts. In some cases, the greatest biodiversity impacts are for those commodities and regions which also have the greatest amounts of food wasted and/or largest environmental impacts. For example, cereal production is a main cause of food wastage in most regions, probably constituting the main threat to biodiversity, both in terms of deforestation and species' threats. This is due to the large extents of land that need to be converted for their production, usually leading to simplification and degradation of habitats. The hostpots of biodiversity impacts linked to crop production are located around the tropics, which is both a global biodiversity hotspot that, in re-

14 http://www.lme.noaa.gov

cent years, has also experienced the most rapid agricultural expansion. Wastage of cereals in S&SE Asia is thus expected to be an important threat to biodiversity (as for other environmental components), due to related deforestation (Figure 34). More generally, important food crops in LA and SSA, such as cassava, rice, maize are continuing causes of deforestation (Figure 34).

More locally, starchy roots can represent important volumes of wastage, but they do not translate into large environmental impacts. However, they may sometimes lead to significant biodiversity impacts. For example, cassava in Thailand and Brazil is increasingly grown in large scale monocultures and it is a cause of deforestation in central Africa (Phalan et al. 2013).

In contrast, while vegetable and fruit production is a considerable source of food wastage, especially in the tropics, with large water footprint, it is likely to have relatively less important impacts on biodiversity than cereal production. Fruits and vegetables are usually grown on smaller scales and involve a diversity of crop types, which may contribute to maintaining a certain habitat diversity.

There may also be some trade-offs between the quantities of food wasted and their impact on biodiversity. Meat, fish and seafood, and oilcrops and pulses represent small volumes of food wastage in all regions. However, they represent important production volumes and intensities and thus, have considerable impacts on biodiversity. Fisheries have been declining or collapsing in most regions, largely as a result of the over-exploitation of fish stocks by large commercial fisheries (Figures 37 and 38). Likewise, while oilcrops and pulses are not important in terms of food wastage, when grown in large scales plantations, their impacts on biodiversity are similar to those of cereals.

Meat wastage actually has overall high environmental impacts because of its land take, and the main producing regions (i.e. Europe, NA&Oce and LA) are expected to also experience high biodiversity impacts. While species threats due to livestock production represent only a third of those induced by agricultural crops (Figure 36), they remain significant. There are higher in developing regions, and LA is a likely biodiversity hotspot of meat wastage. Indeed, in LA, most new agricultural land is cleared for cattle pastures, leading to increasing habitat fragmentation and degradation, resulting in biodiversity declines.

Figure 37: Average change in mean trophic level since 1950 in selected Large Marine Ecosystems (LMEs) of Europe, NA&Oce and Ind. Asia. The percent change is indicated above the bars, blue bars represent significant changes, while red bars represent non-significant changes

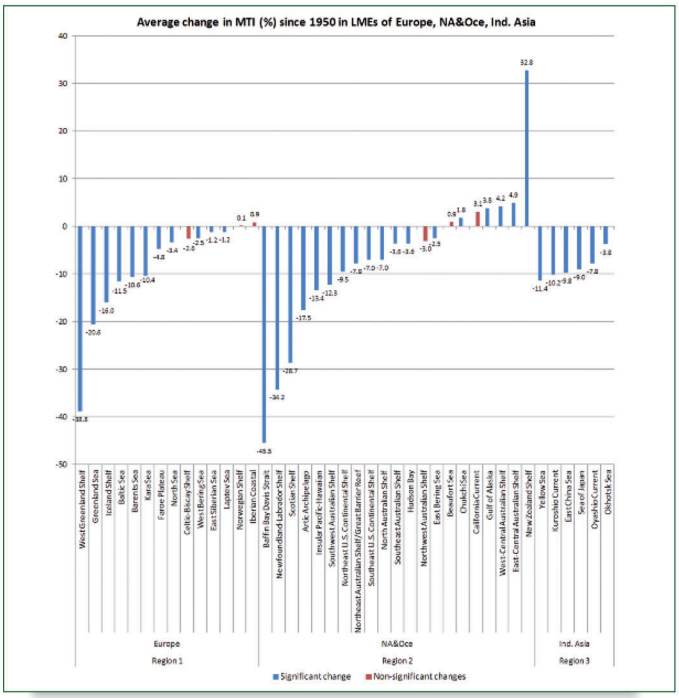
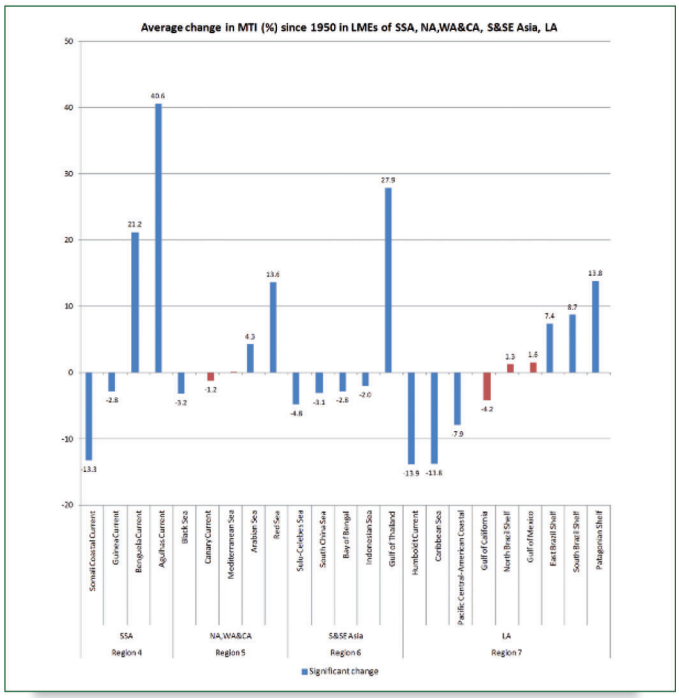


Figure 38: Average change in mean trophic level since 1950 in selected Large Marine Ecosystems (LMEs) of SSA, NA, WA&CA, S&SE Asia, and LA. The percent change is indicated above the bars, blue bars represent significant changes, while red bars represent non-significant changes



Economic assessment

Method

The economic cost of food wastage is based on 2009 producer prices, taken from FAO's PriceSTAT database which provides a dataset of prices for about 180 agricultural products and more than 100 countries. In practice, about 3,800 values for specific "country*products prices" were used. This dataset provides a large vision of producer prices distribution at the world level. The data available are the prices at the agricultural phase (farmgate, expressed in USD/tonne). Due to the lack of data on prices, economic costs for fish and seafood were not accounted for.

Results overview

Besides its environmental cost, food wastage also represents a loss of economic value. On a global scale, the economic cost, based on 2009 producer prices, of the overall amount of food wastage in year 2007 totalled about USD 750 billion. This is approximately the GDP of Turkey or Switzerland in 2011[15].

Figure 39 shows vegetables as the major contributors to the economic cost of food lost and wasted (23 percent of total cost), followed by meat (21 percent), fruits (19 percent) and cereals (18 percent). Meat's contribution to the total cost of food wastage is clearly driven by its high producer cost per kilogram. Indeed, meat accounts for about 4 percent[16] of total food wastage, but for about 20 percent of the total economic costs of this wastage. On the other hand, cereals contribution to total cost is mostly driven by high food wastage volumes. For fruits and vegetables, prices and volumes have a balanced contribution but it appears that average producer prices are higher for fruits.

Figure 40 illustrates that food wastage volumes and economic cost have relatively comparable regional distribution. The major contributors are Ind. Asia (31 percent of total) and S&SE Asia (18 percent), the two regions that are also the largest contributors to food wastage volumes. However, these values are very low estimates, especially in high-income countries, as they only integrate producer prices.

15 UNStats, GDP of countries. Available at: http://unstats.un.org/unsd/snaama/Introduction.asp
16 Excluding fish and seafood in order to allow a comparison on the same grounds.

Figure 39: Contribution of each commodity to food wastage and economic cost

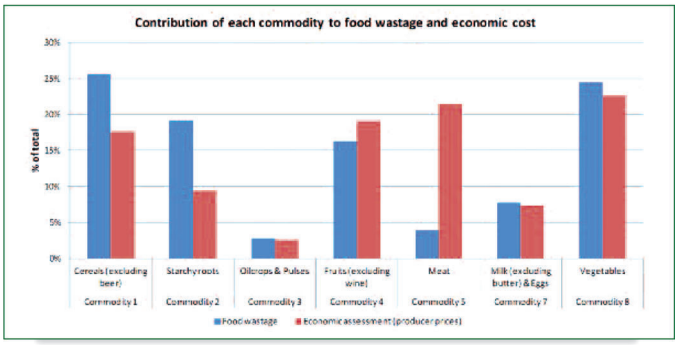
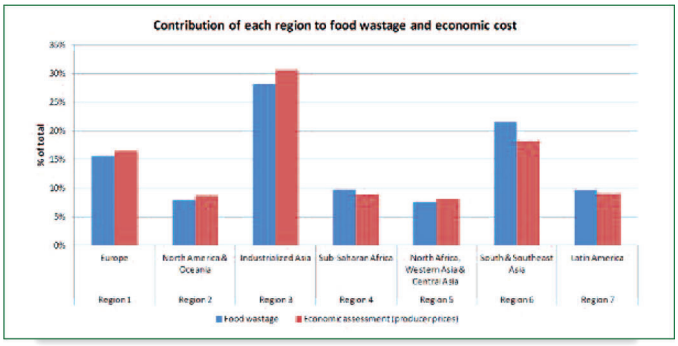


Figure 40: Contribution of each region to food wastage and economic cost



Cross-analysis and key findings

Table 3 presents a cross-analysis of all quantifiable environmental components. All the "region*commodity" pairs that appeared in the top 10 for carbon, blue water or land occupation (arable or non-arable) are presented here with their contribution to total food wastage[17].

Table 3: Cross-analysis of all environmental components, by "Region*Commodity" pairs. In each column: contribution to total in percent and ranking from 1 to 10 (or 5) in bold

Region * commodity	Volume		Carbon		Blue water		Arable		Non-arable land	
Ind. Asia * Veg.	11.2%	1	10.0%	3						
Ind. Asia * Cereals	7.8%	2	14.4%	1	13.2%	2	5.4%	5		
S&SE Asia * Cereals	7.8%	3	11.1%	2	24.2%	1	9.3%	2		
SSA * SR	5.3%	4								
Ind. Asia * SR	4.5%	5								
Europe * SR	4.0%	6								
S&SE Asia * Veg.	3.9%	7	2.8%	10						
S&SE Asia * Fruits	3.6%	8			4.5%	4				
LA * Fruits	3.4%	9			3.3%	6				
Europe * Cereals	3.3%	10	3.3%	9						
Europe * Veg.	3.1%		4.2%	8						
NA,WA&CA * Veg.	2.7%				2.7%	10				
Ind. Asia * Fruits	2.7%				3.2%	7				
Europe * Fruits	2.6%				3.0%	9				
Europe * Meat & Milk	2.3%		5.2%	5			5.1%	7		
S&SE Asia * Meat & Milk	2.3%				3.4%	5	5.4%	4	16.7%	2
NA,WA&CA * Cereals	2.0%				7.8%	3	3.8%	8		
NA&Oce * Meat & Milk	2.0%		5.2%	6			3.7%	10	8.4%	5
LA * Meat & Milk	1.5%		4.9%	7			6.9%	3		
Ind. Asia * Meat & Milk	1.5%		5.3%	4			11.5%	1	11.3%	4
S&SE Asia * O&P	1.3%				3.2%	8				
SSA * Cereals	1.3%						3.7%	9		
NA,WA&CA * Meat & Milk	0.9%								33.2%	1
SSA * Meat & Milk	0.5%						5.4%	6	13.1%	3
Total top 10	**55%**		**64%**		**68%**		**60%**		**83%**	

17 Excluding fish and seafood, in order to allow a comparison on the same grounds. This is why percentages presented here for food wastage volumes and carbon are not exactly similar to those presented in Figure 14.

While from an environmental assessment perspective, combining environmental impacts to define a ranking of hotspots is precarious, it is nevertheless possible to distinguish a number of key findings, as follows:

- Cereal wastage in Asia emerges as a significant environmental hotspot, with major impacts on carbon, blue water and arable land. The relative importance of rice is underlined, given its high carbon intensity, combined with high levels of wastage. While cereal wastage is similar in Ind. Asia and S&SE Asia, the overall carbon footprint is higher in the former, as more cereals are wasted at the consumption phase. However, higher yields for rice and wheat result in a lower water footprint and lower land occupation in Ind. Asia: less land is being used for the same level of production. This echoes a broadly recognizable global pattern: high efficiency and high consumer level waste in middle- and high-income regions versus lower production efficiency and lower consumer level waste in low-income regions. The main contributing crops in this hotspot identification are rice and wheat. Rice emerges as an important element, with high carbon intensity and high levels of wastage. Rice crops emit CH_4 because of the decomposition of organic matter in flooded paddy fields and thus, has higher impact factors compared to other cereals. In terms of land occupation and water footprints, the impacts of rice and wheat are more similar. It can be noted that India and China are the major contributors of the water footprint of cereals in their respective regions.
- Meat has high impacts in terms of land occupation and carbon footprint, making it a major environmental hotspot, although wastage volumes in all regions are comparatively low. Meat is a carbon hotspot in high-income regions and Latin America. In absolute terms, more meat is produced, consumed and wasted in high-income regions (in particular at consumption phase) and Latin America compared with low-income regions. High-income regions and Latin America account for 80 percent of meat wastage. Regarding land occupation, the observed variability across regions for the contribution of arable or non-arable land is due to differences in production systems. This can include composition of feeding rations and amount of land required to produce the constituents of the ration.
- Fruit wastage emerges as a blue water hotspot in Asia, Latin America and Europe, but it is linked more to food wastage volumes than to the blue water intensity of the commodity. Due to data limitations, FAOSTAT identifies a particularly voluminous category in its Food Balance Sheets as "other fruits", which prevents detailing this hotspot by key crop.
- The carbon footprint of vegetables singles them out as a hotspot in Ind. Asia, Europe, and S&SE Asia, mainly due to large food wastage volumes. Nevertheless, some differences in terms of carbon intensity can be seen between regions. For instance, it is likely that the carbon intensity of vegetables wastage is higher in Europe, due to the fact that a higher share of vegetables is grown in heated greenhouses. It can be noted that some assumptions had to be made on these aspects.
- Starchy roots, although experiencing high volumes of wastage in SSA, Europe and Ind. Asia, never appear in impacts top 10. This commodity actually has low carbon, water and land intensity, mostly because yields are high, thus limiting the impacts per kg.

Potential improvement areas

Food wastage percentage

This study quantifies food wastage volumes by applying waste percentages to Food Balance Sheets data. These percentages of food lost and wasted have been gathered based on a thorough literature search, carried-out for the FAO (2011) study. The authors also had to make a number of assumptions for remaining data gaps, most notably for low-income regions. To date, no database consolidates worldwide statistics on food wastage which would provide harmonized datasets for analysis. The prerequisite for developing such a global tool is to have harmonized definitions of the major concepts linked to food loss and waste.

Quantifications of environmental impacts

Due to a lack of data or other methodological constraints, a number of assumptions had to be made to quantify environmental impacts. In some cases, certain aspects of the environmental footprint could not be taken into account, such as land occupation and water footprint relating to non-agricultural phases. All these aspects offer room for improvement. In particular, priority should be given in further research to the integration of land use change in carbon footprint accounting. Moreover, the sources of uncertainty are manifold in this study, since each input of the FWF model has an attached uncertainty. Integrating an uncertainty calculation module in the model would be a valuable option to support analyses of the outcomes of the model.

Biodiversity

The biodiversity impacts of food wastage have only been estimated semi-quantitatively, by identifying the regions where food production is likely to have the greatest impacts on biodiversity. Further research would be needed to clarify the biodiversity impacts of food throughout the supply chain, including trade issues. This could be achieved through advances towards the inclusion of biodiversity impacts in life-cycle analysis tools, or multiregional input-output approaches.

Economic assessment

The economic component of this study is a first step that calls for further research to quantify the costs along the food supply chain. In addition, the environmental cost of lost natural resources due to food wastage could be taken into account in future work. For instance, the blue water wasted in a given year might not have the same economic, social and/or environmental cost in future years.

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REGENERATIVE AGRICULTURE *and the* SOIL CARBON SOLUTION

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RODALE INSTITUTE

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REGENERATIVE AGRICULTURE IS A WIN-WIN-WIN CLIMATE SOLUTION

that is ready for widescale implementation now.

WHAT ARE WE WAITING FOR?

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EXECUTIVE SUMMARY

The way we manage agricultural land matters. It matters to people, it matters to our society, and it matters to the climate.

In 2014, Rodale Institute released its landmark white paper entitled "Regenerative Organic Agriculture and Climate Change: A Down-to-Earth Solution to Global Warming." That white paper was unquestionably influential: it stimulated corporate and governmental adoption of regenerative agriculture, it inspired many farming organizations and farmers to adopt regenerative practices, and it accelerated the recognition that agriculture done properly must be part of an effective global response to our climate crisis. However, while the 2014 paper was a necessary wake-up call, it was not sufficiently effective because change hasn't happened fast enough. The ecological meltdown is accelerating. And its accelerating to a place where we now face the very real challenge of being able to grow enough nourishing food to support the ever-increasing human population. On World Soil Day in 2015, the Food and Agricultural Organization of the United Nations provocatively summed it up by stating "we have about 60 years of harvests left—and then?"

This deteriorating planetary condition, along with a deepening scientific understanding of and support for regenerative agriculture, is the ecological context for this new white paper. Farmers, ranchers, agronomists, and academic researchers have been on task for these past six years, and their great strides alone support the issuance of a fresh assessment of the state of science and practice.

Any success the 2014 white paper had must be viewed in a grim planetary context: in 2014, there were 397 parts per million (ppm) of atmospheric CO_2, while today the Earth is burdened with 416 ppm. Every ppm of atmospheric CO_2 correlates to the release of 2 billion tons of terrestrial carbon, so those nineteen parts per million since 2014 represent the transfer of 38 billion additional tons of carbon from below ground to the atmosphere.

Continuing the climate math, carbon dioxide is 3.67 times the weight of carbon, so this transfer of 38 billion tons of below-ground carbon resulted in the deposition of approximately 140 billion new tons of CO_2 contamination to the blanket of greenhouse gases already overheating our planet. There is no quarreling with this simple but deadly math: the data are unassailable. The World Climate Research Programme, in July 2020, projected that current CO_2 trends would "likely reach the doubling of pre-industrial ppm of CO_2 by 2060,"—up to 560 ppm. As a consequence, that body of distinguished scientists predicted our planet will likely see increased warming in the range of 2.6 °C to 3.9 °C. That magnitude of temperature increase is incompatible with the continuation of life as we know it. We will, if trends are not reversed, cease to inhabit a livable planet.

> ***This paper is not merely a revisiting of the problem or yet another dire report on the state of our planetary health. It is not another "wake up call" asking the reader to pay attention to the science or the climate change we can all see and feel around us. It is an invitation.***

While the planet continues to overheat, conventional agricultural production systems and arable land misuse have, over time, degraded approximately 75% of the Earth's land areas. On top of that existing degradation, we are now losing an estimated 36 billion tons of soil every year, based on the 2017 consensus estimate of the European Commission Joint Research Centre. Once again, using simple but deadly math, this suggests that since 2014 (when the previous white paper was published) the planet has lost more than 200 billion tons of soil, or approximately 26 tons of topsoil for every human. As a global society, we continue to trade our soil and our future for short-term profits and status quo production models.

The environmental impacts of agricultural practices and translocation of carbon from terrestrial pools to atmospheric pools can be seen and felt across a broad spectrum of planetary species. Recent studies declared that we're experiencing a biodiversity apocalypse, with 1,000,000 species at serious risk of extinction due to climate crisis and habitat loss. Couple that biodiversity collapse with the extreme water stress afflicting as many as seventeen nations (with a combined population of approximately 1.7 billion people), and it becomes clear that much of our planet is degraded.

This paper is not merely a revisiting of the problem or yet another dire report on the state of our planetary health. It is not another "wake up call" asking the reader to pay attention to the science or the climate crisis we can all see and feel around us. It is an invitation. An invitation to journey in a new direction. It is intended to be both a road map to change and a call to action to follow a new path. One led by science and blazed by farmers and ranchers across the globe. Blessed with committed soil scientists and the talents of agricultural expert Dr. Jennifer Hayden, Rodale Institute has taken another look at the developing science—and calls upon the reader to take positive steps towards impactful change.

Based on peer-reviewed research and the seasoned observations of agronomists working around the world, this white paper confidently declares that **global adoption of regenerative practices across both grasslands and arable acreage could sequester more than 100% of current anthropogenic emissions of CO_2** and that stable soil carbon can be built quickly enough to result in a rapid drawdown of atmospheric carbon dioxide. We now know enough to have real hope, and with this hope comes the responsibility to journey down a new path.

This introduction is co-authored by representatives of two formative organizations in the regenerative movement. This white paper reflects the Rodale Institute's unique perspective on regenerative agriculture. The DNA of the Rodale Institute is both regenerative and organic, and The Carbon Underground is honored to support Rodale Institute's great legacy. Our organizations do not align on every nuance of what it means to be regenerative, as reflected in the two standards, Regenerative Organic Certified™, and the Soil Carbon Index, associated with Rodale Institute and The Carbon Underground, respectively. While those standards differ in some important respects, we believe that what unites them is far more important than what separates them, and from a carbon perspective, these standards are best understood as complementary, not competitive. The regenerative movement is an ecosystem of involved farmers, ranchers, scientists, governments, and NGOs, and like all ecosystems it is enhanced by robust collaborative diversity.

Together we both sound the alarm and proclaim the regenerative farming solution: It's time to start our journey with a brighter future for our planet and ourselves as the destination.

JEFF MOYER
Chief Executive Officer, Rodale Institute

TOM NEWMARK
Co-Founder & Chair, The Carbon Underground

INTRODUCTION

Human activities radically alter the planet—a power that comes with a responsibility. Dominant societal narratives still favor economic rewards even as the climate crisis and multiple other interconnected environmental disasters shock our planet. Earth has a big say in what happens, but the planet needs us to cooperate in its healing for the sake of humans and all life. Rachel Carson predicted this moment in 1962, and yet her words remind us that it's not too late to change course:

> ***"We stand now where two roads diverge. But unlike the roads in Robert Frost's familiar poem, they are not equally fair. The road we have long been traveling is deceptively easy, a smooth superhighway on which we progress with great speed, but at its end lies disaster. The other fork of the road — the one less traveled by—offers our last, our only chance to reach a destination that ensures the preservation of the earth."***
>
> —Rachel Carson in the Introduction to Silent Spring [3]

The globally connected food and farming system succeeds in producing an enormous oversupply of foodstuffs unimaginable to our great-grandparents because we've focused on calorie yields. It's no surprise to anyone paying attention that this carbohydrate abundance comes at a high price: widespread degradation of land, water and air; biodiversity and ecosystem losses; continued hunger and nutritional deficiencies paired with a rapid rise in obesity and related diseases; and destruction of rural communities and farmer livelihoods around the world [2]. The dominant farming system relies on synthetic and proprietary inputs that increase in cost every year, while commodity crop prices stagnate and soils deteriorate. These problems arise from chemical-based forms of agriculture, crop monocultures, and mismanagement of livestock, which now cover what were once the world's most fertile agricultural lands:

> ***"The uniformity at the heart of these systems, and their reliance on chemical fertilizers, pesticides and preventive use of antibiotics, leads systematically to negative outcomes and vulnerabilities." [4]***

Finca Luna Nueva farm in Costa Rica uses a syntropic farming system on newly established cacao fields, incorporating a diversity of plant species.

What is Regenerative Agriculture?

Regenerative agriculture is a system of farming principles that rehabilitates the entire ecosystem and enhances natural resources, rather than depleting them.

Robert Rodale, son of American organic pioneer J.I. Rodale, used the term 'regenerative' to distinguish a kind of farming that goes beyond simply 'sustainable.' Regenerative agriculture:

> ***"...takes advantage of the natural tendencies of ecosystems to regenerate when disturbed. In that primary sense it is distinguished from other types of agriculture that either oppose or ignore the value of those natural tendencies." [9]***

Regenerative agriculture is marked by working to achieve closed nutrient loops, reduction or elimination of biocidal chemicals, greater crop and biological diversity, fewer annuals and more perennials, and practices that mimic natural ecological processes. Some leaders of the movement also believe regenerative agriculture should extend beyond our treatment of natural resources and include commitments to animal welfare and social fairness. These pillars are included in the Regenerative Organic Certification [see page 23].

At the same time, the climate crisis bears down. A decade ago, the United Nations Environment Program (UNEP) said we needed to limit greenhouse gas emissions to 44 gigatons of carbon dioxide equivalent (44 $GtCO_2e$) by 2020 [5]. If we did nothing new to mitigate climate crisis, projections suggested that by 2020 annual emissions might be 56 $GtCO_2e$, leaving a gap of 12 $GtCO_2e$ between the carbon already in the atmosphere and our desire to continue living normally on Earth [5].

> ***The solution is farming. Not just business-as-usual industrial farming, but farming like the Earth matters.***

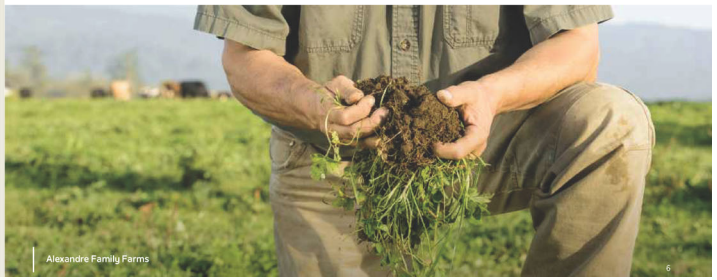
In 2018, total global emissions were 55.3 $GtCO_2e$—approaching the worst case scenario [6]. (A seven percent reduction every year for the next decade is needed to limit warming to 1.5°C) [6]. What's more, "**accelerated soil erosion may be the second largest source of anthropogenic emissions of greenhouse gases, and its credible estimates are not known**" [7]. We spent the last decade walking a path to a precipice. The emissions cuts needed now "may seem impossible," says Inger Andersen, the Executive Director of the UNEP, "but we have to try" [6].

And yet, there is hope right beneath our feet. There is a biotechnology for massive planetary rehabilitation that is tested and available for widespread dissemination right now. The cost is minimal and it is adaptable to local contexts the world over. It can be rolled out tomorrow providing multiple benefits beyond climate stabilization. The solution is farming. Not just business-as-usual industrial farming, but farming like the Earth matters. Farming in a way that restores the quality of soil, water, air, ecosystems, animals, and ultimately humanity. Farming that improves our soil's natural ability to function so the planet and all of its life can also function. This kind of farming is called regenerative agriculture.

Regenerative agriculture revitalizes land. It's a systems approach where farmers work with nature, not against it. It's a biological model based on principles of ecology. With the farmer's help, farm and rangeland can lock carbon underground, thereby restoring degraded soils, addressing food insecurity, and mitigating the impacts of the climate crisis on food production. Regenerative agriculture is also our best hope for a quick drawdown of atmospheric carbon dioxide. Let us learn from regenerative farmers who have been cooperating with nature, who have "solved for pattern" [8]. Their results are the inspiration that will fuel a wholesale shift away from the failed era of sustainability to a golden age of regeneration.

Agricultural Emissions

Agriculture as practiced across most of the world is not yet part of the solution—it's part of the problem. Rather than mitigating the climate crisis, it is a net producer of greenhouse gas emissions both directly through conventional industrial farming practices, and indirectly through land-use change and the greater food system [10]. Agriculture production accounts for around ten percent of annual emissions (6.2 Gt CO_2e) [11]. **The food system at large, including fertilizer and pesticide manufacture, processing, transportation, refrigeration and waste disposal, accounts for 30% or more of total annual emissions [11].**



Alexandre Family Farms

With the widespread industrialization of farming in the mid-20th century, contemporary agricultural practices, such as synthetic fertilizers, pesticides, intensive tillage, monocropping, and yield-based management systems, accelerated the depletion of soil carbon stocks [10,12]. Most agricultural soils have lost from 30% to 75% of their original soil organic carbon to the atmosphere due to conventional farming practices [13]. Two-thirds of the world's corn and wheat cropland now have less than two percent soil organic carbon [14]. Nitrous oxide emissions have been rising due to nitrogen fertilizer over-use [11], and the intensification of livestock and rice production has exacerbated release of methane (CH4) [11].

Yet, there is hope. These degraded soils hold the promise for regeneration. Degraded farm soils are some of the best soils on the planet to achieve carbon drawdown: they are already highly managed, they're accessible, and they have the capacity to hold a lot of carbon—all it takes are management changes to make this happen. While soils are inherently different, agricultural soils were chosen because they are productive and they have the natural capacity to store carbon over long timescales.

Regenerative agriculture, with its focus on achieving positive ecosystem outcomes, can be practiced under many names: agroecology, organic, biodynamic, holistic, conservation, permaculture, management intensive grazing, agroforestry and more. There won't be a one-size-fits-all approach for regeneration of degraded farm and rangeland, but the vanguard of regenerative farmers and researchers know enough now to provide guidance for each farm given its specific physical, environmental, social and economic contexts. Farming in ways that sequester carbon is not just possible in many places, it's already happening across the world.

Soil Carbon Sequestration

Globally, soil organic matter contains three to four times as much carbon as either the atmosphere or terrestrial vegetation [5,14]. Even small changes in soil carbon can lead to large changes in the atmospheric concentration of carbon dioxide, either for better or for worse [5]. The UNEP is unequivocal:

> *"To close the emissions gap, land use must transition rapidly from being a net source of emissions to a net sink." [4]*

Improved management of farm and ranchland with known, low-cost practices can both reduce greenhouse gas emissions and remove carbon dioxide from the atmosphere [8,15]. **Soil carbon sequestration works with biodiversity above and below ground—in plant and soil life—to capture carbon dioxide with photosynthesis, drawing it down underground as soil carbon, and locking it in soil organic matter through microorganism and mineral associations.**

If carbon sequestration rates attained by exemplary cases were achieved on crop and pastureland across the globe, regenerative agriculture would sequester more than our current annual carbon dioxide (CO_2) emissions (Figure 1, page 10), providing a mechanism to meet global carbon emissions goals, drawdown legacy carbon dioxide, and give us the time needed to bring emissions from other sectors in to balance.

Greenhouse Gases

The three most abundant greenhouse gases are carbon dioxide (CO_2), methane (CH4) and nitrous oxide (N_2O). Total greenhouse gas emissions are often expressed in a unit called carbon dioxide equivalent, or CO_2e. This unit puts all greenhouse gas emissions on a level field by expressing them in terms of the amount of carbon dioxide that would have the same global warming effect. In 2018, 55.3 Gt CO_2e were emitted. More than 2/3 of total emissions come from carbon dioxide alone: 37.5 $GtCO_2$.

Nearly 1 trillion metric tons of carbon emissions have accumulated in the atmosphere, leading to CO_2 concentrations of 407 ppm in 2018—47% above pre-industrial levels [13]. Soil carbon sequestration focuses on removing carbon dioxide from the atmosphere, but regenerative farming systems also reduce emissions of carbon dioxide, nitrous oxide and methane.

Degraded farm soils are some of the best soils on the planet to achieve carbon drawdown.

A POTENT CORRECTIVE

In 2018, global emissions of greenhouse gases were 55.3 metric gigatons (Gt CO_2e). The vast majority of these emissions—37.5 Gt—come from carbon dioxide, which could be reduced significantly by regenerative agriculture [4]. **Data from farming and grazing studies show the power of exemplary regenerative systems that, if achieved globally, would drawdown more than 100% of current annual CO_2 emissions.** Global extrapolations of carbon sequestration rates recorded by agricultural scientists in Table 1 are provided as a thought experiment showing the power of regenerative agriculture to drawdown atmospheric carbon dioxide.

TABLE 1: Carbon Sequestration Potentials

PLACE/STUDY	MANAGEMENT PRACTICES	MAIN CROP	CARBON SEQUESTRATION (Mg ha^{-1} yr^{-1})		GLOBAL EXTRAPOLATION[b] (Gt CO_2 yr^{-1})	
			C[a]	CO_2	CO_2	% CO_2 Offset
Cropland – accounts for approximately 30% of arable farmed land						
Global [16]	Cover crops *(global metanalysis)*	Various	0.32	1.17	1.63	4.35
US, Mid-Atlantic [17]	Regenerative organic system - diverse rotation	Grain crop rotation	0.85	3.12	4.34	11.6
US, Mid-Atlantic [18]	Regenerative organic system - compost utilization	Corn & Wheat	2.36	8.66	12.04	32.11
Costa Rica [19]	Multistrata agroforestry	Cacao & Poro	4.16	15.27	21.23	56.61
Mediterranean [20]	Organic amendments	Olives	5.3	19.45	27.05	72.13
Global Tropical* [21]	Cover crops and green manure	Corn	5.8	21.28	29.60	78.93
US, Southwest* [22]	Fungal compost *(BEAM system)*	Carbon *(no traditional crop)*	10.27	37.69	52.41	139.76
Grazing or rangeland – accounts for approximately 70% of arable farmed land						
US, Midwest [23]	Regenerative grazing system (AMP)	Beef	3.59	13.17	43.04	114.77
US, Southeast [24]	Rotational grazing	Dairy	8.0	29.36	133.37	355.65

[a] C is change in soil carbon in (Mg ha-1 yr-1) and CO2 is the equivalent of C as carbon dioxide.
[b] Total potential carbon sequestration in Gigatons (Gt) if all global cropland or grazing land converted to the respective regenerative system and percentage of carbon dioxide offset from 37.5 Gt CO2e global annual greenhouse gas emissions [4].
*Not peer-reviewed.

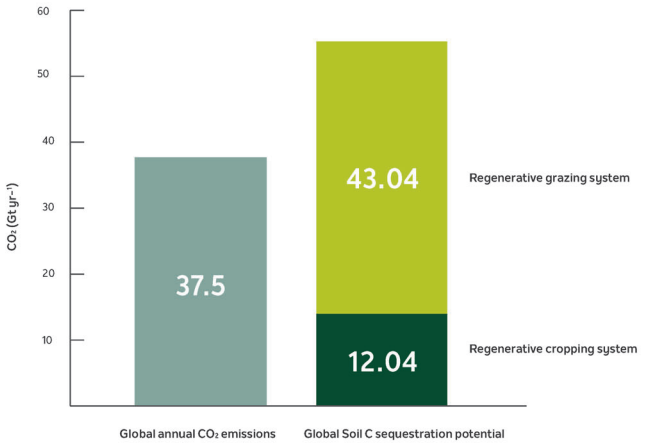
If only cover crops were adopted in otherwise conventional systems across all cropland [16] ~4% of annual CO_2 emissions might be sequestered. However, by bundling practices, if management of all current cropland shifted to a regenerative system like the Mid-Atlantic site [18] we could potentially sequester 8 times more than cover crops alone, or 32% of annual CO_2 emissions (~12 Gt CO_2). And, if all global pasture was managed to a regenerative model like the Midwestern US study [23], an additional 114% of all annual CO_2 emissions (~43 Gt CO_2) might be sequestered.

By those calculations, shifting both crop and pasture management globally to regenerative systems is a powerful combination that could drawdown more than 100% of annual CO_2 emissions (Figure 1), pulling carbon from the atmosphere and storing it in the soil.

While the thought experiment shows us the potential for soil carbon sequestration, soils are varied and it is unlikely that we can achieve such a sweeping shift in agricultural production quickly. But even small changes will have an impact—the Intergovernmental Panel on Climate Change (IPCC) reports "high confidence" in the evidence for soil carbon sequestration as an atmospheric carbon dioxide removal strategy [9].

There is a clear opportunity to restore degraded soils by capturing atmospheric carbon through regenerative agriculture. Investing in human capacity, knowledge infrastructure and safe, proven agricultural techniques can produce the change we need to stabilize the climate while providing significant co-benefits to farmers and consumers everywhere.

FIGURE 1: Carbon sequestration potential of global adoption of regenerative agriculture



REGENERATIVE PRINCIPLES *for* SOIL HEALTH *and* CARBON SEQUESTRATION

Regenerative agriculture is a systems approach to farming that builds soil health by supporting biodiversity above and below ground to return carbon and nutrients back to the soil.

Biodiversity is the primary driver of soil carbon sequestration and many more farm and ecosystem benefits [25]. Soil organic carbon, and the soil organic matter in which it resides, are vital to plant growth by mediating soil aggregation, temperature, water infiltration and retention, and nutrient cycling. Soil organic matter also aids ecosystem services: reducing erosion, filtering pollutants, and providing habitat and food for diverse species.

Without sufficient organic matter, soil cannot support microbial life or plant life without vast amounts of imported inputs. Two-thirds of conventional corn and wheat cropland soils have been depleted to less than two percent organic matter [12], limiting yields and requiring injections of chemical inputs. This is food production on life support, ignoring the vast potential for creating healthy food by healing the land. But there is another way. As J.I. Rodale, a founder of the organic movement in America, wrote on a blackboard in 1942:

Healthy Soil = Healthy Food = Healthy People

Crop and rangeland can be regenerated, soil organic matter can be recovered and soil life can thrive again—through regenerative agriculture.

While regenerative agriculture has to be a place-based, customized, systems approach, there are certain interlinked practices that are part of most regenerative systems.

These practices alone do not signify regeneration—they are a starting point, not the end point. At a minimum, regenerative agricultural practices that support soil carbon sequestration include:

1. Diversifying crop rotations
2. Planting cover crops, green manures, and perennials
3. Retaining crop residues
4. Using natural sources of fertilizer, such as compost
5. Employing highly managed grazing and/or integrating crops and livestock
6. Reducing tillage frequency and depth
7. Eliminating synthetic chemicals

Regenerative agriculture is focused on outcomes and practices that ensure outcomes: these interlinked practices support soil life and minimize erosion by retaining biomass from a wide variety of living and dead roots, shoots, and microbes, which work together to sequester carbon [8,26].

While most of the practices that enable soil carbon sequestration are associated with regenerative farming systems, they are "best management practices" that can be adapted to any type of farm. However, supporting soil life is not as easy as just adding one practice; the synergies from interlinked practices in an overall system are the key to the biodiversity that sequesters soil carbon [27].

Soil Carbon Sequestration

Soil carbon sequestration means maximizing atmospheric carbon dioxide removal and minimizing soil carbon losses.

For soil carbon sequestration to occur, all of the soil organic carbon sequestered must originate from the atmospheric carbon pool and be transferred into soil organic matter through plants, plant residues, microbial residues, and other organic solids [28].

Soil organic matter, while highly variable, is comprised of about 50% percent soil organic carbon [29].

Photo: Brittany App, Tablas Creek Farm

Carbon Cycle Institute's Carbon Farming Practices

- Mulching/compost application
- Residue and Tillage Management
- Anaerobic Digester
- Multi-Story Cropping
- Windbreak/Shelterbelt Establishment
- Silvopasture Establishment
- Forage and Biomass Planting
- Nutrient Management
- Tree/Shrub Establishment
- Forest Stand Improvement
- Contour Buffer Strips
- Riparian Restoration
- Riparian Forest Buffer
- Vegetative Barrier
- Windbreak/Shelterbelt Renovation
- Alley Cropping
- Riparian Herbaceous Cover
- Range Planting
- Herbaceous Wind Barriers
- Critical Area Planting
- Forest Slash Treatment
- Filter Strip
- Grassed Waterway
- Hedgerow Planting
- Cross Wind Trap Strips Conservation Cover
- Wetland Restoration

BIODIVERSITY BELOW GROUND

Soil life is exceptionally complex, comprised of a vast community of microscopic bacteria, fungi, protozoa, and nematodes, as well as meso- and macrofauna like arthropods, earthworms, springtails, spiders and insects.

There are billions of these organisms in just one teaspoon of healthy soil. The soil community builds carbon stores through its interactions underground with the soil physical structure, living roots and decomposing organic matter, and aboveground with plants, animals, weather, people and their farming practices.

The abundance and composition of soil life is heavily influenced by the farm system. To harness soil carbon sequestration and its co-benefits, farmers choose interlinking management strategies that increase biodiversity above and below ground. A systematic review of over 50 international studies found nearly 60% more biomass from soil microorganisms in organically managed farm systems versus conventional [30]. The soil life in the organic systems were also over 80% more active than in conventional systems [30]. This is not surprising, as most organic systems, and all regenerative systems, are built on interlinking practices designed to increase biodiversity and support soil health.

Recent research underscores the predominant role of soil microbes in building soil carbon stores. Contrary to previous thought, it's not the recalcitrant plant material that persists and creates long term soil carbon stores, instead it's the microbes who process this plant matter that are most responsible for soil carbon sequestration [31,32]. Stable soil carbon is formed mostly by microbial necromass (dead biomass) bonded to minerals (silt and clay) in the soil. Long term carbon storage is dependent on the protection of the microbially-derived carbon from decomposition. This protection takes place in soil pores in a specific size range of 30-150 micrometers, which are created by roots from diverse polycultures—not from monocrops [33].

This means that to enable soil carbon storage, farmers should focus on encouraging diverse carbon inputs to create pore structures and feeding soil microbes, both of which are achieved with a wide variety of plant roots. These roots help microbes build biomass that becomes necromass-mineral amalgams that store carbon over very long time periods [34].

Feeding soil life to encourage biodiversity and abundance means managing the farm so that there are living roots in the ground for as much of the year as possible. Roots aid soil health by directly feeding microbes with their exudates including sugars, amino acids, and organic acids, by creating the right kind of soil structure to protect carbon, and by partnering with mycorrhizal fungi to store carbon and cycle nutrients [33,35]. As leading soil ecologist Francesca Cotrufo, PhD of Colorado State University says:

> *"It's becoming very clear that in order to regenerate soils, we have to have continuous and diverse inputs, and that mostly comes from living roots."*
>
> —(Cotrufo Interview)

Farmers must also manage microbial carbon use efficiency by applying high-quality plant inputs. When processing plant inputs, microbes simultaneously use carbon for growth and maintenance. Carbon use efficiency is the proportion of a carbon input that microbes assimilate relative to the carbon lost, or respired, out of the system as carbon dioxide [36]. Soil has a conservative carbon to nitrogen ratio of about 10:1. This means that for soil carbon sequestration to occur, every 10 units of carbon require one unit of nitrogen. This explains why high carbon inputs are, counterintuitively, not associated with proportional gains in soil carbon. Applying diverse but low quality (high C:N ratio) inputs (e.g. high proportion of sawdust or woodchips) or cover crops (e.g. cereal only) results in low carbon use efficiency, which causes a larger proportional loss of carbon. These high carbon to nitrogen ratio inputs also put microbes under stress, resulting in nitrogen mining from existing soil organic matter. To avoid this, farmers should include high quality (low C:N) inputs such as legume cover crops and manure, vegetable based, or worm compost, which are more efficient in building carbon.

Plants rely on available nutrients provided by the soil. This nutrient cycle depends on rapid carbon matter turnover by microbes, resulting in particulate organic matter (POM), which does not store carbon over long periods [34]. Managing agricultural soil to increase biodiversity and soil life abundance below ground results in organic matter buildup that stores carbon for the short and long terms. Both types of organic matter are needed for proper ecosystem function, nutrient retention and cycling, and food production.

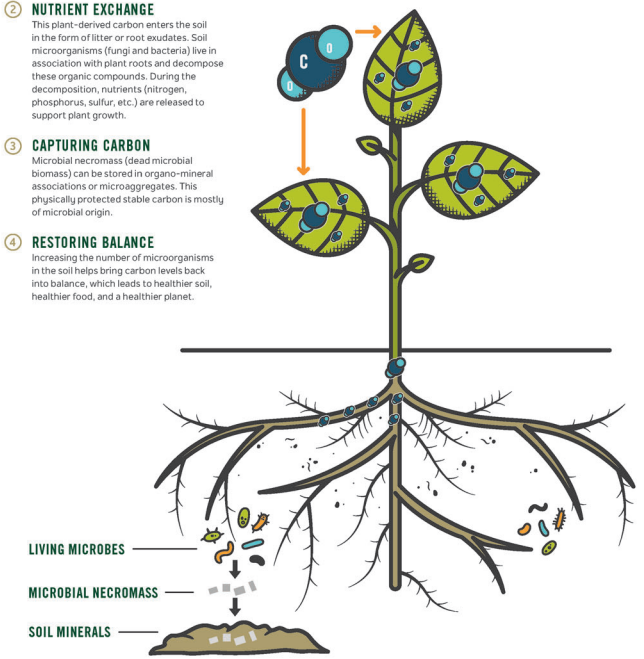
CARBON SEQUESTRATION - HOW IT WORKS

1 PHOTOSYNTHESIS
During photosynthesis, plants convert carbon dioxide (a gas) into sugar (carbohydrate molecules).

2 NUTRIENT EXCHANGE
This plant-derived carbon enters the soil in the form of litter or root exudates. Soil microorganisms (fungi and bacteria) live in association with plant roots and decompose these organic compounds. During the decomposition, nutrients (nitrogen, phosphorus, sulfur, etc.) are released to support plant growth.

3 CAPTURING CARBON
Microbial necromass (dead microbial biomass) can be stored in organo-mineral associations or microaggregates. This physically protected stable carbon is mostly of microbial origin.

4 RESTORING BALANCE
Increasing the number of microorganisms in the soil helps bring carbon levels back into balance, which leads to healthier soil, healthier food, and a healthier planet.



NITROGEN

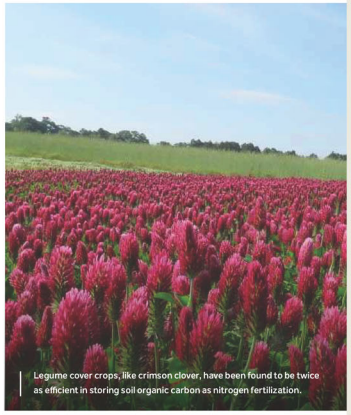
Carbon does not cycle alone. The type of nitrogen used in an agricultural system is linked to the carbon storage capability of that system. Long-term studies demonstrate that providing crop fertility with composts or manures results in increased soil carbon storage, while the use of synthetic fertilty sources results in the loss or no change in soil carbon [37,38]. Organic nitrogen sources support soil carbon sequestration by feeding the microbes responsible for carbon storage. Synthetic nitrogen sources encourage the dominance of bacteria that quickly turn ammonia into nitrate, which is easily respired or otherwise lost from the soil [39–41].

When compost replaces synthetic nitrogen, plants grow more roots.

Reduction of fertilizer nitrogen losses is vital. Less than half of the 109 million metric tons of fossil-fuel-based nitrogen fertilizer used each year is assimilated into crops, the rest is either leached into groundwater creating marine dead zones, or lost as potent nitrous oxide greenhouse gas emissions [42]. In addition, the industrial production of nitrogen fertilizer directly contributes two to three percent of all global greenhouse gas emissions; and the acidification of agricultural soils due to synthetic nitrogen also contributes another two to three percent of emissions [43].

When compost replaces synthetic nitrogen, plants grow more roots, fixing more atmospheric carbon in the process [44]. **Legume cover crops have been found to be twice as efficient in storing soil organic carbon as nitrogen fertilization** [45]. In a multi-decade field experiment comparing soil carbon sequestration and fertilization, organic fertilization significantly improved the capacity of soil organic carbon storage in comparison to chemical fertilization [46]. In a cropping trial of wheat and maize, organic compost led to the formation of long-term carbon storage at the rate of .38 metric tons of carbon per hectare per year, compared to .23 for industrial fertilizers [47]. After 34 years in Rodale Institute's Farming Systems Trial, the organic manure system had between 18 to 21% higher soil organic carbon levels than the conventional system [48]. In this long-term trial, the soil carbon sequestration rate was highest in the first 15 years [17].

Regenerative systems can provide the nitrogen needed for soil carbon sequestration by including nitrogen-fixing legumes and/or trees in the farm plan, making synthetic nitrogen fertilization unnecessary. Legumes planted as cover crops, forage, or cash crops in regenerative systems work with rhizobium, a soil bacterium, to fix atmospheric nitrogen which feeds plants and microorganisms. This nitrogen fixing relationship supports carbon storage while reducing nitrogen losses and environmental damage that comes with synthetic fertilization [49]. Ectomycorrhizal fungi, those associated most with trees, work with bacteria to control the amount of nitrogen available, keeping the soil community in a balance that suppresses carbon respiration and increases soil carbon storage [50–52]. Farmers can encourage atmospheric nitrogen fixation by inoculating legume or tree crops with nitrogen-fixing rhizobia bacteria or ectomycorrhizal fungi.



Legume cover crops, like crimson clover, have been found to be twice as efficient in storing soil organic carbon as nitrogen fertilization.

SPECIAL INSERT: FARMING SYSTEMS TRIAL

RODALE INSTITUTE'S FARMING SYSTEMS TRIAL – EST. 1981

North America's longest-running side-by-side comparison of organic and conventional agriculture.

Rodale Institute has been comparing various grain cropping systems, side-by-side, for more than 40 years. The Farming Systems Trial, divided into 72 plots on 11 acres at Rodale Institute's headquarters in Kutztown, PA, have proven that regenerative practices, including cover cropping, crop rotation, and composting, lead to increased soil health and carbon storage, while producing competitive yields, using less energy, and being more profitable for farmers.

Learn more at RodaleInstitute.org/FST.

Results at a Glance

The FST has shown that, in comparison with conventional methods, organic systems:

- **PRODUCE** competitive yields with a good management plan
- **YIELD** up to 40% more in times of drought
- **EARN** 3-6x greater profits for farmers
- **IMPROVE** soil health and build soil organic matter over time
- **USE** 45% less energy
- **RELEASE** 40% fewer carbon emissions
- **LEACH** no atrazine, a toxic chemical, into waterways

The Systems

CONVENTIONAL SYNTHETIC

This system represents a typical U.S. grain farm. It relies on synthetic nitrogen for fertility, and weeds are controlled by synthetic herbicides selected by and applied at rates recommended by Penn State University Cooperative Extension. GMOs were introduced in 2008.

ORGANIC LEGUME

This system represents an organic cash grain system. It features a mid-length rotation consisting of annual grain crops and cover crops. The system's sole source of fertility is leguminous cover crops and crop rotation provides the primary line of defense against pests.

ORGANIC MANURE

This system represents an organic dairy or beef operation. It features a long rotation of annual feed grain crops and perennial forage crops. Fertility is provided by leguminous cover crops and periodic applications of composted manure. A diverse crop rotation is the primary line of defense against pests.

Each system is further divided into two: tillage and no-till, for a total of 6 systems.

FUNGI

Fungal to bacterial ratios are ecologically important for carbon storage and overall farm system sustainability [53–55]. Soils with higher fungal to bacterial ratios are characterized by higher carbon use efficiencies [53]. The two groups of beneficial soil fungi important for soil carbon sequestration are the decomposers—saprotrophic fungi—and the root-associated, or mycorrhizal fungi [56]. Increases in plant abundance, plant diversity [57] and organic fertility sources [58–60] increase fungal biomass and fungi to bacteria ratios.

Many plant species directly depend on these fungi for growth and survival.

Ninety-percent of all plants live in symbiosis with mycorrhizal fungi [35]. These fungi are particularly important for soil carbon sequestration. Mycorrhizal fungi receive a significant portion of the plant belowground carbon as their only energy source, in return, they provide up to 80% of a plant's nitrogen and phosphorus [61]. Mycorrhizal fungi also provide soil and plants other important benefits, such as resilience from drought and stresses through their mediation of soil physical structure and water [62–65]. So many plant species directly depend on these fungi for growth and survival that researchers have suggested "the role of the symbiosis in global nutrient cycling is significant" [61,66].

Mycorrhizal fungi secrete a protein called glomalin; this particular fungi-root partnership and its glomalin are largely responsible for creating persistent, stable soil aggregates that protect soil carbon from being lost as atmospheric carbon dioxide [67,68]. This initial shorter-term stabilization provides the time for organic matter to create bonds with metals and minerals, the resultant organo-mineral or organo-metal complexes can remain in the soil for millennia [26,34].

Since mycorrhizal fungi need root-partners to survive, farming strategies that include perennial plantings, trees on edges, reduced tillage, and plants with long, fibrous root systems, encourage the long-term stabilization of soil carbon [57,67,69,70]. Long-term systems trials comparing organic and conventional systems find higher levels of mycorrhizal fungi in organic systems [71-73], presumably due to greater plant diversity through longer crop rotations and the use of cover crops and green manures. Promising effects have been shown for inoculation of soils with fungi, especially in cases where frequent or deep tillage has destroyed the native population [22,74]. Mycorrhizal fungi can be introduced through inoculations that are easily prepared on-farm [74,75] and could be a strategy to accelerate carbon sequestration and regeneration of degraded soils.

BIODIVERSITY ABOVE GROUND

An abundance of biodiversity above ground results in greater soil health and soil carbon sequestration below ground [25,76].

A lack of life above ground—bare soil—disables photosynthesis and encourages erosion. Losing soil to wind and rain decreases agricultural productivity and nullifies any hope of shifting agriculture from a climate problem to a climate solution.

Another sign of a poorly designed system is a monoculture—one type of crop covering a vast landscape. Monocultures and simplistic crop rotations require chemical inputs to control weeds, insects, and diseases and to provide fertility. These inputs destroy soil biology and exacerbate soil carbon loss.

In general, systems based on organic management principles foster biodiversity. Recent research comparing more than 60 crops grown in conventional and organic systems worldwide found that organic systems fostered significantly more biodiversity, both in abundance and in species richness [77,78]. Any farm, whether certified organic or not, can borrow from organic models to introduce a set of practices that regenerate soil life by focusing on biodiversity above and below ground.

DIVERSIFY CROPPING

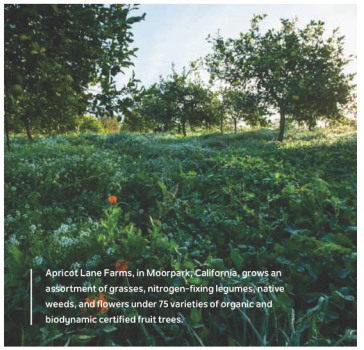
Only nine crops account for nearly 70% of worldwide agricultural land use: sugar cane, maize, rice, wheat, potatoes, soybeans, oil-palm fruit, sugar beet and cassava [79]. These crops are often produced in monocultures or narrow cash crop rotations, like corn-soybean rotations. Growing just one or two types of crop makes a farm prone to devastation from pest outbreaks or extreme weather, which are becoming more common with the climate crisis. Increasing biodiversity above ground by growing diverse crops in rotation, cover cropping, strip-cropping, inter-cropping, multi-story cropping, and integrating crops and livestock leads to resilience from these kinds of shocks while aiding soil carbon sequestration.

Cover crops are equally important for large and small-scale systems.

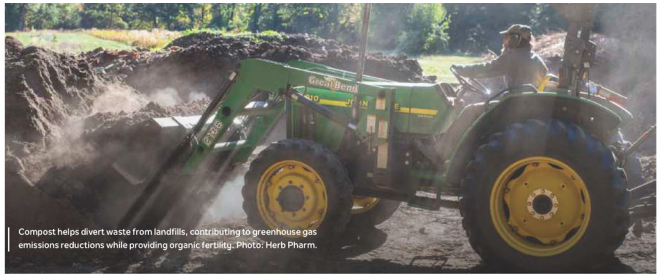
Moving crop rotations away from monoculture with fallow towards polyculture with no fallow increases soil biodiversity and sequesters carbon [30,80,81]. For instance, switching a wheat-fallow rotation to a wheat-sunflower or wheat-legume rotation was found to increase soil organic carbon stocks significantly [80] and a continuous barley system more than doubled soil carbon stocks compared to a barley-fallow system [82]. Integrating seeded grass species as cover crops, living mulches, or in rotation increases soil carbon due to the deep, fibrous root systems of these perennials [80,83]. Both enhanced cash-crop rotations and introducing cover crops result in continuous cover, which increases soil microbial biomass and soil carbon by ensuring available energy and root hosts for bacteria and fungi [81,84,85].

Diversifying with cover crops is more effective than no-till in sequestering carbon. In a 30-year trial of maize cover cropping in Brazil, the effect of a legume cover-crop on soil carbon stores was greater than the effect of not tilling the soil [86]. Similarly, in Rodale Institute's Farming Systems Trial, differences in soil carbon were not impacted by tillage intensity but differed significantly between organic and conventional systems [87]. Soil organic carbon (SOC), microbial biomass carbon (MBC), active carbon (PoxC), and water extractable carbon (WEC) were all higher in the Rodale's organic manure system compared to the conventional system, while SOC and MBC were higher in the organic legume system than the conventional system. Both organic systems include diverse cover crops and green manures with the manure system including a multi-year, mixed perennial hay crop and composted manure as additional inputs. The conventional system is a corn-soybean rotation using standard chemical inputs with no cover crops. After ten years of continuous no-till the conventional system had the lowest soil organic carbon levels in all six Farming Systems Trial systems, including its tilled conventional counterpart, suggesting that no-till alone, in the absence of cover crops and diverse crop rotations, does not sequester carbon. No-till farming limits the speed by which soil carbon loss and soil degradation occur, but it does not sequester carbon.

A meta-analysis of worldwide studies found that cover crops are nearly as effective as afforestation of cropland for sequestering carbon, while also reducing nutrient leaching, wind and water erosion and pest pressure [16]. Cover crops are equally important for large and small-scale systems. Cover crops and green manures are a critical component for regenerative tropical agriculture where smallholder maize systems interplanted with legumes can sequester almost six metric tons of carbon per hectare per year [21]. Importantly, "sequestering that carbon is a free by-product of doubling and tripling their own [smallholder's] agricultural yields" [21].



Apricot Lane Farms, in Moorpark, California, grows an assortment of grasses, nitrogen-fixing legumes, native weeds, and flowers under 75 varieties of organic and biodynamic certified fruit trees.



Compost helps divert waste from landfills, contributing to greenhouse gas emissions reductions while providing organic fertility. Photo: Herb Pharm.

MULCHES AND COMPOST

Diverse crops also play a significant role in soil carbon sequestration when their plant and root residues are retained rather than removed or burned [81,88–90]. These residues fuel the soil food web, constructing more complex biochemical structures that serve as forerunners to building soil organic matter [34,77]. Residue removal, whether of the main cash crop or a cover crop, has become common for the production of biofuel, but this practice depletes soil organic matter [91]. Retaining crop residues as a mulch prevents erosion, inhibits weed growth, moderates soil temperatures, reduces soil water evaporation, provides organic matter that is cycled by earthworms, and protects soil from extreme weather events.

The benefits of compost can accrue quickly.

In addition to retaining residues as mulch, compost made from plant residues and/or manure increases soil biodiversity and microbial biomass which improve soil structure, nutrient cycling, and disease suppression [18,92–96]. Compost is highly efficient in building soil carbon by both feeding microbes and directly forming organo-mineral associations [96]. The benefits of compost can accrue quickly: after only one application of plant-based compost, soil organic carbon and aggregate stability can increase significantly in the following years compared with non-amended soils [97,98]. In a 10-year trial, fields amended with composted dairy manure sequestered more than two metric tons of carbon per hectare per year, while the paired conventional farming system lost carbon [18].

Using only small amounts of fungal rich plant-based compost to inoculate soils can result in substantial carbon sequestration and soil health improvements [22,99,100]. For instance, a single application of compost to grassland soils increased soil carbon in labile and physically protected pools over subsequent years [100]. Compost also helps divert waste from landfills, contributing to greenhouse gas emissions reductions while providing organic fertility [101].

However, relying on compost, especially composted manure, to promote carbon sequestration in cropland soil may be difficult because of limited supplies and the economic and environmental costs of transportation [101,102]. This is especially relevant in limited resource smallholder agriculture when livestock is not present [21]. In addition, carbon inputs originating outside of a farm and transported considerable distances are difficult to attribute carbon sequestration values when considering the amendments' full lifecycle. Therefore, on-farm and local waste stream composting that recycle nutrients naturally should be promoted. For instance, incorporation of manure and crop residues in integrated crop-livestock systems sequesters carbon, improves soil function and mitigates erosion [103-105]. Farmers can select appropriate amendments from a range of on-farm or locally available mulches and composts to support soil life and soil organic matter in a way that adds carbon to the system, rather than redistributing it.

REDUCING TILLAGE

Plowing clearly affects soil life—it breaks up aggregates, destroys fungal networks, increases water trans-evaporation, increases the breakdown of organic matter, and can lead to wind and water erosion. Tilled, exposed, and eroded soils allow formerly stable soil carbon to be released as a greenhouse gas [106,107]. Switching from deep, regular tillage to reduced tillage programs improves soil structure, reduces carbon dioxide emissions and contributes to increases in soil organic carbon [108,109].

There is growing evidence that conventional no-till alone does not sequester carbon.

The interlinking effects of regenerative practices are highlighted by the highly variable outcomes researchers record in tillage experiments. **There is growing evidence that conventional no-till alone does not sequester carbon, but must be part of a systems approach**, especially when considering the entire soil profile rather than the surface soil [110]. For instance, after seven years comparing conventional industrial maize systems under reduced and conventional tillage, the reduced tillage system resulted in more carbon dioxide and nitrous oxide emissions [111]. A review of more than 30 studies found no difference in annual soil organic carbon stocks between tilled and untilled plots [16]; and an experiment testing conservation tillage with cover cropping on soil carbon sequestration potentials in conventional systems, found no benefit of reduced tillage in soil carbon storage [112]. No-till systems can best reverse the trend of soil organic carbon losses when they are part of a systems approach to regeneration that includes cover cropping, enhanced crop rotations, and reduction or elimination of synthetic inputs [90, 91]. Soil improvements occur when conventional, no-till farming practices are replaced with organic farming methods, even though some tillage is used in organic systems [113]. Soil carbon and nitrogen were higher after nine years in an organic system with reduced tillage compared with three conventional no-till systems, two of which included cover crops [113]. Any soil carbon gains achieved under conventional no-till may be countervailed by the greater nitrous oxide emissions from synthetic nitrogen fertilization in these systems [114,115].

Regenerative organic reduced tillage systems depend on heavy cover cropping for weed suppression [116]. Coupled with the benefits of organic management in general, organic reduced tillage has been shown to increase soil organic carbon by nine percent after two years and more than twenty percent after six years [116,117]. A recent review of reduced tillage in organic systems found that using inversion tillage to only a shallow depth results in significantly higher soil carbon stocks, and while weed abundance increased, yield was not necessarily affected [118].

Rodale Institute's roller crimper, shown here, rolls cover crops into a weed-suppressing mulch in an organic no-till system.

GRAZING MANAGEMENT

Regenerative grazing couples the sequestration potential of highly managed grazing systems to enhance the large natural sink capacity of perennial pasture and woodlands [5,25,104,119]. Grazing lands account for more than 70% of the global agricultural land area (there are 1.4 billion hectares of arable cropland versus 3.3 billion hectares of meadows and pastures) [79]. Thus, grazing lands may provide the greatest potential to sequester carbon through regenerative agriculture if managed properly to regenerate soils, providing a massive carbon sink with many co-benefits for ecosystems, ruminant livestock and ranchers.

> ***Livestock itself is not the problem, it's the way we have chosen to raise livestock that creates the problem.***

However, livestock production is increasingly "landless" [79]. Even in places previously known for grass-fed production, such as Brazil and Argentina, deforested land that once held extensive pastures for cattle are now being turned into conventional soybean cropland to feed cattle held in crowded lots [120]. These conventional livestock production systems contribute an estimated 7-18% of global greenhouse gas emissions [23].

But livestock itself is not the problem, it's the way we have chosen to raise livestock that creates the problem. Levels of greenhouse gas emissions from beef production are dependent on the type of grazing system [23,122], or lack of grazing. With appropriate grazing management, ruminant livestock can increase carbon sequestered in the soil that more than offsets their greenhouse gas emissions, and can support and improve other essential ecosystem services [121, 122].

Regenerative grazing is an umbrella term encompassing many forms of management intensive grazing such as adaptive multi-paddock (AMP) grazing, holistic grazing management, and mob grazing. While these systems do have differences, their commonality is in the frequent, calculated movement of high densities of ruminants with decisions made based on the herd size and qualities of the available forage. Critically, this highly managed movement of the herd allows forage to recover between grazing (Teague interview), mimicking large herds found in nature, allowing soil organic carbon to increase even at stocking rates thought to be detrimental to soil health in set-stocking systems [122, 123].

Regenerative grazing can also be employed in integrated crop-livestock systems. The careful management of grazing in these systems is critical to increasing soil organic carbon. In a nine-year study of cover crop grazing, Brazilian researchers found greater stocks of soil organic carbon and nitrogen under moderate and light grazing intensity (20–40 cm height) than for ungrazed or higher intensity grazing [124]. Similar conclusions about intensity have been made by other researchers investigating integrated crop-livestock systems [105,125,126]. The addition of rotational grazing to a cash crop rotation can provide multiple benefits beyond the increased carbon storage, including increased soil glucosidase activity, available calcium, magnesium, nitrogen, soil pH, and an increase in the carbon to nitrogen ratio [127].

> ***Researchers have also found reduced methane emissions from cattle in regenerative systems.***

In addition to managing grazing activity, more diverse pasture grass mixes, and those that include legumes, better sequester carbon than less diverse pastures [128]. Researchers have also found reduced methane emissions from cattle in regenerative systems, suggesting this may be due to the increased diversity of pasture grasses in theses systems [121]. In general, shifts in grazing management present a great potential for agricultural mitigation of the climate crisis, besting even policies aimed at reducing deforestation or targeting crop production practices [129].

SYSTEM COMPLEXITY

Regenerative agriculture is a knowledge-intensive, systems-based approach grounded in ecological thinking. It is not simply reducible to a handful of practices, instead it's guided by principles and outcomes. Even within organic systems growing the same crops and using the same tillage, management choices like cover crop type and frequency and the use of compost, have significant effects on soil health over the long-term [85]. Researchers studying nine different vegetable systems, some organic, some conventional, over almost twenty years found that only one of those systems—an organic corn-tomato-cover crop and manure system—increased soil organic carbon along the full soil profile [102].

The potential and rate of soil carbon sequestration for any farming system depends on many interacting factors [85,130,131] including: existing and historic soil organic carbon content, climate and landscape position, and length of growing season [See Sidebar for more factors].

This complexity means that farmers can best create regenerative systems when they draw from a basic ecological literacy to make management decisions for their particular farm's context.

> ***"Globally, farmers risk becoming passive customers of the agroindustry, in which a declining ecological literacy translates into an increased reliance on purchased synthetic inputs." [132]***

Longer more complex rotations, including cover crops, perennials, and trees, ensure there are diverse living roots in the soil for as much of the year as possible—an important principle for regenerative agriculture. Reintroducing highly managed livestock, retaining crop residues, reducing tillage and adding composts or microbial inoculants can further amplify soil health.

These synergistic practices combine to form regenerative systems that promote biodiversity above and belowground. The suite of practices that make an appropriate system for any one farm will differ, but the menu of regenerative practices is broad and substantiated enough now that every farm can implement some management changes that help move agriculture from a climate crisis problem, to part of the solution.

Carbon Sequestration Factors

- existing and historic soil organic carbon content
- climate and landscape position
- length of growing season
- soil type, depth, and water holding capacity
- the main cash crops or livestock
- type and rate of fertilizer used
- available soil nitrogen
- use of insecticides, fungicides, and herbicides
- cover crop types and rotation
- tillage intensity
- type and frequency of compost applications
- use of irrigation
- prevention of land use change once carbon is stored and many other management choices.

Photo: Alexandre Family Farms

SPECIAL INSERT: CERTIFICATIONS, PRODUCTS AND INITIATIVES

WHERE *is* REGENERATIVE FARMING *in the* MARKETPLACE?

In recent years, a number of nonprofits and brands have been developing definitions of regenerative agriculture, product labeling and certifications, and measurement systems to track outcomes.

While the term "regenerative" is currently vulnerable to greenwashing, these initiatives are attempting to develop criteria—and transparency—to help consumers identify regenerative products in the marketplace:

Regenerative Organic Certified™

Regenerative Organic Certified™

RegenOrganic.org

Regenerative Organic Certified™, a new high-bar label led by the Regenerative Organic Alliance (and backed by brands and nonprofits such as Rodale Institute, Patagonia, and Dr. Bronners), requires organic certification as a baseline, while adding additional criteria for soil health, animal welfare and social fairness such as:

SOIL HEALTH	ANIMAL WELFARE	SOCIAL FAIRNESS
• Builds Soil Organic Matter	• Five Freedoms:	• Capacity Building
• Conservation Tillage	1. Freedom from discomfort	• Democratic Organizations
• Cover Crops	2. Freedom from fear & distress	• Fair Payments for Farmers
• Crop Rotations	3. Freedom from hunger	• Freedom of Association
• No GMOs or Gene Editing	4. Freedom from pain, injury or disease	• Good Working Conditions
• No Soilless Systems	5. Freedom to express normal behavior	• Living Wages
• No Synthetic Inputs	• Grass-Fed / Pasture-Raised	• Long Term Commitments
• Promotes Biodiversity	• Limited Transport	• No Forced Labor
• Rotational Grazing	• No CAFOs	• Transparency and Accountability
	• Suitable Shelter	

ROC Star Farms

The first Regenerative Organic Certified™ products hit shelves in 2020. The certification is for food, fiber, and personal care products.

Photo: Savory Institute

LAND to MARKET™

Savory Institute's Land to Market Program

savory.global/land-to-market

Ecological-Outcome-Verification (EOV) is the outcome-based science protocol inside of Savory Institute's Land to Market regenerative program. It is intended to give a voice to the land in the marketplace. The scientific protocol evaluates a comprehensive aggregate of environmental health indicators including: soil organic matter, soil carbon, soil water holding capacity, water infiltration rates, and biodiversity. The protocol utilizes a mix of quantitative and qualitative data and photographic records that work synergistically to account for changes in ecosystem services. EOV employs a variety of indicators that help producers make management improvements, alongside other empirical indicators that have value in the marketplace. As of July 2020, through Savory's global network of Hubs, over 2 million acres have been measured by EOV.

SOIL CARBON INITIATIVE

Soil Carbon Initiative

SoilCarbonInitiative.org

The Soil Carbon Initiative (SCI), created by The Carbon Underground and Green America, is an outcomes-based, scientific, agricultural standard designed to help farmers and supply chains measure improvements in soil health and soil carbon. The SCI creates a framework that calls all who touch the soil to address the climate crisis by building soil health and increasing soil carbon sequestration through better soil health. The SCI does not dictate practices, so no matter the underlying agricultural system (organic, regenerative, non-GMO, conventional), the SCI can measure soil health and soil carbon. The outcomes-focus allows supply chains to use SCI to measure the results of customized soil health programs.

Farmers demonstrate commitments annually by submitting evidence of learning/teaching about soil and ecosystem health, and of actions taken to improve ecosystem and soil health. The actions are aligned to five principles of soil health:

1. Minimize Soil Disturbance
2. Maximize Crop Diversity and On-Farm Biodiversity
3. Keep the Soil Covered
4. Maintain Living Roots Year Round
5. Integrate Livestock

Coconut Farmer in Sri Lanka, Courtesy of Serendipol, Ltd., Dr. Bronner's sister company and supplier of Regenerative Organic Certified™ Coconut Oil.

LOCKING CARBON UNDERGROUND

Regenerating soils while sequestering carbon can happen quickly, but trapping carbon in the soil for long periods of time is a more time-consuming process.

Since the carbon cycle is dynamic and the study of soil is inherently complex, the factors influencing retention time of carbon in soil are actively being researched [34,133].

All soil carbon is in flux and the degree to which it is protected in undisturbed soil aggregates protected from decomposers and respiration largely determines how long it is held in soil [26].

Carbon is more likely to be protected deeper in the subsoil at one to two meters.

Carbon locked in mineral-associated organic matter (MAOM) has a saturation point, but is stable over millennial time periods, while particulate organic matter (POM) cycles more quickly to provide plant nutrients each season but may be able to accrue carbon indefinitely [134]. Soil structure plays a critical role in the stability of soil carbon [33, 135, 87], which can be improved by crop management and diverse types of plant roots growing for as much of the year as possible.

Carbon is more likely to be protected deeper in the subsoil, at one to two meters [5,136–140]. And yet, it remains rare that soil carbon is measured below plow depths of 30 to 40 centimeters [16] meaning it is likely that current data sets underestimate soil carbon stocks. Recent results from paired organic and conventional vegetable and grain systems found significant differences in the deeper soil profiles [48, 87, 102]. If soil had not been measured below 30 centimeters, almost 60% of the soil organic carbon in the organic system would not have been accounted for [102]. Conversely, the shallow measurement depth would have suggested that carbon was gained in the conventional system, when in fact the deeper measurements revealed an overall loss of carbon in that system [102].

This is important as reduced tillage systems that once were assumed to have lost soil carbon compared to no-till, rather may have redistributed carbon to below the plow level and out of reach of most soil sampling [28]. Beyond 30 centimeters in the soil profile, the age of carbon increases, much of it persisting for thousands of years [141].

Both rapid and stable carbon sequestration under the conditions encouraged by regenerative agriculture are possible. Additions of fresh organic matter can, under the right circumstances, be effectively sequestered rapidly. After only one application of compost and cattle manure, soil organic carbon levels were significantly higher in the ensuing years, even after accounting for the carbon in the amendments [97,99]. Two years after conversion from a degraded conventional row crop system to regenerative grazing, dairy farms in the Southern US began sequestering carbon at a rate of 4.6 metric tons of carbon per hectare per year. This increased to a very high 9 metric tons a year before the researchers saw a plateau and decline in the rate of sequestration after six years [24]. Similarly, in tropical soils, results suggest that two years of organic system management may significantly and consistently enhance microbial biomass carbon [142].

These results suggest that stable soil carbon can be built quickly enough to result in a rapid drawdown of atmospheric carbon dioxide upon transition to regenerative agricultural systems.

Photo: Savory Institute

Rodale Institute's Farming Systems Trial has proven that organic systems (right) can outperform conventional systems (left) during times of drought.

THE QUESTION *of* YIELDS

Crop yields are often touted as the reason why we cannot scale up organic and regenerative systems, but evidence does not support this claim.

Meta-analyses of refereed publications show that, on average, organic yields are lower than conventional [143,144]. But the yield gap is most prevalent when practices used in organic mimic conventional [145], that is, when the letter of organic standards are followed using an input mentality akin to conventional chemical-intensive agriculture. Regenerative systems are based on a holistic approach to farming that aims to improve soil health, they are not simply replacing conventional chemicals with organic-approved chemicals.

Actual yields in well-designed regenerative organic systems, rather than agglomerated averages, have been shown to outcompete conventional yields for almost all food crops including corn, wheat, rice, soybean and sunflower [18,72,143]. Researchers have found that "adoption of organic agriculture under agroecological conditions, where it performs best, may close the yield gap between organic and conventional systems" [144,146].

In 2016, Rodale Institute's organic no-till with manure system produced 200 bushels of corn per acre—a record-breaking yield for the organic system and well above the county average and the conventional corn yield that same year (140 bushels per acre). Over a forty-year period there has been no statistical difference in yield between the organic and conventional systems within that trial [17,147].

It has been noted that the organic yield gap also arises, in part, due to a lack of varieties adapted for organic systems [31]. Conventional seeds, and the chemical systems they are locked in, have benefitted from immense R&D funding by private corporations and their university researcher partners, whereas ecological plant breeding for organic production has not [148-150].

Importantly, yields under organic systems are more resilient to the extreme weather accompanying climate change. As found in the long-running Rodale Institute Farming Systems Trial, during drought years, yields are 30% to 100% higher in the organic systems [151,152]. Crop resilience in a changing climate is an important economic co-benefit because "climate-resilient soil can stabilize productivity, reduce uncertainty, and produce an assured yield response even under extreme weather conditions" [5].

A strong evidence base has been building that shows regenerative systems bring a wide range of traditionally under-valued benefits that are equally as important as yields [2,77,146,153]. When compared to conventional industrial agriculture, regenerative systems improve:

- Biodiversity abundance and species richness
- Soil health, including soil carbon
- Pesticide impacts on food and ecosystem
- Total farm outputs
- Nutrient density of outputs
- Resilience to climate shocks
- Provision of ecosystem services
- Resource use efficiency
- Job creation and farmworker welfare
- Farm profitability
- Rural community revitalization

THE MYTH OF A FOOD SHORTAGE

There is no global food shortage. Nor are we on a trajectory for a global food shortage. World food production has been steadily rising, currently providing 2,900 calories per person per day, 22% more than is needed [154].

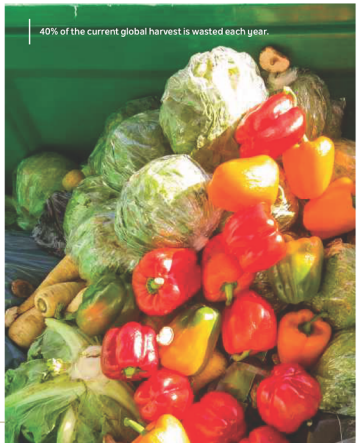
The continued use of the trope that 'we will soon need to feed nine billion people' as justification for seeking ever greater yields is duplicitous. **Hunger and food access are not yield issues.** They are economic and social issues which, in large part, are the result of inappropriate agricultural and development policies that create and reinforce hunger [155]. We currently overproduce calories. In fact, we already produce enough calories to feed nine billion people. However, we do it in a manner that degrades soils and harms the environment, putting our health and future food production at risk.

Over 40% of the current global harvest is wasted each year.

Worldwide hunger and food access are inequality issues that can be ameliorated in part by support for small-scale regenerative agriculture, both urban and rural [156]. For those smallholder farmers for whom yield is a matter of eating or not eating, regenerative agriculture with few inputs is the best means of increasing yield as documented across tropical regions for more than 50 years by development agronomists [21].

Just over 55% of world crop production is eaten directly by people [158]. Calorie availability could be increased by 70% by shifting crops away from animal feed and biofuels to direct human consumption [157]. If livestock were raised on pasture instead of competing for arable land suited for human food production, "a 100% shift to organic agriculture could sustainably feed the human population in 2050, even with a yield gap" [158]. What's more, over 40% of the current global harvest is wasted each year, largely before it ever reaches consumers [159].

It's clear we need to make environmentally conscious food choices, but we also need to focus resources on solving food waste, returning ruminants to pasture, and curtailing the use of fertile land for fuel production. When we take a holistic perspective on the food system, we see that yields alone mean little. **Regenerative agriculture absolutely can feed the world. And it can do it while stabilizing the climate, regenerating ecosystems, restoring biodiversity, and enhancing rural communities.**


40% of the current global harvest is wasted each year.

TAKING ACTION

We need to reduce greenhouse gases in the atmosphere now.

This requires strong policy action that can support the total transformation of our energy and transportation sectors. At the same time, we know that the terrestrial carbon pool is a massive reservoir that's been drained by intensive agricultural practices. We can refill that reservoir by recarbonizing farm and rangeland soils.

Farmers have led the revolution in regenerative agriculture, and many need little more than knowledge, experience and support to switch practices. However, beyond a certain eyes-to-acres ratio [160], taking a new approach may be more difficult. Large-scale conventional, industrial farming is locked in a system that needs more than the farmer's will to shift. It's a system built on high capital expenses, proprietary inputs, seeds purposefully designed to work only in tightly controlled chemical regimes, and on scales reliant not on eyeballs and acres, but by satellites geolocating across miles. The great capital expenses involved produce low-priced commodity crops. The only way these systems work is through externalization of costs and sheer scale coupled with support from government agricultural policies and entrenched interests of large agribusiness corporations. To recarbonize, we need to support place-based, customized regeneration for all farms, including large scale operations.

In the past five years, there has been an explosion of attention on regenerative farming, carbon farming, soil carbon sequestration and soil health. Among several international initiatives, the "4 per 1000" launched at COP21 in 2015 galvanized many governments to support soil carbon sequestration as part of their climate change strategies. The voluntary program draws attention to "an annual growth rate of 0.4% in the soil carbon stocks in the first 30-40 cm of soil, would significantly reduce the CO_2 concentration in the atmosphere related to human activities." In the U.S., a bill introduced in early 2020, the Agriculture Resilience Act, would have the country join the 4 per 1000 initiative, and lists a comprehensive set of regenerative agriculture policy support measures.

Policymaker, farmer, or eater—everyone can do something to support shifting the food system from industrial to regenerative.

WHAT CAN EATERS DO?
Put the Pressure On!

1. ***Put pressure on supply chains.*** We need to take away the social license for food companies to use food and fiber products and ingredients that degrade ecosystems. Tell food manufacturers that ecologically destructive supply chains are a time bomb about to explode for their brands. Let them know it's no longer ok to produce food at the expense of humanity's future. Demand food and fiber products that are sourced from farms employing regenerative practices.

2. ***Give policymakers hope.*** We need to approach governmental leaders with regenerative strategies. Many of them buy into the green revolution myth that we can sustainably intensify conventional agriculture. They know the soils of their states and nations are being destroyed, but they don't see an alternative. Tell them there is a better way, show them this report and others like it. Let them know you support their actions to shift agriculture from the problem side of the climate equation to the solution side.

3. ***Start a conversation.*** Ask your grocer, school, workplace, local hospital, and other institutions and organizations you frequent to carry products from farms practicing regenerative agriculture. If they can't talk to the producer directly, tell them to look for third-party verified labels like Regenerative Organic Certified, Land to Market, Real Organic Project, and the Soil Carbon Initiative.

4. ***Buy regenerative.*** When possible, buy from brands who source food stocks and ingredients from regenerative farms. Let them know you appreciate their sourcing practices. Or better yet, buy directly from regenerative farms. Many regenerative farms that sell to the public are proudly transparent about their practices. But remember that most farms, especially large-scale ones further from metropolitan areas, are not set up to sell directly to the public—shopping alone is not going to shift this.

WHAT CAN FARMERS DO?
Grow This Movement!

1. ***Grow the community.*** The regenerative agriculture movement is farmer-led; if you don't know of a group nearby, join a regional, national or international organization for farmer-to-farmer learning about organic, regenerative, agroecological, holistic grazing, or syntropic agroforestry, among others. If you already frequent these circuits, consider creating a Carbon Farm Plan or becoming certified to a more stringent standard that goes beyond organic, such as Regenerative Organic Certified, Real Organic Project, Land to Market (for graziers), or Soil Carbon Initiative. You can also set up a local or regional group to regenerate at the landscape scale, organize a Regeneration Alliance, or start or join a food policy council where diverse constituents make a path for a regenerative food system that is adapted to the local context.

2. ***Experiment, observe, share.*** As a farmer-led movement, experimentation on real farms is critical. When you shift management practices based on what you are learning, observe and measure changes in soil health and biodiversity, and then share those results with others. Whether informally talking to your neighbors, hosting field-days, posting on social media, collaborating with researchers, or speaking at conferences and other meetings, when you experiment, observe and share your farm's regeneration story, you inspire others, provide data for researchers and policymakers, and enhance the benefits to your farm, community, and the greater food system.

3. ***Measure outcomes.*** Regenerative systems provide a wide host of beneficial outcomes that society values. High total farm outputs, nutrient density, resilience to extreme weather, ecosystem services like reduced runoff or fertilizer use, and job creation are a few [2]. In addition, farms can track the buildup of soil organic matter where testing services are available and affordable. In general, 50% of soil organic matter is soil organic carbon [29]. For some regions, testing soil carbon sequestration may be feasible in the near future with affordable soil sensors and other accurate soil carbon measurements [140]. There are also many no-cost observations to determine soil health impacts related to management changes, including biodiversity observations, soil aggregation and water infiltration tests. You can obtain or design a soil health card to record observations and track your farm's progress.

WHAT CAN POLICYMAKERS DO?
Defund Soil Destruction!

1. ***Learn from constituents.*** Regenerative agriculture is a farmer-led and consumer-supported movement the world over, it does not have the lobbying power of industrial agribusiness. Prioritize actively building relationships with this movement. Even in unlikely places, there are passionate people working to shift the food system from a climate problem to a climate solution. Find these constituents; they may be regenerative farmers, natural food store and co-op buyers, sustainable agriculture organizations, or even university researchers. Build the relationships that will keep you informed about regenerative agriculture locally and globally.

2. ***Support regenerative, organic, and regenerative organic agriculture.*** Policies that support regenerative agriculture recognize and reward farmers for building soil organic matter. These policies are best focused on supporting and rewarding positive outcomes. There are a wide range of policy options, from direct cost-sharing for cover crops to facilitating farmer-to-farmer peer learning, funding organic research, creating local or regional food policy councils and integrated landscape initiatives, and much more. The current complexity of precise outcome measurements means that it may be more feasible to support systems of interlinked practices, such as those proposed in the U.S. Agriculture Resilience Act, than to reward outcomes.

3. ***Defund soil destruction.*** Policymakers can shift soil destructive policies in many ways. Start by rethinking commodity-based subsidies and support, crop insurance, biofuel mandates, government procurement programs, government funding for chemical-intensive research, and agribusiness corporate mergers. Consider how a Healthy Soil Act might be introduced to give soil rights [5]. Be vigilant to the global political power of industrial agribusiness corporations; their consolidation is a serious threat to shifting the food system to regenerative approaches [161].


Photo: Rodale Institute

SOIL HEALTH *for a* LIVABLE FUTURE

The climate crisis is a monumental opportunity to change course.

Now is the time to create a future that embraces life, a future bent on encouraging health, a future where healthy soil, clean air and clean water is available to all. In so many ways, a fundamental restructuring of how we cultivate our food is at the heart of this shift; we need to cooperate with nature. The tired era of sustainability is over. We turn now to regeneration. Regenerative agriculture is our best hope for creating a future we all want to live in, and a future our children will be happy to inherit.

Regenerative agriculture is aligned with forms of agroecology practiced by farmers concerned with food sovereignty the world over. Choosing farming practices that create regenerative systems can increase soil carbon stocks, decrease greenhouse gas emissions, maintain yields, improve water retention and plant health, improve farm profitability, and revitalize traditional farming communities while ensuring biodiversity and resilience of ecosystem services.

Soil carbon sequestration through regenerative agriculture is a human-scale remedy to global warming that's ready for implementation now. Farmers are already leading the evolution to regenerative systems. But we need to scale up and out, to make regeneration possible on conventional farms, on smallholder tropical farms, on orchards and ranches the world over in ways that make sense for each place.

This shift is going to take all of us working together—farmers, eaters, and policymakers—to create widespread societal support for moving to regenerative systems. We need to put positive pressure on supply chains, get better at measuring and sharing on-farm progress, and defund soil destruction.

Robert Rodale urged us toward this vision of regeneration in 1985:

> ***My hope is that the period of sustainability will not be sustained for more than 10 or 15 years but that we will move beyond that to the idea of regeneration, where what we are really doing with the American Land is not only producing our food but regenerating, improving, reforming to a higher level the American landscape and the American Spirit [162].***

Nearly 35 years later, the specter of the climate crisis has provided an unparalleled opportunity to harness cutting-edge technological understanding, human ingenuity and the rich history of farmers working in tandem with the wisdom of natural ecosystems to arrive at a stable climate. It's time now to heal our land and ourselves.

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Senate Committee on Environment and Public Works
Hearing Entitled, *"Legislative Proposals to Improve Domestic Recycling and Composting Programs"*
February 2, 2022
Questions for the Record for Rhodes Yepsen

Senator Whitehouse:

1. The United States has an abysmal recycled content rate for single use plastics of only two percent. A recent report found that across five major cities, only 8.8 percent of the plastic that goes into garbage and recycling bins actually ends up getting recycled. What needs to be done to solve our plastic recycling failure?

Senator Whitehouse,

You pose an excellent question, one that requires input from a wide set of stakeholders, including the five cities in the report you cite, to analyze what is leading to these low recycling rates. The Biodegradable Products Institute, Inc. (BPI) works exclusively on the value of certified compostable packaging in diverting organic waste to composting and cannot speak to all aspects of plastics recovery.

We can highlight the role compostable products and packaging can play in improving the recovery of packaging and materials.

In general, products and packaging associated with food can be challenging to mechanically recycle, and if non-compostable they can prevent recovery of food scraps. In fact, the very things that make food packaging difficult to recycle are all assets for composting. Recycling requires sufficient weight in order to turn the material into a commodity (and food packaging is often lightweight); recycling favors clean and dry materials (food packaging is often soiled); and recycling typically requires items to be made from a single material or be easily separated (food packaging often involves coatings and layers).

Compostable products and packaging address these challenges. Being lightweight and food-soiled are assets for composting, because this means the packaging is associated with feedstocks the composter wants (ie, designed for the right system), and that the packaging is ancillary rather than the primary feedstock. Multiple layers and polymer types are not a problem for compostability either, as the layers don't need to be manually separated; the final product must meet ASTM specifications for compostability in entirety.

As an Advisory Council member of the US Plastics Pact, we point you to that organization as a resource on the broader efforts underway to address plastics reduction, reuse, recycling and composting. It involves stakeholders across the value chain: raw material producers, packaging convertors, brands, retailers, food companies, recyclers, composters, environmental advocates, municipalities and states, etc. The Plastic Pact groups around the world are not just setting voluntary commitments, but are putting in time and energy to identifying the barriers and

necessary steps to get to an acceptable level of recycling and composting, which we agree are long overdue.

We are excited to see the Recycling and Composting Accountability Act proposal, and would encourage you to support it, noting that these new datasets are foundational, helping with national statistics on packaging, access to recycling and composting, processing capacities and limitations, end markets for recycled materials and finished compost, and education/labeling. Data alone won't solve the issue, but it will ensure we are framing it correctly as we develop other federal efforts to move towards a circular economy.

Sincerely,

Rhodes Yepsen

Executive Director, BPI

Senator CARPER. The honor is ours. Thanks, Mr. Yepsen. Thanks for the good work that you are doing and for joining us today.

Pashon, you have already been introduced by Senator Stabenow, so we will just turn it over to you to give your statement. Please proceed.

STATEMENT OF PASHON MURRAY, FOUNDER, DETROIT DIRT

Ms. MURRAY. Thank you.

Good morning to all of the Senators. It is an honor to be here.

First, I would just like to read a letter that I addressed, and then I will just make a couple of statements, but just for the record, I do support both bills, or legislation. I think that we are moving in a positive step, moving forward for the future for generations to come, so thank you.

Senator CARPER. Thank you.

Ms. MURRAY. At Detroit Dirt, our mission is to create a zero waste mindset and drive forward a low carbon economy. The foundation of our work is in climate change adaptation in terms of food waste. This is rooted in specific actions that create movement toward carbon dioxide reductions. We must also address food loss and waste because the U.S. spends $218 billion a year growing, processing, and transporting food that is not consumed.

At Detroit Dirt, we transport food waste from clients and process it into a high quality compost. This impacts the environment by using food waste to its highest and best use, as a compost product for agriculture. Diverting food waste from landfills also mitigates the generation of carbon dioxide and methane.

The benefits of using compost in agriculture are many, including increased crop yields and healthier plants. Beyond agriculture, incorporating compost into contaminated soils mitigates contaminants such as lead and other pollutants. Compost also helps increase soil's ability to hold stormwater runoff, which impacts nearby lakes.

Another important part of our work is in soil erosion on agricultural lands. The rates of soil erosion and depletion exceed new soil production by billions of tons per year. The unprecedented loss of soil health and productivity has been well documented. In the U.S., there are reported to be less than 60 years of productive harvests. This speaks to the critical need to take organic materials like food waste, capture its embedded energy, and bring it back into the soils to increase the organic matter that agricultural soils must maintain.

In terms of the environmental stewardship and circular economies, we know that we must take positive steps to make changes through strong partnerships. With these partnerships, we must establish foundations to support the next generation of people who will inherit a different world. Part of our vision is to prepare them for what is to come through education so that everyone can understand their own role, especially as climate change creates an environment where changing seasons will make food production more difficult and where a changing world will take competing interests for natural resources into uncharted territory.

Our vision is to create a thriving, sustainable enterprise where employment opportunities are available to support healthy neigh-

borhoods and sustainable agriculture. Infrastructure for food waste management within an urban setting means reducing our overall carbon footprint, while our high visibility and community outreach will create markets for a variety of products. The new generation of powerful electric trucks manufactured in Michigan will further support our vision of transporting food waste and generating zero emissions.

The challenges of climate change mean that we must invest in innovation and creativity. While our work is measurable, we know some aspects extend far beyond those matters that are measurable or tangible. Supporting our community is a large part of our vision. We understand the value of citizenship and the responsibility of service to our community. To this end, I am in support of the legislation, the Recycling Infrastructure and Accessibility Act of 2022, as well as the Recycling and Composting Accountability Act.

I would like to add a few comments. When we speak about innovation, I, for the last 10 years, have been primarily focusing on replacing landfills and bringing education around anaerobic digestion and vessel technology and other technologies that we can actually make byproducts. If we think about the methane when we bury food waste in the landfills, that carbon not only should be recycled, but when we look at the innovation of technologies that can capture that energy and use it for heating buildings, fuel, and other byproducts, this is imperative.

I believe that, across the country and the world, we are having issues around education. If more of our people understand, in vulnerable communities that are impacted, what composting means, what recycling means, and translating science, this is the low hanging fruit of actually impacting climate change. Because it is not just about recycling our carbon cycles. This is actually about creating and manufacturing byproducts that we can create markets and retail, which is something I am very excited about, so we will get into that later. Thank you.

[The prepared statement of Ms. Murray follows:]

Detroit Dirt Foundation

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January 31, 2022

Testimony for Senate Committee on Environment and Public Works

Detroit Dirt Brief

Our mission, is to create a zero-waste mindset and drive forward a low-carbon economy. The foundation of our work is in climate change adaption in terms of food waste. This is rooted in specific actions that create movement towards carbon dioxide reductions. We must also address food loss and waste because the U.S. spends $218 billion a year, growing, processing, and transporting food that is not consumed.

At Detroit Dirt, we transport food waste from clients and process it into high quality compost. This impacts the environment by using food waste to its highest and best use, as a compost product for agriculture. Diverting food waste from landfills also mitigates the generation of carbon dioxide and methane.

The benefits of using compost in agriculture are many, including increased crop yields and healthier plants. Beyond agriculture, incorporating compost into contaminated soils mitigates contaminants such as lead and other pollutants. Compost also helps increase soil's ability to hold storm water runoff, which impacts nearby lakes.

Another important part of our work is in soil erosion on agricultural lands. The rates of soil erosion and depletion exceed new soil production by billions of tons per year. The unprecedented loss of soil health and productivity has been well documented, and in the U.S., there are reported to be less than 60 years of productive harvests. This speaks to the critical need to take organic materials like food waste, capture its embedded energy and bring it back into soils, to increase the organic matter that agricultural soils must maintain.

In terms of environmental stewardship and circular economies, we know that we must take positive steps to make changes through strong partnerships. With these partnerships we must

establish foundations to support the next generation of people who will inherit a different world. Part of our vision is to prepare them for what is to come through education, so that everyone can understand their own role. Especially as climate change creates an environment where changing seasons will make food production more difficult and where a changing world will take competing interests for natural resources into uncharted territory.

Our vision is to create a thriving, sustainable enterprise where employment opportunities are available to support healthy neighborhoods and sustainable agriculture. Infrastructure for food waste management within an urban setting, means reducing our overall carbon footprint while our high visibility and community outreach will create markets for a variety of products. The new generation of powerful electric trucks manufactured in Michigan, will further support our vision of transporting food waste and generating zero emissions.

The challenges of climate change mean that we must invest in innovation and creativity. While our work is measurable, we know some aspects extend far beyond those matters that are measurable or tangible. Supporting our community is a large part of our vision. We understand the value of citizenship, and the responsibility of service to our community. To this end, I am in support of the legislation Recycling Infrastructure and Accessibility Act of 2022, as well as the Recycling and Composting Accountability Act.

Pashon Murray
Chief Executive Officer
Detroit Dirt & Culture of Carbon

About us: Detroit Dirt Foundation is a minority, woman owned business. I am the CEO with more than fourteen years of experience operating in Detroit. Detroit Dirt Foundation has a non-profit status in the state of Michigan. We are recognized as tax exempt from the U.S. Federal Government's Internal Revenue Service, under the 501(c)(3) of the Internal Revenue Code.

We drive the low-carbon economy.


CHANGE
Carbon is the solution
PARADIGM
Carbon is the problem

Managing Urban Landscapes as Climate Action:

A strategy development guide for communities & local governments to manage urban landscapes and organic resources to achieve climate action and community resilience and well-being objectives

Overarching Goal

Support cities in developing climate action strategies that address mitigation, adaptation/resilience and equity.

Focus Area

Utilize management of urban landscapes and urban organic material flows to achieve climate action objectives.

This Guide

This document will enable its users to go through the process of creating a carbon management opportunity assessment for their city using a combination of their city's planning documents and external tools.

Natural Asset-based Climate Action: 6 Action Areas

Urban Forests
Tree populations in urban settings which form green infrastructure

Parks & Grassland Mgmt
Management of parks and open space to preserve and protect natural areas, water resources, recreation, floodplain mgmt, & aesthetic value

Agricultural Systems
Urban agriculture systems like community gardens and agricultural land managed by a municipality

Greenways and Riparian Areas
Management of greenways and riparian areas for habitat protection, water quality enhancement, floodplain management, recreation, & cultural resources.

Aquatic Systems
This refers to water-based systems that have significant carbon cycling and sink roles e.g. wetlands, estuaries, coastal systems

Organics Management
Using a community's organic "waste" as a resource rather than direct it to a landfill

Carbon Flow and Climate Action Objectives

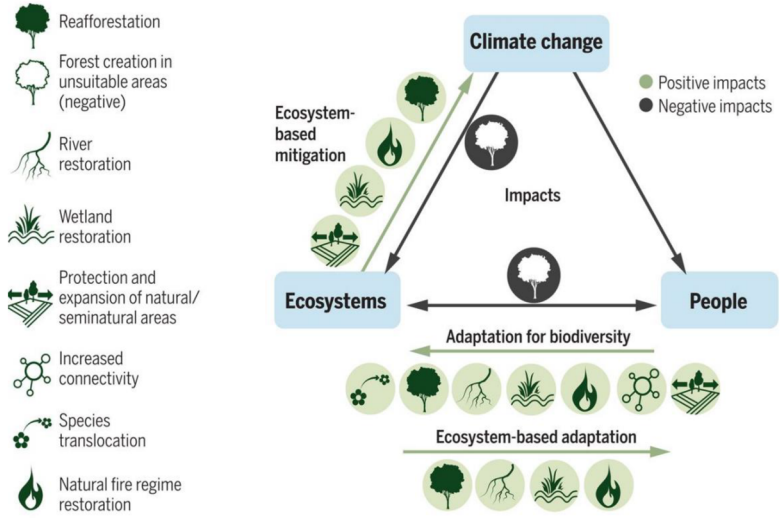
Capturing atmospheric carbon into urban landscapes provides opportunities for **carbon sequestration, benefits from ecosystem services, and climate resilience**. In order to conduct ecosystem-based climate change mitigation successfully, cities will need to **integrate the benefits to people with healthy, functioning ecosystems**.

Managing urban ecosystems and resource flows with the idea that **carbon is a resource** to be utilized in living systems reframes climate action and builds on climate resilience. This process guide outlines ways to create opportunity assessments that can serve as a starting point for bringing together and aligning **carbon sequestration goals (climate mitigation), ecosystem service opportunities (adaptation & resilience), and the needs of a city's communities (equity)**.

America's Food Waste Epidemic

- The United States spends over $218 BILLION growing, processing, transporting, and disposing of food that is never eaten.
- Each year, 52 million tons of food is sent to landfills and an additional 10 million tons remains unharvested at farms.
- 1 in 7 Americans are food insecure. Wasted food is lost nutritional opportunity.
- Food waste fills 21-25% of landfills.
- $5.6 Billion could be saved annually by cutting unnecessary spending on food that is never eaten.

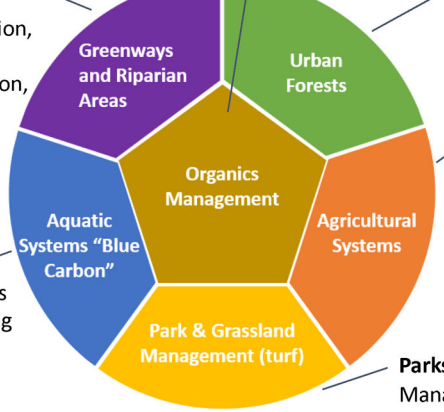
Carbon Flow and Climate Action Objectives



This figure outlines the relationships between people, ecosystems, and climate change

Ecosystems with High Potential for Climate Action

There are **five natural systems** and **one resource management system** with high potential for ecosystem-based climate actions in or adjacent to urban areas:



Organics Management
Using a community's organic "waste" as a resource rather than direct it to a landfill

Greenways & Riparian Areas
Management of greenways and riparian areas for habitat protection, water quality enhancement, floodplain management, recreation, and cultural resources.

Urban Forests
Tree populations in urban settings which form green infrastructure

Agricultural Systems
Urban agriculture systems like community gardens and agricultural land managed by a municipality

Aquatic Systems
This refers to water-based systems that have significant carbon cycling and sink roles e.g. wetlands, estuaries, coastal systems

Parks & Grassland (Turf)
Management of parks and open space to preserve and protect natural areas, water resources, recreation, floodplain management, and aesthetic value

Managing Urban Landscapes and Organic Resource Flows as Climate Action

Process Overview

Phase I ***Phase II***

Step 1	***Step 2***	***Step 3***	
Align with Existing Plans	**Opportunity Identification with Stakeholders**	**Conduct Opportunity Assessment**	**Engagement, Implementation, Policy**
Review city plans, documents, and other supporting materials as well as identify key stakeholders to establish key design objectives	Identify opportunity areas within mitigation, adaptation, and equity; align opportunities and objectives among stakeholders with ranking values	Articulate value for landscape management as climate action and analyze opportunity areas across primary design objectives	Conduct stakeholder engagement and feedback; project identification and implementation; integration of policy

DETROIT DIRT
ZERO WASTE FROM THE GROUND UP

March 2, 2022

U.S. Senate Statement for Single Use Plastic Reduction and Recovery

Senator Whitehouse: The United States has an abysmal recycled content rate for single use plastics of only two percent. A recent report found that across five major cities, only 8.8 percent of the plastic that goes into garbage and recycling bins actually ends up getting recycled. What needs to be done to solve our plastic recycling failure?

Please review our ideas and suggestions regarding the needs required to solve plastic recycling failures. Keep in mind that landfill cost are inexpensive and most local municipalities, plastic manufacturers, and corporations are in need of more mandates and incentives for recycling plastics or investing in technologies for waste to value. Energy conversion from waste is the best solution and utilizing the waste to meet increased energy demand. I'm in support of advocating for energy recovery due to the high labor cost of sorting and separating. If we have stipulations for corporate responsibilities coupled with waste to energy practices it will shift the culture of wasting materials.

Single use plastic reduction ideas

1. Green packaging specifications. Over the years we've discovered that material substitutions require extensive research. The manufacturing of bioplastics, material substitution and design are priority with various sectors such as packaging manufacturers globally. Plastic specifications are in need of more quality designed in order for us to implement a standard that is less harmful and eco-friendly.

2. Gasification/biochar
    - Single use plastics typically have contamination, are made with mixed polymers, thermoset materials, including composites, they are very difficult to recycle in traditional ways (shred/grind, melt and compound new resin). In order to process these very challenging streams, pyrolysis, gasification processes are one of the few options to create syn-gas (energy source) and biochar (for beneficial reuse) of mixed organic plastic constituents. These systems are not without challenges however, but development to create efficient and effective systems needs to continue with entrepreneurs, academics and governmental agencies. We need investment with technologies that will advance the infrastructure for positive impact.
3. Multi-sector collaboration. In order for us to communicate and bring awareness to the crisis for single use plastics we need to create multi-sector collaborations that will assist with demonstrations or pilots. With all of various industries that utilize plastic, it seems to be a disconnect with communication. Everyone from the manufacturers to packaging companies need to convene and began to utilize alternative solutions. We believe if most industries understood that they had a waste to energy convenient location, they would be more supportive with making sure the plastic wouldn't be discarded.
4. Material substitutions/ Design for the Environment/Disassembly
    - This is a twofold concept. First, using more sustainable materials (reusable, repurpose, recyclable) should be done. Second, when products are designed, they should be done in a way to enable quick and efficient dispositioning into a predetermined second life, with those outlets secured.
5. Extended producer responsibility and corporate goals. It's always positive when corporations implement goals that align with sustainability.
6. Bioplastics and biodegradable plastic derived from biological substances.
7. Infrastructure, including processing and remanufacturing—rebuilding of a product to specifications of the original manufactured product using a combination of reused, repaired and new parts.

8. More OEM direction in material designs
    - Material specifications and other requirements from OEMs, directing suppliers in their manufacturing systems and products that enable continued material use and phasing out single use plastics.
9. Film programs
    - Single use plastic films account for a very large percentage of single use plastics. This includes packaging films that protect food and beverage industry products. More development is needed to help the food and beverage industry in maintaining freshness in food products while maintaining quality, throughput, cost, health and safety for all. Multi-layer, incompatible polymer films that are contaminated with bio-matter are one example of a challenge in this space.
10. Preferences in purchasing recycled content
11. Low landfill costs preventing innovation, the cost to discard materials has consistently disrupted the innovation of industries. It's imperative that we replace landfills with innovative technology for the purpose of reducing carbon dioxide (CO2).
12. Regulatory burden easements for P2
    - Regulation is not keeping up with technologies and advances in pollution prevention. Beneficial reuse concepts need to be considered and enacted when feasible in a swift manner. This is particularly challenging given some aspects of the current RCRA regulation. It was understood that the development of the Pollution Prevention Act of 1990 was to address this issue, but that does not appear to be the case. Perhaps we need to revisit the Pollution Prevention Act or create new legislation based on new regulations.

The challenges of climate change means that we need to invest in innovation and creativity. While our work is measurable, we know aspects extend far beyond those matters that are measurable or tangible. I am in support of the Legislation Recycling Infrastructure and Accessibility Act of 2022, as well as the Recycling and Composting Accountability Act. I truly believe that it's time to revisit specifications of single use plastics and implement legislation that will provide incentives and investments. Thank you for your time and consideration.

Pashon Murray
Chief Executive Officer
Detroit Dirt LLC. & Detroit Dirt Foundation.

Senator CARPER. Thank you for that p.s., and for joining us today, and your testimony.

Next, we are going to hear from Ben Harvey, I think, remotely.

Ben Harvey, we are delighted that you can join us, and would ask you to just proceed, please. Thank you.

STATEMENT OF BENJAMIN HARVEY,
PRESIDENT, E.L. HARVEY AND SONS, INC.

Mr. HARVEY. Thank you.

Good morning, Chairman Carper and Ranking Member Capito and members of the Committee. My name is Ben Harvey, and I am President of Westborough, Massachusetts, based E.L. Harvey and Sons, Inc., a full service waste and recycling firm servicing residential, commercial, industrial, and municipal customers throughout eastern New England.

I am testifying today in my capacity as Chairman of the National Waste and Recycling Association, which represents the private sector waste and recycling industry that is essential to maintaining the quality of American life.

I thank you for the opportunity to appear before the Committee today and present you with the industry perspective on recycling infrastructure and accessibility and discuss its impact on us.

Ensuring that all Americans have access to recycling provides sustainable materials management across the Nation. Rural areas have unique challenges collecting recyclables and accessing recycling markets, leaving many communities underserved.

Recycling has become increasingly complex over the past 20 years. To manage the growing diversity of materials, material recovery facilities, or MRFs, must have more and increasingly sophisticated equipment.

Today's MRFs do not just have magnets, eddy current separators, and screens. They include optical sorters and robots. To account for the increasing equipment costs, today's modern MRFs are larger and service regions rather than single communities. They are increasingly run by private sector companies that can adapt quickly to the changing makeup of packaging.

These attributes make recycling in rural communities particularly challenging. MRFs are sited near population centers sometimes great distances from rural communities. Rather than curbside collection, rural residential recycling often consists of drop off programs or private sector subscription programs, with limited participation. Once recyclables are collected, transporting the materials to processing facilities and ultimately, to end markets, represents another hurdle.

However, rural recycling can achieve success through the hub and spoke model, which creates consolidation hubs that service small communities. These transfer stations are where smaller truckloads of materials are consolidated into larger truckloads for their final transfer to processing facilities. Rural communities interested in adopting such a model would benefit from grants for transfer station infrastructure construction and recycling tractor trailers and transfer trailers to move the material.

Hub and spoke systems reduce transportation and provide much needed operational efficiency to make recycling viable for rural

areas. That is why I was encouraged by the approach undertaken by Senator Capito's legislation. The private and public sector usually benefit from a model where public sector can efficiently collect materials from rural areas and transfer them to privately operated MRFs for processing. Privately operated MRFs typically share revenues from the sale of the processed recyclables with the communities that bring the materials to them. We wholeheartedly support a program where rural communities can access the global recycling markets.

Whatever we do needs to be undergirded with good data. Recycling, composting, and waste composition has changed significantly over time. Paper and cardboard have long made up the largest component of our recyclables, but this has changed significantly with newspapers now only a third of where it was in 2005, and cardboard boxes from households increasing due to what we call the Amazon effect.

Food waste has become the largest part of what ends up in landfills, and disposal of clothing has doubled over the last 20 years.

As a businessman, it is important for me to be able to make decisions founded on good data. That is why I am also pleased to support the Recycling and Composting Accountability Act that empowers EPA to perform the studies that we need.

Again, thank you, Mr. Chairman and Ranking Member Capito, for this opportunity to testify today. I will be happy to respond to any questions.

[The prepared statement of Mr. Harvey follows:]

STATEMENT OF
BENJAMIN A. HARVEY, PRESIDENT
E.L. HARVEY & SONS, INC.

ON BEHALF OF
THE NATIONAL WASTE & RECYCLING ASSOCIATION

REGARDING
RECYCLING INFRASTRUCTURE AND ACCESSIBILITY PROGRAM
&
RECYCLING AND COMPOSTING ACCOUNTABILITY ACT

BEFORE THE
COMMITTEE ON ENVIRONMENT & PUBLIC WORKS

UNITED STATES SENATE

February 2, 2022

Good morning, Chairman Carper, Ranking Member Capito and Members of the Committee:

My name is Ben Harvey, and I am president of Westborough, Massachusetts-based E. L. Harvey & Sons Inc., a full-service waste and recycling firm that provides services for commercial and industrial corporations and municipalities throughout eastern Massachusetts, New Hampshire, Rhode Island and Maine. I am testifying today in my capacity as Chairman of the National Waste & Recycling Association (also referred to as "NWRA" or "the association"), which represents the private sector waste and recycling industry.

I thank you for the opportunity to appear before the committee today and present to you the industry's perspective on recycling infrastructure and accessibility and to discuss its impact on our industry.

By way of background, E. L. Harvey & Sons Inc. was founded in 1911 and is a four-generation family-operated business. In 2021, it became a subsidiary of Waste Connections, Inc. We handle residential, commercial, and construction contracts that include waste disposal, recycling services, secure document shredding, product destruction, food waste and more. We currently have over 4,000 commercial clients that range from hospitals and business parks to malls and government agencies. Our commercial waste and recycling can be custom-tailored to fit the needs of individual businesses. Residential customers have access to a variety of services including curbside recycling collection, dumpster rentals and junk removal.

E.L. Harvey runs two waste disposal and recycling sites, each accessible to the public. Our facilities can handle a wide range of items, including single stream recycling, construction & demolition material, electronics, and other types of waste. In 2007, E.L. Harvey committed to recycling construction materials by building a new facility solely for that purpose and installing state-of-the-art material sorting equipment. The facility allows us to separate different materials, making the process both quicker and more efficient.

The National Waste & Recycling Association is the voice for the private sector waste and recycling industry that is essential to maintaining the quality of American life. The delivery of waste and recycling services impacts all residential, commercial, and industrial properties on a daily basis.

NWRA's mission is to provide leadership, advocacy, research, education, and safety expertise to promote the waste and recycling industry. NWRA's goal is to create a favorable business climate where our members can prosper and provide safe, economically sustainable, and environmentally responsible services and jobs that benefit communities throughout America.

Association members operate in all 50 states and the District of Columbia and can be found in most, if not all, U.S. congressional districts. Waste and recycling facilities number nearly 18,000 scattered throughout the U.S., mirroring population centers. NWRA's nearly 700 members are a mix of publicly traded and privately owned local, regional and Fortune 500 national and international companies. NWRA represents approximately 70 percent of the private sector waste and recycling market.

It is estimated that the private sector waste and recycling industry accounts for more than one million jobs and generates nearly a quarter of a trillion dollars in U.S. GDP. The industry's publicly traded companies are among the largest components of the Dow Jones U.S. Waste & Disposal Index

Ensuring that all Americans have access to recycling provides equity and ensures sustainable materials management across the nation. However, rural areas often have unique challenges in collecting recyclables and accessing recycling markets leaving these communities underserved. Worse, global import restrictions over the past few years have resulted in reduced recycling access.

Recycling has become increasingly complex over the past twenty years. The public demands greater amounts of packaging be recycled. To manage this growing diversity of materials, materials recovery facilities, or MRFs, must have more and increasingly sophisticated equipment. Today's MRFs do not just have magnets, eddy current separators and screens. They include optical sorters and robots. To account for the increasing equipment costs of today's modern MRF, the MRFs are larger and service regions rather than single communities. They are also increasingly run by private sector companies that can adapt quickly to the changing makeup of packaging.

These attributes make recycling in rural communities particularly challenging. MRFs are sited near population centers, sometimes great distances from geographically remote rural communities. Rather than curbside collection, rural residential recycling often consists of drop-off programs or private sector subscription programs with limited participation. Once recyclables are collected, transporting the material to processing facilities and ultimately to end markets represents another hurdle.

However, rural recycling can achieve success through the "hub and spoke" model, which creates consolidation hubs that service the spokes leading out to small communities. These recycling hubs, often referred to as transfer stations, are where smaller truckloads of materials can be consolidated into larger truckloads for their final transfer to processing facilities. Rural communities interested in adopting such a model would benefit from grants for transfer station infrastructure construction, recycling transfer tractors and trailers. Hub and spoke systems reduce transportation and provide much needed operational efficiency. It improves recycling access and lowers the overall costs for rural areas thereby making recycling much more viable for them. That is why I was encouraged by the approach undertaken by Senator Capito's legislation.

Large, privately operated MRFs are more resilient to market downturns because of their close integration with materials buyers and other stakeholders. Their large size contributes to economies of scale that improve operational efficiencies. They have relationships with end markets and leverage due to the volume of materials that are managed. Privately-operated MRFs typically share revenues from the sale of the processed recyclables with the communities that bring the materials to them.

The private and public sector mutually benefit from a model where the public sector can efficiently collect materials from rural areas and transfer them to the privately operated MRFs for

processing. We wholeheartedly support a program where rural communities can access the global recycling markets.

Whatever we do, however, needs to be undergirded with good data. Recycling, composting and waste composition has changed significantly over time. For example, paper and cardboard have long made up the largest component of our recyclables but this has changed significantly with newspapers now only a third of what they were in 2005 and cardboard boxes from households increasing due to what we call the "Amazon effect." Food waste has become the largest part of what ends up in our landfills and the amount of clothing disposed has doubled over the last twenty years. As a businessman, it is important for me to be able to make decisions founded on good data. That's why I'm also pleased to support the Recycling and Composting Accountability Act. This act will empower EPA to perform the studies that we need.

Again, thank you Mr. Chairman and Ranking Member Capito for this opportunity to testify today. I will be happy to respond to any questions.

Senate Committee on Environment and Public Works
Hearing Entitled "Legislative Proposals to Improve Domestic Recycling and Composting Programs" February 2, 2022
Response to Questions for the Record for Benjamin A. Harvey

In response to Senator Whitehouse:

Question 1.

The United States has an abysmal recycled content rate for single use plastics of only two percent. A recent report found that across five major cities, only 8.8 percent of the plastic that goes into garbage and recycling bins actually ends up getting recycled. What needs to be done to solve our plastic recycling failure?

Plastic currently makes up only about 6% of the material by weight that goes through our Material Recovery Facilities, or MRFs. The most effective ways to increase the rate of recycling for plastic packaging is by:

1. Creating demand – this can be done by establishing a minimum recycled content for the packaging – this will result in true "circularity" of the packaging. We must be able to use more post-consumer plastics in food and product containers to complete the recycle circle. The majority of the recycled plastics today are used in non-packaging products like carpet, drainage pipes and irrigation pipes.
2. Reducing confusion – with so many different plastic resins and packaging formats and shapes as well as multi-layered packaging, no wonder the public is confused about what can be recycled. Consistent and continued education on recycling is a must for high quality recycling. An easy way to do this is to have labeling on the packaging itself that correctly identifies whether the packaging can be recycled. The current resin codes add to the public's confusion – making them believe that any package that has a resin code on it is recyclable even when it isn't.
3. Design for recycling – MRF owners are being asked to handle more and more different types of materials, many of them not designed for recycling. Each resin must be sorted and stored and marketed due to different properties and different end uses. Also, it is much easier for MRFs to separate single resin plastic containers than multi-resin plastic products. Recycling should be considered at the outset and should be part of how the packaging is designed before being put on store shelves.

In response to Senator Sullivan:

Question 1.

This hearing explored the accessibility and effectiveness of recycling throughout the country and what Congress should be doing about it. But as you of course know, state and local law—not federal law—governs most recycling program implementation.

For example, in Anchorage, glass is recycled locally—used in city projects—while many other recyclables are barged to Washington State. This sounds inefficient, but it actually might be the best local solution, because these barges would otherwise be dropping off items in Alaska and returning empty.

What are your thoughts on how to avoid a top-down mandate on recycling and instead balance a potential federal framework with maximum state and local flexibility?

It is extremely important to allow State and Local governments to have the flexibility to manage the recyclables that are generated within their jurisdictions. There can be opportunities to manage some recyclables close to the source like glass that has a low value and needs specialized handling equipment. For higher value materials that can be consolidated, baled and shipped as a back haul, there can be endless opportunities to ship these materials anywhere. Examples are paper, cardboard, plastic, aluminum cans and metal. For years, our industry has exported recyclables globally. Despite that, developing local markets, where feasible, should always be encouraged. Long range sustainability is the key to success of any proposal to Improve Domestic Recycling.

Question 2.

According to the EPA website, "The National Recycling Strategy is focused on enhancing and advancing the national municipal solid waste (MSW) recycling system." The EPA definition of MSW does not include industrial waste. From your perspective, would it be beneficial economically and environmentally to include industrial waste in a national recycling strategy as well?

I think the focus of the National Recycling Strategy should be on the public and commercial sectors rather than industrial wastes. Most industrial waste generators are clean and consistent and as a result usually have good recycling programs for them. Nevertheless, we should continue to encourage and inform industrial waste generators about the economical and environmental benefits of a good recycling strategy.

Respectfully Submitted.

March 2, 2022 Benjamin A. Harvey
Chair: National Waste and Recycling Association

Senator CARPER. Mr. Harvey, thank you so much. I know that Senator Capito also appreciates your testimony and your presence. Thanks for joining us remotely.

Batting cleanup, Mr. Levell Hairston; I am going to ask you to go ahead and give us your opening statement. Levell, thanks so much for coming.

STATEMENT OF CHARLES LEVELL HAIRSTON, VICE PRESIDENT AND GENERAL MANAGER FOR RECYCLING AND RECOVERED FIBER, INTERNATIONAL PAPER

Mr. HAIRSTON. Thank you, Chairman Carper, Ranking Member Capito, and Senator Boozman, and distinguished members of the Committee. Thank you for the opportunity to speak today. My name is Levell Hairston, and I am the Vice President and General Manager of Recycling for International Paper.

We are a leading global supplier of renewable, fiber based products, which includes corrugated packaging products and pulp for diapers, tissue, and other personal care products. We are headquartered in Memphis, Tennessee, and employ approximately 27,000 colleagues in the U.S.

In our business, recovered fiber refers to paper and fiber based packaging products that have served their primary purpose and are now ready to be collected and recycled. In addition to manufacturing, International Paper recovers more than 7 million tons of recovered fiber annually.

In 2020, International Paper released a Vision 2030 goal, which demonstrated our commitments to building a better future for people, the planet, and the company. These goals are detailed in my written statement.

As a company that truly embraces the concept of a circular economy, our renewable solution goal includes a target to create innovative products that are 100 percent reusable, recyclable, or compostable, a metric designed to accelerate the transition to a low carbon economy throughout the company's value chain.

I am pleased to share our support of the Recycling and Composting Accountability Act and the Recycling Infrastructure and Accessibility Act today, and to add some insights into International Paper's recycling business and the papers industry's commitment to circularity and sustainable practices.

End markets for recovered paper products are strong, and thanks to the significant private investments by our industry over the past decades and established value chain of our customers. We support market based approaches, like the provisions in these two bills, to improve the Nation's recycling system.

The paper industry is a leader in recycling. According to the EPA, by weight, more paper is recovered for recycling from municipal waste streams than plastic, glass, steel, and aluminum. Paper recycling rates have continuously grown over recent decades and remain consistently high, at or above 63 percent since 2009.

In 2020, nearly 66 percent of the paper and 89 percent of the corrugated boxes were recycled. The paper industry has planned or announced approximately $5 billion in manufacturing infrastructure investments by the end of 2023 to continue to best use of recycled fiber in our products. These investments will help increase the

amount of recovered paper used by U.S. paper and paperboard mills by approximately 8 million tons, which would represent about a 25 percent increase in U.S. recovered paper consumption over the 2020 levels.

Legislation like the Recycling and Composting Accountability Act would help companies like International Paper reach our goals. As a data driven company, we understand to improve something, you must be able to measure it. International Paper proudly developed these goals, and it will take resources, like in this bill's data finding, to help us achieve them.

Our industry prioritizes data collection to improve recycling rates. The American Forest and Paper Association has completed two key data projects in the last year. This includes AF&PA's Access to Recycling Study, which found that 94 percent of Americans have access to community paper or paperboard recycling programs. The study also finds that 79 percent of Americans now have access to curbside residential recycling programs, making it easier for them to recycle at home. This represents an increase of more than 14 million people since the 2014 study was done.

Second, last year, AF&PA released a design guidance for recyclability. The guide provides data for packaging designers and consumer brands to better understand how non-fiber elements such as coatings and additives impact the recyclability of paper based packaging. This is another example of our industry's commitment to circularity.

We appreciate that Senator Boozman's and Chairman Carper's bill supports EPA's national recycling strategy and acknowledges that industrial efforts are part of the circular economy. We strongly support the provision that requires EPA to conduct a study of recyclable materials in commercial and municipal waste streams that, for the previous 10 years, were diverted from the circular market. We believe studies like this will highlight the strong recycling rates of the paper industry, and it will also help identify that we are close to a practical maximum and that more regulation is not needed to be able to increase paper recycling rates.

Senator Capito's bill to help increase recovered materials used by industries and access to communities without MRFs, or material recovery facilities, is also important. Without clean material, for us, it is hard for us to serve the needs of both the growing e-commerce and customer needs for our essential businesses.

Again, I just want to say thank you for the opportunity.

[The prepared statement of Mr. Hairston follows:]

Written Testimony of Charles Levell Hairston
VP and General Manager of Recycling and Recovered Fiber, International Paper
Before the United States Senate
Committee on Environment and Public Works
Hearing on Legislative Proposals to Improve Domestic Recycling and Composting Programs
February 2, 2022

Chairman Carper, Ranking Member Capito, Senator Boozman, and distinguished members of the Committee, thank you for the opportunity to speak today. My name is Levell Hairston and I am Vice President and General Manager of Recycling for International Paper. I've worked at International Paper for 15 years in various roles that began in a manufacturing facility in Selma, AL to now leading our recycling team that provides high quality recovered fiber to our company's operations and our domestic and global customers.

International Paper is a leading global supplier of renewable fiber-based products. We produce corrugated packaging products that protect and promote goods and enable worldwide commerce, and pulp for diapers, tissue and other personal care products that promote health and wellness. Headquartered in Memphis, Tenn., we employ approximately 27,000 colleagues in the United States. We serve customers worldwide, with manufacturing operations in North America, Latin America, North Africa and Europe.

In our business, "recovered fiber" refers to paper and fiber-based packaging products that have served their primary purpose and are now ready to be collected and recycled. In addition to manufacturing, International Paper recovers more than 7 million tons of recovered fiber annually. Our 18 locations in North America collect and process recyclable materials for their highest value end use. These facilities service commercial entities, manufacturers and governmental organizations, helping them to reduce transportation costs and meet sustainability goals. With our value-added services around document destruction, office and distribution centers and non-fiber recycling materials capability, we offer a complete recycling solution. International Paper is also one of the world's largest purchasers of recovered fiber. This recovered material flows into our mills like in Cedar River, Iowa, where International Paper is proud to operate the largest 100 percent recycled corrugated packaging mill in North America.

We also recycle from our own manufacturing processes. One example is our use of industrial clippings called Double Lined Kraft Cuttings (DLK). DLK is industrial clippings generated from trimming rolls of paper for packages. We collect the trimmings and use them in our mill system, increasing circularity and avoiding waste. The use of recovered fiber in all forms is vital to our process of manufacturing sustainable and circular packaging for our customers in the U.S. and around the world.

I am pleased to share our support of the Recycling and Composting Accountability Act (RCAA) and the Recycling Infrastructure and Accessibility Act (RIAA) today and some insights into International Paper's recycling business and the paper industry's commitment to circularity and

sustainable practices. End markets for recovered paper products are strong thanks to significant private investments by our industry over many decades and an established value chain of customers. We support market-based approaches, like the provisions in RCAA and RIAA, to improve the nation's recycling system.

Paper Recycling Is a Success

The paper industry is a leader in recycling with about 50 million tons of recovered paper recycled every year — totaling more than 1 billion tons over the past 20 years. According to the EPA, by weight more paper is recovered for recycling from municipal waste streams than plastic, glass, steel, and aluminum combined. Our industry has an ownership stake in the recycling system and 80 percent of paper mills use some amount of recycled fiber.

Paper recycling rates have continuously grown over recent decades and remain consistently high, at or above 63 percent since 2009; in 2020, nearly 66 percent of paper and 89 percent of corrugated boxes were recycled. The paper industry has planned or announced approximately $5 billion in manufacturing infrastructure investments by the end of 2023 to continue the best use of recycled fiber in our products. These investments will help increase the amount of recovered paper used by U.S. paper and paperboard mills by approximately 8 million tons. As a frame of reference, 8 million tons would represent about a 25 percent increase in U.S. recovered paper consumption over 2020 levels.

As the demand for corrugated packaging grows to support ecommerce and our customers across various essential industries, we will need a strong supply of quality recovered material to complete the circularity of our products. Contamination in the recovery stream remains a concern, which is why we supported the RECYCLE Act provisions in the Infrastructure Investment and Jobs Act that is now federal law. We appreciate the Senate's leadership in advancing the RECYCLE Act so that consumers will better understand how and what to recycle. We believe that educating consumers on the best way to recycle will increase the yield of clean material coming into the system and further grow the recovery rate.

Sustainable Practices are the Foundation of our Industry

The paper industry is a leader in sustainability. We are circular by nature. We make essential products from renewable and recycled resources, generate renewable bioenergy and are committed to continuous improvement through the industry's sustainability initiatives.

In 2020, International Paper released our Vision 2030 goals which demonstrate our commitment to building a better future for people, the planet and the company. Through the goals, International Paper plans to advance its contributions to the circular, low-carbon economy while building on its commitments to its people and communities.

The company has committed to achieving the following goals by 2030:

- Healthy & Abundant Forests: Lead forest stewardship efforts globally
- Thriving People & Communities: Promote employee well-being by providing safe, caring and inclusive workplaces and strengthen the resilience of our communities

- Sustainable Operations: Improve our climate impact and advance water stewardship
- Renewable Solutions: Accelerate the transition to a low-carbon economy through innovative fiber-based products

Each International Paper 2030 goal includes one to three specific, measurable targets, enabling the company to track its progress throughout the decade. The targets include commitments to reduce greenhouse gas emissions by 35% from 2019 levels, to reduce water usage by 25% and to create innovative products that are 100 percent reusable, recyclable or compostable.

We are committed to driving significant progress in the low-carbon circular economy and leading our industry toward a more sustainable future. International Paper is proud to announce that our 35% Greenhouse Gas reduction target has been approved by Science Based Targets initiative (SBTi) as consistent with levels required to meet the goals of the Paris Agreement. The targets covering greenhouse gas emissions from International Paper's operations are consistent with reductions required to keep warming to well-below 2°C. Additionally, International Paper's target for the emissions from its value chain meet the SBTi's criteria for ambitious value chain goals, meaning they are in line with current best practice. SBTi is a collaboration between the Carbon Disclosure Program, United Nations Global Compact (UNGC), World Resources Institute (WRI), World Wide Fund for Nature (WWF) and one of the We Mean Business Coalition commitments.

International Paper is also among a growing group of companies embracing the concept of the circular economy. Our Renewable Solutions goal includes a target to create innovative products that are 100% reusable, recyclable or compostable – a metric designed to accelerate the transition to a low-carbon economy throughout the company's value chain. We work throughout the value chain, with suppliers and customers to develop more circular solutions – from sourcing and purchasing to the reuse, recovery, and recycling of materials – evolving the design of our products so that they can enjoy multiple lives through continuous cycles of recovery and reuse. International Paper works to develop innovative products with a focus on design for recyclability like ClimaGuard® containerboard, which meets the Fibre Box Association's (FBA's) certification standard for recyclability and repulpability.

Legislation like the Recycling and Composting Accountability Act will help companies like International Paper reach our goals. As a data-driven company we understand that to improve something, you must be able to measure it. International Paper proudly developed stretch goals and it will take resources like the bill's data around recycling, reuse and composting to help us achieve them.

Industry-wide, paper and paper-based packaging manufacturers are making commitments across the board. We have come together in our industry association – American Forest & paper Association ("AF&PA") – to commit to *Better Practices, Better Planet 2030: Sustainable Products for a Sustainable Future*, which builds on our success and continues our commitment to manufacture sustainable products for a sustainable future. Included in our 2030 goals are commitments to strengthening the role our industry plays in advancing the circular economy

through innovations in manufacturing processes products and packaging; increasing the utilization of recycled fiber and wood residuals in manufacturing across the industry to 50%; increasing the percentage of our products that are recyclable or compostable; and collaborating with stakeholders and educating them on the value of renewable materials.

The Paper Industry's Research Initiatives
Our industry prioritizes data collection to improve recycling rates and we have long invested in research into the current state of paper recycling and how we can improve. I will discuss two examples that AF&PA has completed in the last year.

AF&PA recently released a new report indicating that the vast majority of Americans, 94 percent, have access to community paper and paperboard recycling programs. The *2021 AF&PA Access to Recycling Study* is a comprehensive national report that tracks and measures the growth of consumer access to community paper and paperboard recycling in the U.S. The study also finds 79 percent of Americans now have access to residential-curbside programs making it easier to recycle paper at home. This represents an increase of more than 14 million people since 2014, when the previous edition of the Access Study was conducted. With such a high rate of collection, Americans can feel confident knowing that paper products, whether it's the shipping box that lands at your doorstep or the box delivering your next pizza, can and should be recycled.

Second, last year, AF&PA released The Design Guidance for Recyclability. This guide provides data for packaging designers and consumer brands to better understand how non-fiber elements, such as coatings and additives, impact the recyclability of paper-based packaging. This is another example of our industry's commitment to circularity.

The Recycling and Composting Accountability Act
International Paper is pleased to support the RCAA, along with the American Forest & Paper Association, and we applaud the leadership of Senators Carper and Boozman. Although we know that paper recycling is strong, there is always room for improvement. The bill underscores Congress' support for recycling and notes how industrial efforts are part of the circular economy. It will help further increase and improve recycling and composting in the United States by helping the Environmental Protection Agency (EPA) to improve measurement, data and reporting tools. It supports EPA's National Recycling Strategy by putting data collection needs into legislative text and ultimately law.

The bill will require EPA to prepare an inventory of U.S. public and private materials recovery facilities, including the number of materials recovery facilities by state and locality and a description of the materials that each materials recovery facility can process. We applaud the bill's provision that commits to protecting confidential business information.

The bill will calculate the number of community curbside recycling and composting programs, understand barriers, and the inbound contamination and capture rates of community curbside recycling, drop-off recycling, or composting programs. As discussed above, the 2021 Access to

Recycling Study shows that the vast majority of Americans, 94 percent, have access to community paper and paperboard recycling programs. The bill should help determine rates for other commodities.

The bill will require EPA to conduct a study of recyclable materials in commercial and municipal waste streams that, during each of the 10 calendar years preceding the year of submission of the report, were diverted from the circular market. We believe that this study will highlight the strong recycling rates of paper and paper-based packaging and will help clarify why our current paper recycling rates are reaching a practical maximum that regulations cannot improve. For example, products like wall tape used in construction or soiled tissues are not intended for recovery.

Lastly, the bill will assess the recycling and composting rates reported by Federal agencies, including the total annual percentage of products containing recyclable material, compostable material, or recovered materials purchased by all Federal agencies. This study asks for recommendations for updating the comprehensive procurement guidelines and the environmentally preferable purchasing program. International Paper would like to caution that any reconsideration of the post-consumer recycled content requirement must incorporate industry input so the EPA can understand any potential unintended consequences of changes. Raising the percentage of recycled content above certain levels may be impractical and could lead to market distortions. One of the attributes that makes fiber based packaging a desirable material is its ability to be used multiple times. Recycled paper fibers can be reused 5 to 7 times to make new products. However, packaging does require some amount of new fiber periodically to ensure strength of the packaging.

The Recycling Infrastructure and Accessibility Act

International Paper is pleased to support the RIAA, along with the American Forest & Paper Association, and we applaud the leadership of Senator Capito. The bill would improve recycling accessibility in communities, including in underserved communities, by increasing the number of transfer stations, expanding curbside recycling collection programs where appropriate, and leveraging public-private partnerships to reduce the costs associated with collecting and transporting recyclable materials in underserved communities.

Thank you again for the opportunity to share International Paper's perspectives with the committee. We are pleased to support the Recycling and Composting Accountability Act and the Recycling Infrastructure and Accessibility Act and appreciate the work of Senators Carper, Boozman, Capito and their staff to further improve recycling nationwide.

Responses from Charles Levell Hairston, Vice President of Recycling and Recovered Fiber International Paper

Hearing titled: Legislative Proposals to Improve Domestic Recycling and Composting Programs on February 2, 2022

Senator Whitehouse:

Question:

The United States has an abysmal recycled content rate for single use plastics of only two percent. A recent report found that across five major cities, only 8.8 percent of the plastic that goes into garbage and recycling bins actually ends up getting recycled. What needs to be done to solve our plastic recycling failure?

Answer:

From my perspective, it's important to first convey that the wise use of resources and sustainable forest management is at the core of everything we do. It in large part drives our commitment to recycling. International Paper has been in existence for nearly 125 years, and the renewable forest resources we manage and use in our products are of the utmost importance to our employees and external stakeholders. Thus, I believe we have always approached the question of recovery and reuse from a much different starting point than other industries. This philosophy has driven our continued investment in our own recycling infrastructure.

To best answer your question, I will reference the paper and paper-based packaging industry's efforts over several decades. We invested and continue to invest in our own recycling infrastructure, without government intervention or mandates, because we had growing markets and a value chain and saw the potential to benefit our operations and the environment. As a result, nearly 90 percent of Old Corrugated Containers (boxes) and 65 percent of paper were recovered in 2020. Our customers truly appreciate the value of our renewable fiber-based products and their sustainability benefits and contributions to the circular economy.

More recently, we worked as an industry to tackle the recyclability of pizza boxes by conducting research on their acceptability in packaging mills and then educating stakeholders about their acceptance to increase recovery.

Design for recyclability is another important aspect toward increasing recovery rates. Last year, the American Forest & Paper Association released their Design Guidance for Recyclability. This guide provides data for packaging designers and consumer brands to better understand how non-fiber elements, such as coatings and additives, impact the recyclability of paper-based packaging. This is another example of our industry's commitment to circularity.

We encourage the Senate to focus their efforts on market-based solutions to increase recycling and oppose efforts that degrade the definition at the core of recycling. For example, we oppose advanced recycling policies that use pyrolysis and gasification to convert plastics into fuel or

energy as they are not "recycling" and should not be defined as such. The U.S. EPA differentiates energy recovery (through processes like pyrolysis and gasification) from recycling and places it in a lower category than recycling on its Waste Management Hierarchy. Proponents advocating for the expansion of the definition of "recycling" to include pyrolysis and gasification are attempting to conflate breaking down polymers into original monomers for use in making new plastic products (chemical recycling) with thermochemical conversion of post-use polymers into fuels or for energy production (energy recovery). They are not the same.

Senator Sullivan:

Question:

In Alaska we collect materials for recycling, but we have very limited processing facilities or other industries that can directly re-use these materials, so most of it has to be shipped out of state.

As someone who brings the business perspective, what do you see as Congress' role in making recycling more economically feasible for lower population areas far from processing facilities?

According to the EPA website, "The National Recycling Strategy is focused on enhancing and advancing the national municipal solid waste (MSW) recycling system." The EPA definition of MSW does not include industrial waste.

I note with interest International Paper's commitment to a circular economy, including recycling from your own commercial processes. From your perspective, would it be beneficial economically and environmentally to include industrial waste in a national recycling strategy as well?

Answer:

Recovered fiber is a high-value, high-demand global commodity. If we can collect it, our industry will consume it and turn it into new, circular products. In my remarks at the hearing, I reinforced the importance of recyclable materials that are collected from mills, converting facilities and other International Paper business operations. In the recycling world, those are known as "ICI" or Industrial, Commercial and Institutional sources. Recyclable materials collected from ICI sources are currently counted in EPA's national recycling data and should be included in the EPA National Recycling Strategy.

We would like to see EPA recognize these materials in their strategy due to the critical role that industries like ours play in the circular economy. For International Paper, this is one way to help meet our triple bottom line: planet, people, and profit.

Because of our approach to collecting and consuming a significant amount of recovered fiber to meet the growing need for packaging, it's important to note that mandates that require certain amounts or types of recovered fiber in a given product disrupt the global supply chain, add costs to consumers, and result in other environmental impacts and unintended consequences. If recycled content mandates are proposed in the Senate, I hope that we can be a stakeholder and share our real-world experiences in the discussion.

In terms of making recycling more economically feasible in lower population areas, International Paper is pleased to support the Recycling Infrastructure and Accessibility Act (RIAA) by Senator Capito which develops a pilot program for areas without a Materials Recovery Facility within 150 miles. We believe that this type of market-based approach is a great example of how business and government can work together to increase access without distorting markets. The bill will allow greater access to recycling for Americans in states like Alaska by providing additional options for recovery. An increase in the yield of clean recovered material can make recycling more economically feasible because of a strengthened value chain that can utilize the materials to make new products.

Senator CARPER. Thanks very much for your testimony, Levell.

Let me ask a couple of questions, and then I will yield to Senator Capito. She will be followed by Senator Whitehouse, Senator Boozman, and Senator Stabenow, and then by others as they join us, remotely or in person.

Question to start off with, Rhodes Yepsen. Mr. Yepsen, with respect to curbside composting data, you mentioned in your testimony that your organization has been working on tracking residential composting programs, I think you said, for nearly a decade. Yet significant data gaps remain. How would a study of curbside programs at the Federal level help eliminate existing data gaps and arm communities with the information they need to set up successful composting programs? Please proceed.

Mr. YEPSEN. Yes, thank you for that question. I was fortunate early in my career to work with BioCycle Magazine on some of that data tracking for residential curbside composting programs, and yes, while I have been working on it for a little over a decade, BioCycle has been at it for many decades. I think what I would like to highlight is that, as we heard earlier from Senator Capito, there are a lot of trade publications; WasteDive is one of them.

So, part of the challenge is in collecting the data, and part of it is how does that information get out to the public. As a publication, BioCycle does wonderful investigative journalism, contacting States and municipalities to get that data collected, collate it, and then report back out on it.

However, there is a big distinction between that and what we see with something like the EPA facts and figures. Those reports are incredibly important for standardizing the type of data that is collected and for getting that information out to the wider public. So I think that is the main thing that I would highlight, that is how this would help fill that data gap.

Senator CARPER. OK, thank you very much.

Next question to Ms. Murray. This question is with respect to the national composting strategy and carbon reduction. As I mentioned, my wife and I are avid home composters and have been for some time. I am deeply interested in the role that reducing our food waste could play in conserving space in our landfills and reducing the harmful methane emissions that contribute to climate change.

Delaware is not a big State. We are about 100 miles from north to south, about 50 miles from east to west, and we need all the land we have. We have got about a million people, so we don't need to create more and more space for a lot of landfills. We need to figure out how to compost and recycle.

I think that this is an issue of social justice as well, as 30 to 40 percent of our Nation's food supply is wasted, while nearly 14 million Americans, many of whom are children, experience food insecurity. With these potential benefits in mind, the Recycling and Composting Accountability Act would direct the Environmental Protection Agency to conduct a study on the capability of the United States to implement a national residential composting strategy. The question is this: What do you see as the potential benefits of creating a national composting strategy?

Ms. MURRAY. Thank you, Senator, for that question. I have been waiting for years to have someone address these issues.

Senator CARPER. The wait is over.
Ms. MURRAY. Hallelujah.
Senator CARPER. The day has come.
[Laughter.]
Ms. MURRAY. And it being bipartisan, this is amazing.

First, I would like to say that if we really break the waste stream down and look at the economics of what the waste stream really is and the value of how much we are burying in landfills, that should actually create a red flag right there, because there is over $200 billion of food waste being wasted annually in this country alone. So first of all, we need to make sure that the education and the awareness around this is just very crucial and imperative.

But it is the byproducts that can be made from this. In the past history, people have been interested in the tipping fees and creating sites where they are looking at the front end of how much money they can make by discarding the waste, but it is not waste. It is a resource. Composting is actually healthy for soils, for our landscapes, our urban landscapes, for water runoff, et cetera.

We have to look at the market and actually, on a national level, of creating retail and wholesale markets around this product as well. When you walk into a Home Depot or a grocery store, you have all these chemical fertilizers and chemically based products that we have to replace. There is no need to do that. We have the technology to actually create byproducts that can replace those chemically based products.

And it is also healthy for not just the environment, but also we are looking at the economic benefit of that. I also would like to say that the more access we have to sites, whether they are boutique sites of two to three acres or a larger composting site, we have to look at the energy embedded in this, as well. When you truck compost or waste 30, 40 miles outside of the city, that is a lot of energy wasted. When you create a closed loop cycle or a closed loop market within an urban community or a rural community, you are actually keeping those products within that circular economy, which is a great benefit. So we are looking at social, economic, and environmental impacts.

The key here is, at Detroit Dirt, we wanted to be able to display the fact that we could take manure from the zoo, food waste from automotive communities, and keep that product right in the community for urban farming, for people to purchase, but also reducing emissions. So I think a national campaign around education and implementing these practices and doing away with antiquated practices is key. We have technologies, weather permitting, whatever region we are in, to actually divert that waste and create byproducts from that.

So I think we have to look at the energy embedded in that. We also have to look at, you know, creating the circular economy or local economy and the benefits. But I think on a national level, if we can look at a few factors here, making sure that we have education and awareness for the general public. Creating curriculum for K–12 schools, we are doing that in Michigan right now. I think that that is crucial when our youth and younger students can see themselves playing a role in this. That is key because they can take that home to their households.

But I also think that when we start building these new markets to pinpoint what products we can replace that are on the market that is doing more harm, but also, when we are looking at reducing or omitting emissions, that is something, to me, from a moral and just ethical standpoint is key. So, I think, at the end of the day, socially, economically, and environmentally, we are taking a step forward in a positive direction.

Senator CARPER. Great. Thank you. Thanks for all of that. You read my mind. I had one more question I was going to ask you, and you have answered it without it being asked, so thank you for that.

Now, it is Senator Capito's turn. She will be followed by Senator Whitehouse.

Senator Capito.

Senator CAPITO. Thank you, Mr. Chairman.

Thank all of you for being here again.

I have a question for Mr. Harvey. Your family's company operates and provides recycling services in rural areas in New England. Can you explain why certain regions within New England have the infrastructure, geography, or special characteristics that enable curbside recycling, and why other areas in that region may not have that?

Mr. HARVEY. It comes down to the density of the municipality that we operate in. Our industry is all about density, and it is all about volume. We need to be able to send our trucks out in a dense area, and we need to collect the recyclables or the trash in one truck and bring it back to a central location. We want volume. So when you have a highly populated area, it is much easier to do curbside recycling.

When you get into rural areas, even in the State of Massachusetts or in New England when you go up into northern New England, it is so much harder to send that truck out and collect the material. We send two trucks out a lot of times. What the industry has started to do is to start to use what we call split bodies, so we are only sending one truck out at a time to do it.

But even in the Commonwealth of Massachusetts where we operate, we have feeder transfer stations that feed into our MRF in central Massachusetts. And we need those. We need those feeder systems to come in and make it profitable for us to run our MRFs.

So we run into the same aspects, not quite as rural as West Virginia or Oklahoma or some of the other States, but that is the biggest reason. It is density.

Senator CAPITO. Right. Well, so, investments, you mentioned, and I think you have already answered this, in transportation and other mechanisms for increasing collection and transportation would be long term solutions for rural; do you think those would be long term solutions for our rural communities, then?

Mr. HARVEY. Definitely, it would be, yes. Yes.

Senator CAPITO. OK, so our previous witness, Ms. Murray, was talking about a circular economy, so if you were looking at a transfer station system, such as you have, would you consider that a circular economy way of dealing with recycling?

Mr. HARVEY. I think the circular economy goes from the collection to the processing to the marketing and then turning it back into another product. So, collection and the processing are only one-

half of that or one part of that. We still need the outlets for the materials. We still need to establish good, solid markets, which we have worked hard for years to establish those.

We need to be able to collect the materials, but at the end of the day, we need to be able to ship them out to consumers, wherever they may be, domestically or export, wherever that market is. We need to do that to close the whole loop.

Senator CAPITO. Are those markets increasing for you now, or are they static? What is the state of the aftermarket, after it has been processed?

Mr. HARVEY. That is a very good question. We have certainly had some issues when China stopped accepting a lot of our recyclable materials. We have been very fortunate since that time that our domestic mills have picked up the need for more materials. You heard the gentleman from IP say about all the tons that they handle.

So, yes, the markets right now are actually pretty robust. They have fallen off a little bit from where they were at the end of calendar 2021, but they are still fairly robust. Another reason why we need to get into these areas that are underserviced and collect those recyclables is because there is a need and a desire to use those materials currently.

Senator CAPITO. Right.

Senator CARPER. Senator Capito, can I interrupt for just one moment?

Senator CAPITO. Oh, sure.

Senator CARPER. We all serve on different committees. Some of them are in session right now. I am being summoned to come to the Homeland Security Committee for a business meeting. They need my vote, so I am going to slip away for a while.

Senator CAPITO [presiding]. So you just need to recycle back over here. I got that one in before you could.

[Laughter.]

Senator CAPITO. Thank you.

Just a quick question for Mr. Hairston on the data collection. The most recent Recycling Economic Information Report from EPA was released in November 2020, but it was relying on 8 year old data from 2012. I know in my own community, the ebbs and flows of recycling have been very apparent, a lot of it depending on the age of the facility that can recycle, the will of the municipal government, the available funds, the participation of the residents, all kinds of things. If this legislation were to become law and improve EPA's recycling data, what insights do you think we would be able to gain from analyzing this data?

Mr. HAIRSTON. Thanks, Senator.

When we think about the data, again, when you think about the forest products industry, and you think about what we do, we have a very strong and historical track record of investing in this infrastructure. We do a great job of collecting that product and bringing it back.

The opportunity for us is how to make sure we are accessing all the fiber available. So when I think about this study and what it will do is, even the data that we do as AF&PA is a sample. The data that EPA will be able to do will give us a more detailed view

of the country and the breakdown and truly be able to identify where those opportunities are to be able to collect that fiber, collect those recyclable materials and get them back to some end use to make a new product. So I see the data as being very valuable in helping both public and private sectors understand where the opportunities are to drive a circular economy.

Senator CAPITO. Thank you.

Senator Whitehouse.

Senator WHITEHOUSE. Thank you, Chairman.

Thank you, everyone, for being here.

It strikes me that we have slightly different recycling markets for newsprint, for paper, for glass, for compost, and for plastics. I would like to focus on plastics, because I think we have a real failure happening in the plastics recycling market.

In theory, this should be a pretty vibrant market because we are seeing immense public pressure on the plastics industry to clean up its act, particularly in regard to waste that ends up in the oceans and in our rivers. We are seeing, frankly, outright bans on certain single use plastics, sending what you would think would be a strong message to the industry to clean up its act.

There is considerable reputational risk for these companies as the propagators of the material that ends up around some turtle's neck in the sea somewhere. So you would think that the conditions would be about as good as they can be for a corporate response with respect to recycling plastic instead of just churning out new plastic.

In fact, the numbers tell a completely different story. If you look at single use plastic, which is the stuff most likely to end up in the ocean, in a whale's belly, tangled around a coral reef, the industry, by my information, has managed to achieve a grand 2 percent recycling component for single use plastics, 2 percent. I mean, that is probably the number you would get by accident. Under all that pressure, the best they can do is 2 percent.

So, something needs to change if this is going to get serious. Everything tells me that the reason industry is still at 2 percent, despite all this pressure, is that the real decision driver is dollars, and it is cheaper to buy new nurdles of plastic and put out your single use plastic items than it is to buy recycled plastic. Therefore, the industry spurns recycled plastic, despite all that public pressure, because of the pressure of cost.

So, it seems to me, that is a really simple gateway to a solution to the problem to get us above 2 percent. If you look at it at our blue bins, I have blue bins that we fill with recycling. The record that I think we have on actual recycling, when an American goes to their blue bin and takes the soda bottles and the plastic waste from their household and actually puts it in the blue bin, is less than 10 percent.

Most likely, 6 to 8 percent of that actually gets recycled. More than 90 percent of it doesn't actually get recycled. It is almost at the level of being a scam on the consumers who, in good faith, are putting their plastics in those blue bins and aren't being told that the industry isn't recycling that stuff. A lot of it is simply being packed up and put into the dump. A lot of it is simply being packed

up and shipped overseas to be put into open air dumps and end up in the rivers and end up in the oceans, and go on from there.

The responsibility of the industry for getting above 2 percent in terms of recycled content for single use plastics and for doing better than having more than 90 percent of what we actually put into those blue recycling bins be recycled ought to be a lot higher. They ought to be accountable for those, I would say, catastrophic failures verging on being a fraud on the public.

So, I am hoping that we can work together not just to measure the disastrous state of plastics recycling, but to solve it. And I would really appreciate it if each of the witnesses would take a minute when this hearing is over, and take this as a question for the record and give me your ideas and suggestions as to what needs to be done to solve this dilemma of total plastics recycling failure that we are stuck in. I think it is purely cost, and I think if you are not going to put any kind of a price on dumping the plastic, any kind of a price on any type of an equivalence for recycled plastic versus new plastic, we are just never, ever, ever going to solve this.

We can talk our way around this problem forever, but the dollars drive the decisions, in my view. I would like your response to that, if you don't mind putting it in writing, so that I don't take up more time in the hearing. I appreciate it. Thank you.

Senator CAPITO. Thank you, Senator Whitehouse.

Senator Boozman.

Senator BOOZMAN. Thank you.

Mr. Hairston, Arkansas is proud to have two major companies willing to set voluntary sustainability goals. Walmart set a goal to achieve zero waste in their operations and reach 100 percent recyclable, reusable, or industrial compostable private brand packaging by 2025, while Tyson Foods' transition from virgin fiber paperboard to 100 percent post-consumer recycled content across their Jimmy Dean brand and launch zero waste to landfill pilot programs at three production facilities, diverting nearly 5.2 million pounds of waste from their landfills, which was a 60 percent increase from the previous year.

Mr. Hairston, how will the Recycling and Composting Accountability Act help companies like Walmart, Tyson Foods, others that are working hard in this area as they try and meet their needs?

Mr. HAIRSTON. Thanks for the question, Senator.

Again, I go back to your companies that you referenced. Just like International Paper, we have some pretty strict goals out there, and we believe that we can achieve those goals. One of the challenges and opportunities as we try to get there is understanding what is impacting circularity. The first piece is, you want to be able to have packaging or a material that is circular, meaning that it is recyclable, it is reusable, or it is compostable. Once we do that, the next question has to be, is it coming back around?

The thing that this act is going to do for us, it is going to help identify and help point out clarity, where the gaps are, so that we can take responsible actions with our private and public partners to be able to figure out how to continue to drive toward that 100 percent goal.

Senator BOOZMAN. Very good.

Mr. Hairston, oftentimes, companies implement sustainability programs because it fits within their mission statement or core beliefs. But sometimes companies develop innovative sustainability practices because it makes economic sense to do so.

Can you give us some examples of the private sector investing in sustainability practices to protect the environment while also helping their bottom line? This is really what Senator Whitehouse was alluding to, and it is very, very important.

Mr. HAIRSTON. Yes, I think it is definitely a good question, and I think you are always able to meet that momentum and drive when you can figure out a way to have both an economic and social solution.

At International Paper, we are integrating our sustainability goals and targets into our strategy, into our capital plan, and operating plans. This will ensure that we create that long term value for our shareholders, and we operate a business that drives and delivers a sustainable outcome.

We are not afraid to innovate in this space to meet the market demands and to advance the vision to build a better future for both the people, the planet, and our company. A recent service that we developed that meets this triple bottom line, people, planet, and profit, is a system that we call eBOSS. eBOSS is a service that we provide to our customers. My service focuses on analyzing the customer needs and being able to understand their shipping history and box utilization to then suggest to them the right size box to one, reduce their cost for packaging, and two, ensure that they have a solution that is recyclable or reusable.

Those are some ways that, again, we are able to one, meet our goals of sustainability and a circular market, and at the same time, being able to help reduce costs and drive economic benefits for the companies that we are working with.

Senator BOOZMAN. Right. As you allude to, paper recycling rates are one of the great success stories within the industry, with an approximate 66 percent recycling rate, and 94 percent of Americans having access to community paper recycling programs. Additionally, 80 percent of the U.S. population has access to community recycling programs that accept pizza boxes.

What are some lessons other commodities could learn from the paper industry to improve their rates, again, going back to the very important question that Senator Whitehouse raised?

Mr. HAIRSTON. Yes, again, I think it continues to go back to, we believe in producer responsibility, and we continue to show our commitment with our investments over our last three decades. And as we continue to meet the needs of our customers, working together as an industry is important.

The pizza box recyclability was a concern that, as an industry, we put our heads together and said, how can we resolve that issue? What is a concern that is out there, and how can we manage that in a way that can truly allow that box to be recycled? I think that collaborative effort is the way that you improve. That has worked well for the forest products industry, and I think it is something that other industries should look at if they are having difficulties.

Senator BOOZMAN. Very good. Thank you.

Senator CAPITO. Thank you.

Senator Stabenow.

Senator STABENOW. Thank you very much, and thank you to all of our witnesses today.

Ms. Murray, in the 2018 Farm Bill, I championed the Composting and Food Waste Reduction pilot project under the Office of Urban Agriculture and Innovation Production. I am so glad to see the work that you are doing in Michigan and in Detroit. Working with my partner, Senator Boozman, I am looking forward to building on that work in the next Farm Bill and focusing on supporting composting activities and decreasing food waste.

What types of barriers has Detroit Dirt faced in its efforts to transport food waste and process it into compost?

Ms. MURRAY. Thank you, Senator, for that question.

Some of the barriers have been—well, there are multiple barriers, but over the years, we have experienced transportation from food banks to homeless shelters and folks that could actually use the food. At first, it was an insurance issue. A lot of people were concerned about insurance. But with stadiums, restaurants, and any type of manufacturer of food, a lot of times, that excess food is getting dumped into landfills or burned in incinerators, because they don't have enough companies to actually transport that excess material.

So I think there is an opportunity to build on that and have more companies that are transporting and logistics to help fill those voids.

Some of the other challenges have been with education. We have simply—we feel like we have to go above and beyond with education. Because the municipalities, I think, at times, what happens is we focus on food waste, but we look past other low hanging fruit, such as yard waste, and the municipalities actually can buy back, when I speak about the circular economy, and we talk about markets, some of the municipalities on a State and as well as local level can purchase that product back. They are already buying supplies or materials or resources from other sources. They can buy back compost and process yard waste as well. So we have to look at those barriers.

I just think it is a matter of bridging the gap and understanding what the byproducts are and the value.

At General Motors, when we ran a pilot with the Detroit Zoo and General Motors and Blue Cross Blue Shield, they bought a lot of the compost back for their landscape, and they weren't really thinking about that. But landscapers and other municipalities with yard waste and food waste or other products, but I think the other challenge is just making sure that people understand what food waste is, because they get a little bit scared about the ick factor of it. That is why I think that education is the key, bringing awareness, so they understand how to compost.

Senator STABENOW. Right. Thank you so much. This is an exciting area, I think, for all of us to be working in.

Let me ask, Mr. Hairston, you mentioned in your testimony, and Senator Boozman indicated as well, that the 2020 paper recycling rate was just about 66 percent, 65.7 percent. That is really amazing. I also want to agree with Senator Whitehouse that plastics recycling is woefully inadequate.

So, I really appreciate overall what the industry has done. Your industry has recovered more than 47 million tons of paper for recycling. But even with those impressive numbers, I know you are pushing to go even higher, which is very important. So, with that in mind, I introduce the PAPER Act that prevents waste energy facilities from earning a tax credit for burning recyclable paper.

Could you talk about the importance of recovered fibers to your company and whether eliminating a tax incentive for burning paper would increase the recycling opportunities for the paper industry?

Mr. HAIRSTON. Thanks, Senator.

International Paper supports the PAPER Act. The bill will help ensure that the Federal production tax credit protects the integrity of recovered fiber stream so that paper recycling can continue to be an environmental success story.

When we think about the recycling, in general recycling, it has been able to take something that has completed its primary use and be able to collect that and reuse it in a similar fashion going forward. We do think that, again, being able to do that in the paper industry, we have shown that that is important.

One thing that I said in my opening statement is $5 billion of investment, 8 million tons increase, that is going to happen. We are going to need that fiber. So being able to have all the fiber available to support that industry, support sustainable packaging for the customers, is going to be important to drive the circular economy going forward.

Senator STABENOW. Thank you very much.

Thank you, Madam Chair.

Senator CAPITO. Thank you.

Well, for our witnesses, I am going to ask a few more questions in anticipation of our Chairman coming back in.

I see Senator Kelly, so we will wait just a second.

If you are ready, Senator Kelly, or I can ask a question.

Senator KELLY. Ready to go.

Senator CAPITO. Ready to go. Just like a good astronaut would be. Thank you. Sorry to rush you, there.

Senator KELLY [presiding]. Thank you, Madam Chairwoman, and thank you for holding this hearing today.

This question is for Mr. Harvey, who I believe is remote.

Mr. Harvey, I appreciated that you took time in your testimony to discuss the unique challenges rural communities face when establishing and sustaining recycling programs. And I appreciate that both of the bills we are discussing today take steps to address these challenges.

Many rural communities want to offer curbside recycling programs, but in recent years, it has gotten increasingly challenging for these programs to make financial sense. For example, in 2019 the city of Sierra Vista in Arizona was forced to end their curbside recycling program because they had to ship their recyclables nearly 200 miles to Phoenix, and then the numbers, the math, the financials on this just didn't add up. In the past 3 years, seven cities in Arizona have ended curbside recycling.

Mr. Harvey, can you expand upon your testimony about the costs that rural and disadvantaged communities face when they must

choose whether to ship recyclables tens or hundreds of miles to the nearest processing facility or to end recycling programs? And then what can the Federal Government do to support recycling in rural areas?

Mr. HARVEY. Thank you. I think what the biggest issue facing us is certainly the cost to collect, transport, and process.

When we ran into this situation where China was not accepting any of our material, the recycling markets throughout the world collapsed. They went negative on us. There was no value for the materials that we were collecting.

So we had to institute, in a lot of cases, we instituted processing costs at our MRFs, where before, we didn't have to do that because the value of those recyclables after we process them covered that. It doesn't matter what materials that you put in a truck; it costs money to send that down the road. It costs money to buy special trucks to collect the recyclables. It costs money to buy the tractor trailers to transport now from a satellite facility to a MRF. It costs to process that material, and then it costs to ship it out to the consuming mills.

So all of those costs can add up significantly, depending on what part of the country that you are in. That is why I think you are facing these issues right now. As we start to get into a more robust marketplace with recyclables, hopefully we will see some of those costs come down, and I think that this is where we need the support of the Federal Government to come in and subsidize, maybe, in some of these situations where it is costing a municipality too much money to transport and process those recyclables.

Senator KELLY. Mr. Harvey, what within the market could change to result in a more robust market for recyclables?

Mr. HARVEY. I guess the easy answer to that would be a guaranteed price for what we get paid for the materials that we process. But it doesn't. It fluctuates. It is a very supply and demand basis, and it fluctuates on that supply and demand.

If we knew that every day for the next 10 years, we were going to receive a certain threshold of price for the materials, then at least we would know what we would have. But we have to be able to adapt to that pricing and make changes in our systems to adapt to that pricing.

Senator KELLY. Is the only way for that to happen is that there needs to be some support from the Federal Government, or is there another free market scenario where that could come to pass?

Mr. HARVEY. I don't see anything happening in the free marketplace, and I am a free marketplace guy. I built my business; I have been doing this for 50 years, and we have ridden it up, and we have ridden it down, and I believe in the free marketplace, but there is no guarantee in the free marketplace. So that is the only issue that we deal with.

Senator KELLY. Thank you, Mr. Harvey.

If the Senator from Alaska is ready—I have one more question. I will go over the time, unless you are ready right now.

Senator SULLIVAN. No, go ahead.

Senator KELLY. All right.

This question is for Mr. Yepsen. One of the biggest challenges recycling programs face right now is finding end markets for recycla-

ble materials and finished compost. In fact, one of the leading challenges I hear from communities in Arizona who are struggling to maintain recycling programs or beginning composting programs is that it is costly to find buyers willing to take a finished product. That is why I appreciate the Recycling and Composting Accountability Act, which takes the first steps to address this problem through a comprehensive study on the end markets for recyclable and composted materials.

Mr. Yepsen, can you expand upon why this study could be so groundbreaking, and has anything like this been done before?

Mr. YEPSEN. I do think it would be groundbreaking. There has been some research done on end markets for finished compost. The U.S. Composting Council has published reports on this and really advocates for different markets, and has case studies around use for things like the Department of Transportation, which has really helped spec compost into Department of Transportation projects.

I think, as we heard also earlier from Pashon, we see more and more efforts from whether that is a business or a community that is trying to divert their food scraps and yard trimmings to compost, also committing to buying that back. So we know that whether it is a corporate campus that has a composting program and has grounds, or a municipality that has landscaping needs.

And I think that having a Federal level tracking of this would be really helpful, because I think it is oftentimes just that composting is so new that a lot of communities don't have an understanding of just how many varieties of avenues that that finished compost could be used in.

Senator KELLY. How many communities nationwide actually have composting programs? Do you know by percentage?

Mr. YEPSEN. For yard trimmings composting, the number is fairly large, but it is seasonal in most places for yard trimmings collection. So there are around 4,700 composting facilities taking yard trimmings. But the number is much smaller when it comes to food scraps composting and really robust curbside programs, and that is less than 10 percent of the population.

Senator KELLY. Thank you.

The Senator from Alaska.

Senator SULLIVAN. Thank you, Mr. Chairman.

I want to thank the witnesses for being here today.

This is an area that actually has a lot of bipartisan support. When you are helping us think through solutions, I want you to try and help us think through what would be bipartisan solutions.

Let me give you an example. Senator Whitehouse, I know, has already asked some questions about plastics. You may have seen, he and I have been putting forward legislation that has been very strongly supported. The Save Our Seas Act, the Save Our Seas 2.0 Act have all been passed and signed into law, and now we are working on implementations.

So let me ask Mr. Harvey and Mr. Hairston. Give me your thoughts, quickly, particularly really following up on Senator Whitehouse's question earlier about plastics and what you see as a bipartisan approach. You think you guys have a sense of what that would be? I am not looking for big, top down mandates and taxes, but there are other things that I think can achieve a lot of

broad based support here on an issue that, in many ways, is a uniting issue. The oceans clean up, ocean plastic issue certainly is one here in the Senate.

Do you have any thoughts on those, in terms of plastics in particular? Mr. Hairston, we will start with you.

Mr. HAIRSTON. Yes, thanks, Senator, for the question.

I spoke to it a little earlier. As we think about addressing those issues, I think coming from a fiber based industry, and what have we done, and what are the things that have been successful for us. We believe, one, honestly, that the producers have a responsibility. Over our three decades, we have been focusing on infrastructure investments to help drive that piece. The recycling rate for cardboard continues to be high.

Senator SULLIVAN. Why is that high, and it is not high in other areas? Do you guys know, or have a sense?

Mr. HAIRSTON. I can't speak to what is driving the economics of plastic. I can speak to the things that we see in the fiber based, where we have a local commodity that is collected that has global demand, and we have been able to leverage that to provide sustainable, fiber based packaging for our customers. And we think that that continues as an opportunity. Exactly what is the problem with plastic, I can't speak to. I don't feel comfortable speaking to it at this time.

Senator SULLIVAN. OK.

Mr. Harvey, do you have a sense on the questions that I posed?

Mr. HARVEY. So, I am having just a little bit of trouble hearing, but you are talking about plastics, and a solution. From our standpoint, we are kind of like, in the middle. We don't manufacture it, and we don't use it. We just kind of pick it up and process it.

But I will tell you, in all my years of doing this, there has been a tremendous amount of confusion on what is and isn't recyclable and the different types of resins that are available. And it is very, very difficult when these manufacturers keep coming out with new products and a different resin that looks the same as maybe something else [audio gap] sorted out, and our opticals can't, either.

So again, I think a lot of what will happen, I think this accessibility that we need to get into these rural areas is going to help that. If we can collect those materials and not dispose of them or throw them out the window of a car or throw them into a creek that now it ends up in the ocean, it is the accessibility and it is going after these robust programs and getting them working.

Senator SULLIVAN. Great.

Let me ask a follow up question, Ms. Murray, maybe you can lead off on it. It relates to what Mr. Harvey just mentioned, and then if anyone else wants to jump in.

My State is a very big State in terms of size, but a pretty small population, so about 70 percent of the households do not have access to curbside recycling. So, how do you bring recycling infrastructure to many parts of the country that don't have it, particularly big, rural, spread out parts with limited or spread out populations?

Then related, I think it is related, does the answer to that question also have something to do with to what degree you think the emphasis should be on local government initiatives versus kind of

big, Fed, top down? In Alaska, we often say, hey, one size does not fit all. Federal Government comes up with some plan, and we are usually the State that it doesn't work in. So that is a secondary question, but I think it is related to the first question.

Ms. MURRAY. Yes, thank you, Senator. That is an excellent question. I am a strong believer in local policies and ordinances, simply because those mandates will give you benchmarks that are going to produce the data. It simply lets you know who is and what neighborhoods are doing what. Municipalities have resources, as well. They have yard waste and other things that these households can actually use.

So if we are creating ordinances around a circular economy where it says, OK, if you are going to utilize, depending on what region and where you are, your yard waste clippings, as well as your food waste, those are byproducts that we can actually manufacture and distribute back to landscapers or others who need it for tree planting, for water runoff, and other necessary needs too, as well as soil remediation.

I am in an industrial city, so we are always looking to remediate soils for brownfields and other issues that we face. So I think education is key. Making sure households understand the difference between carbon.

In our composting world, you have the greens, right? All the decomposable food waste and spent grain from breweries, food waste from restaurants, manufacturers. But then you have the browns: The cardboards, the leaves. You have to process these things in a certain way that makes sense.

I think with education, that makes it simple for most residents to understand that. So I think the Federal Government, as well as local, should be working together, depending on what region you are in in the country. Because these are all processes that can be done.

But there are also technologies if you are in Alaska or Michigan, where, weather permitting, you have a bunch of snow, if you have these closed facilities with in vessel, anaerobic digestion, certain technologies that can take that material, you can produce and accelerate the process easier. But we really don't have these facilities set up around the country, as much as we should. I think that investment in infrastructure is going to be huge to accelerate that.

That is really what we need to be able to do, is to sort and separate that waste stream so we know what the value is. Also not just MRFs, but there has to be composting facilities as well as recycling facilities. And I think that that is something that we are sleeping on. A lot of people talk about transfer stations, but they are not looking at actually taking certain technologies that exist in Denmark and Germany and other places around the world that can replace the landfill. It is happening.

So I hope that I answered your question, because education is the key in households. But also mandates and ordinances with the local government are going to be key. I have seen Detroit slow walk this thing for years for the last decade, and then last year, the education and the investment in education and having the people understand what these processes are has accelerated the process, es-

pecially with K–12 schools and universities taking that home to those households, as well.

Senator SULLIVAN. Thank you.

Thank you, Mr. Chairman.

Senator BOOZMAN [presiding]. Thank you.

Mr. Hairston, in the last 10 years, and especially in the last 2 years, we have seen a rise in total online retail sales, which means an increased demand for paper packaging. To meet the demand, it has been vital to have as much recovered fiber in the circular market as possible.

How has the paper industry's investment into research helped you prepare for the upswing in e-commerce we are seeing right now?

Mr. HAIRSTON. Thanks, Senator.

The data that the act will provide is really going to give us more detail on where e-commerce sales and that packaging material is available to be recovered. One of the things that we have talked about, historically, recycling has been a percentage of residential, a percentage of commercial. As we see the e-commerce shift, we are seeing a lot more of the recycling of fiber based products coming through the residential stream. Understanding that stream, understanding what is available to be recovered, will allow our industry to continue to invest in the right infrastructure and support to be able to drive the circular economy and get that commodity back into the value stream.

Senator BOOZMAN. Very good.

The rest of the panel, anybody who wants to jump in, in regard to the Recycling Infrastructure and Accessibility Act, what type of projects do you expect to be completed should this program be enacted?

Mr. YEPSEN. Building off of this question about how you make sure that we have solutions that fit the wide variety of States, whether that is rural, urban, or suburban environments, I think that what I would be really hoping is, I think, connected to that rural environment. For composting, we have seen a lot of success for drop off programs for food scraps composting in more rural States. I know, maybe not as large as Alaska, but in Vermont and in Wisconsin, they have had successful drop off programs for composting where curbside isn't available, so I think that would be one indicator of success.

Senator BOOZMAN. Anybody else?

Mr. HARVEY. I just would add to that, that we would look for these programs to give us a source of more material to process and get that material, collect all that material, and get it into something where we have a package, a bundle, a whatever, that the end users can use. That is basically what we are looking at today, is to try to get the recycling rate up in not only rural America, but all of America, get the whole nationwide recycling rate up. Let's use these resources that we have in front of us and turn them into another product or into the same product.

Ms. MURRAY. Hopefully, Senator, we will be able to see more mandates around banning food waste from going to the landfills. I am a little aggressive with this, because I have been involved for the last 12 or 13 years of my life. And I have seen places like

States like Massachusetts and California, different pockets who have aggressively mandated the banning of food waste going to the landfill or being burned in the incinerator to begin with.

But I also think the investment in creating these sites with the right equipment and technology is going to be key. So I think we are going to see a lot of excitement around entrepreneurs and advocates who have been working in this, particularly me. I would love to be able to expand in Detroit. We went from a 2 and a half acre site. We are going before city council here soon to expand to 5 or 6 acres. I believe that once we create these larger pilots, that is going to open up a door for more opportunity for expansion.

Senator BOOZMAN. Very good.

Mr. HAIRSTON. Senator, just one thing I would like to add to that question, the power of the data is going to allow us to solve the right problem for that community. One of the things that we talk about sometimes, maybe more of a Federal or a broader brush, the reality is, the solution is different based on each community, and by having the data, it allows that community to really focus there. It may be education; it may be infrastructure, it may be something else. But by having this data that this bill or this act will put in place, it is going to allow us to really tailor that need to meet each community's gap and solve that problem.

Senator BOOZMAN. That really was going to be my next kind of follow up. One of the things that Senator Carper and I did in the Recycling and Composting Accountability Act was make it so that we collect a lot more data and making sure that the data is out there to help you all do your stuff, but also to inform the legislators, the people at all levels of government as to what exactly is going on, so that we have a better ability to respond.

Thank you, Mr. Chairman.

Senator CARPER [presiding]. Senator Boozman, thank you so much.

This is an interesting morning. We have all these votes going on on the floor, committees meeting, marking up, voting on issues, and trying to hold a hearing on an important issue. But thank you for helping to make it all work and for being a great partner in this.

I also want to say what I think of it. I want to thank our staffs. Sometimes we get the credit as members, or blamed for progress made or not made. We are blessed with the staff we have on both sides of the aisle, so I want to thank all of them, including one who is leaving at the end of this week.

I want to come back to Mr. Hairston for a question dealing with recycling end markets, recycling end markets.

Mr. Hairston, we all know that the existence of robust end markets for recycling products is critical to the longevity and effectiveness of the recycling industry. The Recycling and Composting Accountability Act would require the Environmental Protection Agency to study and issue a report on the end market sale of all recyclable materials collected from households and processed at a materials recovery facility. This would include looking at the end market sale of materials like, for example, plastic, like paper, like glass, like aluminum, just to name a few of the most common ones.

My question of you, Mr. Hairston, is this. Based on your experience, how could this study on end markets be a useful tool to both the public and private sector, and what kind of benefits might we see from studying this at the Federal level?

Mr. HAIRSTON. Thanks for the question. Again, I think what the study is going to allow us to do is really have data to go in and confirm or potentially identify what is the hypothesis or the opportunity we are trying to solve.

The end markets; International Paper, again, has a 2030 goal of 100 percent recyclable, reusable, compostable material. Our goal is that that product that we are producing is able to meet that circularity. This data will help prove that, and it would help us continue to innovate solutions for our customer base and for others.

So I think, again, when I think of the Recycling and Composting Act, and the data that we will have on both a local and Federal level, it will allow private companies, along with the public, to partner on how to solve the gaps and where materials are really being diverted, and how can we do the right things to drive that end market.

Senator CARPER. Thank you, sir.

Mr. Yepsen, a question for you, if I could, also on composting end markets. What are some of the differences between composting and recycling end markets? What are some of the differences between composting end markets and recycling end markets, and how will this separate study be useful in ultimately reducing the amount of food waste in our landfills?

Mr. YEPSEN. It is a good question. There are so many differences, I think, for the end markets for recyclables versus compost. When we are thinking about recycling end markets, we are thinking about post-consumer recycled content going back into new packaging as a direct input.

When we are thinking about compost end markets, those are not a direct input back into new packaging materials or directly into new food, there is a slightly longer system there. So I think the reason that this study and extra data will be so important is just showing all those varieties of avenues for end markets for finished compost and making sure that we are driving those end markets.

Because the commonality between recycling end markets and composting is that if you don't have an end market, your business falls apart. We heard about this earlier, that a lot of composting businesses have historically focused on that tip fee, the money generated from materials coming in, rather than the markets for the finished compost and the sale of that compost. Obviously you need both of those for recycling and composting, the tip fee and the end market.

But I think that that is where there is some commonality. We have to have that, more knowledge and data around what those end markets are and ways that we can make sure that we drive that through.

Senator CARPER. Thanks for that response.

Mr. Yepsen, we are going to stay with you for just a minute. I will direct the same question on proper management of composting facilities. I want to direct this to you, but also to Ms. Murray. I will direct it to you initially, and then we will get over to her.

One of the challenges that often—and this deals with proper management of composting facilities—and may act as a deterrent for communities who might otherwise want to start a program is the odor. In fact, my State of Delaware has faced some challenges with this issue in the past. We have a lot of chickens in Delaware. We are not a big State, but we are a big ag State, as it turns out, and we raise, I think, for every person in Delaware, there are 300 chickens, and they create a lot of chicken manure.

We have been working for decades to figure out what to do with all of that chicken manure and straw and sawdust that comes out of our poultry houses. And I think we are making some pretty good progress, some really good progress.

But my question to you is what can composting facility managers do to reduce or eliminate any odors associated with composting?

Mr. YEPSEN. That is a good question, and I am familiar with some of the composting facilities that have existed and are no longer in Delaware, partly around issues due to odor. I think that the simple answer is, there are ways to successfully compost without huge amounts of odor. The U.S. Composting Council has a Certified Operator Program, and there are composting classes that happen all around the country in different States hosted by the U.S. Composting Council or universities or master gardener programs.

So it is definitely possible to run a facility without odors, and it comes down to biology, I think. They are not super high tech solutions to control odor; they can be taught within these schools. Again, it kind of leads back to that other question of what is the business model of those composting facilities? Are they really driving to get the maximum tonnage coming in to get that tip fee, or are they really taking their time to compost successfully and well, rather than trying to rush that process?

Senator CARPER. All right, thanks for that response.

Ms. Murray, really the same two questions. The first question again was, what can composting facility managers do to reduce or eliminate any odors associated with composting? Then a follow up question is how can education programs like the development of voluntary guidelines in the Recycling and Composting Accountability Act that we are having this hearing on today, how can those guidelines help enhance existing or new compost programs? Take it away; thank you.

Ms. MURRAY. Thank you. Really quickly, on the end market question that you asked earlier.

Senator CARPER. Please.

Ms. MURRAY. The Department of Transportation, construction companies, the Department of Environmental Quality, these are all sources that can actually use as an end market for water runoff of freeways and interstates. Construction sites buy millions, millions of dollars of compost and soils. They are always looking for resources around that.

So I just wanted to put that on record, that there are opportunities with the Department of Transportation and other government organizations, as well as construction companies that buy it as fill. But also when you look at land, lakes, rivers, when you look at soil

remediation, there is an opportunity for us to divert that compost in those directions, as well.

We have run pilots, so we have seen the water, the soil, it captures water as a filter as well, so we have seen these things happen.

Of course, you mentioned data. That is very important, but we have to hold waste management companies in general and others who control these landfills, we can collect all the data we want, but we have to mandate and make sure that we are getting the right data and that all honesty and transparency is happening when you are collecting the data, as well.

Now, when we are talking about odor, what I have done with manure, spent grain from breweries, restaurants, you have to look at, again, the carbon and nitrogen, as you mentioned. It depends on what the model is.

So, if you are receiving a lot of feedstock, if you will, that has odor, it is imperative that you manage that in a certain amount of time. There is a timeframe in which you do not want to allow those materials to sit and rot and decompose. So you have to have mandates around holding facilities accountable, depending on zoning.

This is where the local government is going to come into play as well. Municipalities have to have zoning and laws around what they are going to do in specific areas, because the zoning is key. In a place like Detroit, we are located along the river. We have certain zones that we only allow composting to be operated. That is going to be key. You do not want residents to smell these odors.

But can we retain this water runoff and make sure that we are reducing odor? Absolutely. It is about process. There are simple solutions. You can use sawdust, woodchips, all kinds of browns, I call them, products, the carbon, to suppress that.

But in vessel technology, anaerobic digesters, the zoo that we work with, the Detroit Zoological Society, has an anaerobic digester. That works as a simple system. That manure and that food waste is processed, that energy that is retained, that methane is used to heat a building, the animal hospital. The solids go into one area; the liquids go into another. So it can be done. So the odor can definitely be suppressed.

Your last question, I believe, you talked about education? Is that what you mentioned?

Senator CARPER. Yes.

Ms. MURRAY. What I have seen, which is phenomenal, is, let's take a company like General Motors or an automotive community. They feed thousands of people. General Motors has 25 restaurants in their headquarters. Then you take a small mom and pop restaurant, or you have someone as large as Campbell's or a brewing facility.

What happens is, all those materials represent something different. They all have a certain lifespan. You have to go in and educate the head chef of these restaurants to make sure that they are sorting and separating, just like you have to talk to a major corporation about how long is that food waste going to sit on that docking area. We have collected food waste from numerous sources, but it is all in process and education, depending on if you are manufacturing food, if you are cooking the food, whoever you are,

whether it is a household, there is a lifespan in which you have to manage that food waste properly.

Senator CARPER. Every now and then, we have witnesses, after we ask questions, they will say thank you for that question. I want to say, thank you for those answers. Those were very good, very helpful.

This next question is for all of the witnesses, and I think every one of you has mentioned the term circular market or circular markets, as we have been in this hearing today. We will kind of go in reverse order here. We will go with Mr. Harvey, Ben Harvey.

I will ask you to respond initially, Ben.

This past fall, as you know, we held a roundtable series and a Committee hearing on the concept of a circular economy. We heard from stakeholders from a variety of industries and organizations as well as State and local governments as to what it would take to truly transition to an economy that values and promotes circularity at every step of the industrial process.

The Recycling and Composting Accountability Act would continue this conversation by directing the Environmental Protection Agency to conduct a study on the amounts of recyclable materials that are being lost out of the circular market in a variety of ways.

Ben, I am going to ask you to lead off on this one. How can having a better understanding of how materials that could otherwise be reused being lost from the circular market be beneficial to each of your industries and the country as a whole?

Mr. Harvey, I am going to ask you to take that one initially, and then we will turn to Mr. Hairston.

Mr. HARVEY. OK, thank you.

The great data gives us the opportunity to plan our MRFs and our markets to take this material, and again, bring it in. If we have the data soon enough, the correct data, the amount of material that we are going to be gathering, where it is going to come from, what we can turn it into, then we can make smart business decisions. We can make those decisions, OK, do we put in more, in our industry's case, can we put in more optical sorters, do we need to have more robotics, do we need to establish and look for more markets for this material to go into.

Without this information, it comes into our facilities, and we are dealing with it kind of on the go. We are very adaptable. We are used to doing that. But again, concrete, good data is so important to moving this along.

Senator CARPER. All right. Thank you.

Mr. Hairston, please, same question.

Mr. HAIRSTON. Thanks, Senator.

We strongly support the provisions that require EPA to conduct a study of recyclable materials, the commercial and municipal waste streams, where the previous 10 years that were diverted from the circular market. We believe that the study will highlight the strong recycling rates of paper and paper based packaging and help clarify why our current recycling rates are reaching a practical maximum without potential regulations to improve.

Examples like products similar to wallboard tape and tissue, which aren't really identified for recovery, are things that may

show up in the study. But the data will also, again, allow us to make sure we focus on the right items.

One of the biggest things impacting the circularity of fiber based products is contamination. The Recycle Act is focused on education, and we think what education does is it reduces contamination. But the data will also help make sure we are focused in the right areas going forward.

Senator CARPER. All right, thank you.

I am going to ask our other two witnesses to, Mr. Yepsen and Ms. Murray, I am going to ask you to answer that question for the record.

Now I am going to yield to Senator Boozman; you are all done? OK, all in.

OK, in that case, I am going to ask Senator Yepsen——

[Laughter.]

Senator CARPER. If you stay long enough, you might be. Mr. Yepsen and Ms. Murray, to go back and answer the same question that has just been answered by our other witnesses, and that is, just to remind you, how can having a better understanding of how materials that could otherwise be reused are being lost from the circular market be beneficial to each of your industries and to our country as a whole?

Please go ahead, Mr. Yepsen, Ms. Murray.

Mr. YEPSEN. Yes, thank you.

I think one of the reasons that this would be so important is that we need the systems based approach, right, it is not just the number of the facilities or the number of collection programs. Having Federal data and studies that show all of these different elements and to start using some common language are really important. Because right now, we have different State reporting requirements.

I think that has been part of the challenge when we look at something like composting, is that there are different definitions of what is recyclable or compostable from community to community, from State to State. States have different requirements for what has to be reported to them or not reported, and that makes it really challenging as we start trying to think of what a national strategy is to make sure that we are able to have more communities with composting programs.

Senator CARPER. Thank you.

Ms. Murray, do you want to bat cleanup on this one?

Ms. MURRAY. Sure.

I agree with Rhodes that, with a national strategy, we have to look at throughout the country the different regions and States, because it is all different. For instance, in Michigan, when you look at ordinances on the local level with the city and whether you look at the State level, I agree with the language. It all has to translate the same in a harmonious way. We need a commonality around speaking climate and speaking around composting.

But the Department of Transportation may get a different message from the State than what they may get on language from the city. I think it all has to align in order for us to positively move forward.

When I first started Detroit Dirt, the city did not have any ordinances in place. We had to adhere to guidelines with the State on

composting. But now with Part 115, which is what they are working on in Michigan, we are looking at categorizing, if you will. A small household composting, or an urban farmer is different than a mid-sized level composter, or an industrial composter.

So we definitely want to make sure that we are categorizing the businesses according to certifications, but also making sure that we adhere to a common language that is being used on a city and State and Federal level, so it all translates the same.

Senator CARPER. Thank you.

Last question, from me and from our Committee today, will be directed to Mr. Harvey. It deals with, Mr. Harvey, technical assistance.

As you know, many communities have a desire to improve their recycling programs, but oftentimes, they lack the expertise to make meaningful changes to those programs. The Recycling and Composting Accountability Act that Senator Boozman and I have co-sponsored would allow the Environmental Protection Agency to provide technical assistance to States, to local, and tribal communities that wish to reduce their overall waste or improve their composting and recycling programs.

Mr. Harvey, my question is simply this. Do you believe that the ability to provide technical assistance is important? Can you share with us an example or two of how receiving technical assistance has helped improve a recycling program?

Mr. HARVEY. I definitely think that technical assistance is critical to our industry to help the municipalities or help the rural areas to increase their recycling. The Commonwealth of Massachusetts has given grants for technical assistance that have helped us develop markets. Developing those markets, now that we can bring more material in through our system, helps us. They have developed the technical market, the technical assistance on glass. They have also given us technical assistance on organics, how to process organics, given us the tools we need to collect and process that material. We are actually using it for anaerobic digestion. We are not composting it. But those are a couple of types of the technical assistance that we have used in our operation.

Senator CARPER. Well, good. Thank you.

Those are all the questions we have today. I want to do just a quick wrap up, here, if I can. We have a couple of sisters who work in our Dover offices and Wilmington office, the King sisters. They have a favorite saying. Their saying is "Teamwork makes the dream work." How about that? Teamwork makes the dream work.

We are blessed in this Committee to be really good at teamwork, and we don't agree on every single thing, but we reported unanimously out of this Committee last year bipartisan infrastructure legislation dealing with roads, highways, bridges, bipartisan legislation dealing with water, drinking water, wastewater sanitation, all kinds of issues that can end up being a part of the bipartisan infrastructure bill that the President signed into law.

We have seen another good demonstration here today of teamwork. I ran out of here to go over to one of my other committees, Homeland Security Committee, I think we had a dozen or more nominations to vote on. We had, I think, a dozen or so bills to go through and to vote on separately. I had an opportunity to speak

on at least one of those and make all of our votes, and another vote on the floor, and it could not have happened without the great teamwork we have here, especially been demonstrated by Senator Capito and Senator Boozman. I just want to say especially thank yous to them and to others who participated in this hearing, both here in person and remotely.

I want to thank our staffs as well. We couldn't do it without you, and this is such an important issue, and one that I am quite passionate about. I know a lot of folks on our Committee are, and across the country.

Every now and then, we have an opportunity on issues that are important to our country on which there is agreement. I like to say, the sun, the moon, the stars are coming into alignment. This is one such day, one such issue. I have been waiting for this issue, for this day, for a long time, and I believe that Senator Capito and Senator Boozman and others on our Committee have, as well.

I have all these aphorisms that I like to use, and I could just go through them. In adversity, lies opportunity. That is Einstein. We have plenty of adversity in terms of what do we do with all this waste, whether it is food waste or whether it is other kind of waste that ends up maybe in our trash cans, or maybe in recycling, but there is plenty of opportunity here, too.

I am always looking for ways to put people to work. I am a recovering Governor, and the idea of doing something that is good for our planet and good for putting people to work and helping them be self-sufficient, that is always something that is near and dear to my heart.

Someone mentioned hub and spoke systems. I think a couple of people mentioned that; a couple of our witnesses did, with respect to making improvement to opportunities to recycle and compost in more rural parts of our country. I especially appreciate hearing that, from a State that has a lot of urban, not up north, but a lot of rural in the southern part of our State.

One of the other thoughts that came to mind for me during the course of this was, find out what works, and do more of that. There you go. Find out what works; do more of that. I was Governor and Chairman of the National Governors Association, and Tommy Thompson, Governor of Wisconsin and I helped create something called Center for Best Practices, kind of a clearinghouse for good ideas. I am going to be sharing with them, I still share with the National Governors Association's Center for Best Practices. We are going to be talking with them probably later this week about this hearing, and some of what we are learning and some of what we are hearing is we can use the NGA as a way to get good information out.

I just am so encouraged by what we have heard here today, encouraged by what is happening, particularly in places like Detroit, but other places, including Delaware and places across the country, rural, urban, and somewhere in between. There are any numbers of ways to do good things for our planet and create economic opportunity and jobs, and we are onto some really good stuff here, really good stuff here.

Let me see. I think I need to say, this is printed out for me, so I won't forget it. Again, thank you for all those who joined us in

person and one from afar. Your support of the two pieces of legislation is going to be really important as we work to pass both of them and make them better, and hopefully pass them and work with the House and the Administration to get them done.

I am thrilled that the EPA, led by Michael Regan, has gotten really serious about recycling. They have taken a lot of input from our Committee, as they have provided in their recent paper.

We enjoyed hearing all the ways that these bills can improve our Nation's recycling and composting programs. It also helps us to appreciate that our waste challenges are vast, but not insurmountable if we take steps now.

Before we adjourn, a little bit of housekeeping. I would like to ask unanimous consent to submit for the record a variety of materials that includes letters from stakeholders and other materials that relate to today's hearing.

I love to ask for unanimous consent when I am the only one here, because I am not going to object to my unanimous consent request, so. It is agreed to.

[The referenced information follows:]

February 2, 2022

The Honorable Tom Carper
Chairman
U.S. Senate Committee on Environment and Public Works
410 Dirksen Senate Office Building
Washington, D.C. 20510

Comments for the *Recycling Infrastructure and Accessibility Act of 2022* and the *Recycling and Composting Accountability Act*

Dear Chairman Carper and Members of the Committee,

On behalf of the Glass Packaging Institute (GPI), I am pleased to provide comments on the two discussion drafts under consideration today, the *Recycling Infrastructure and Accessibility Act of 2022* and the *Recycling and Composting Accountability Act.*

Together, these drafts address key recycling data, infrastructure, alongside investment opportunities and challenges facing the glass container and other recycling-focused manufacturing industries. We appreciate both your and Senator Boozman's long-time dedication and attention to recycling issues and identification of areas for improvement that can be made across the board.

Background
GPI is the North American trade association for the glass food and beverage container manufacturing companies, glass recyclers, as well as suppliers of raw materials and equipment to the industry. The industry works throughout the country on issues surrounding sustainability, recycling, energy and greenhouse gas emissions reduction efforts.

Glass has long been recognized as a core, and one of the original, recyclable packaging materials. It is a circular and sustainable package format that can be reused, and infinitely recycled back into containers with no loss of quality.

Glass Container Recycling – *Improving Energy Efficiency & Air Quality*

Recycled glass use is an integral component of the manufacturing process. The domestic glass container industry purchases 2.1 million tons of recycled glass each year. This reduces plant GHG emissions over 800,000 tons (equivalent to taking greater than 90,000 cars off the road for a year) and negates the need for over 2.6 million tons of virgin materials use, saving natural resources.

The average glass container manufactured in the US is made with nearly one-third recycled content. For every 10% of recycled glass re-melted to produce new bottles and jars, manufacturing energy use can be reduced 2-3%. For every three tons of recycled glass used, carbon dioxide emissions are reduced by one ton. This is because recycled glass melts at lower temperatures than raw materials alone.

Recycling Infrastructure and Accessibility Act of 2022

GPI supports the centerpiece of the first draft, which would create the *Recycling Infrastructure and Accessibility Program*, providing federal funds via competitive grants to underserved communities, in support of spoke and hub recycling infrastructure and investments.

As we have stated in testimony to the US Congress and state legislatures across the country, there is both a need and a role for policymakers to include direct funding to improve the collection and processing in recycling streams.

GPI and its members are engaged in ongoing discussions with local and state policymakers to examine how glass can be collected in underserved and remote areas (those with one or fewer materials recovery facilities within 150 miles, as defined in the draft).

The geographic distance provides an excellent opportunity for local governments and communities to model and develop drop-off or separated collection for glass bottles and jars, and to leverage funding for aggregation (collection) sites, to ensure the quality of the glass remains clean. Supporting funding could be leveraged for this effort under the draft's *collecting and transporting recyclable materials in underserved communities* eligibility provision.

Keeping glass (and other recyclables) separate from one another provides the best chance for any recyclable to come back as a new product. The more remote areas outlined in the draft lend itself nicely for glass recycling collection efforts that will result in higher quality of the recycled glass collected, providing an easier path to container manufacturing end markets.

Recycling and Composting Accountability Act

GPI is also supportive of the *Recycling and Composting Accountability Act,* which would provide a comprehensive review of recycling program effectiveness.

Section 7 of the bill is critically important to understanding glass recycling from the manufacturing end. It directs the EPA to review and report on how glass, and other recyclables are prevented from remaining in a "circular economy".

This review, and subsequent Report to Congress and accompanying recommendations for recycling program improvements is welcomed by the glass container industry.

Many of the recycling and hauling companies also operate landfill operations, where much of the collected glass is ultimately sent to for disposal. The EPA should also review under **Section 7** the economics of landfill disposal for glass and other recyclables, and how they may be improved to provide a greater incentive to recycle what has been collected.

To this point, we continue to recommend to all policymakers that disposal of glass in landfills (for use as alternative daily cover, ADC), should not count towards recycling or recovery rates for municipalities.

A thorough review of the recycling process will provide insight as to the effectiveness of various recycling programs, and will likely highlight the challenges glass faces in many of the single-streams programs as currently structured.

We look forward to working with the EPA and other stakeholders on **Section 7** to ensure the Report and recommendations remained focused on quality improvements, and cleaner streams of materials for glass and other circular economy products.

Section 6

While glass is not specifically excluded from the materials recovery facility (MRF) data collection study outlined in **Section 6** of the draft, we asks that "glass" be inserted alongside the other listed commodities.

It is important for the federal government to undertake the proposed assessment for MRFs in this section; their capabilities, contamination levels, materials accepted, alongside other data on quality inputs and outputs.

Due to the lack of glass sorting equipment, and how glass is treated at the majority of single stream recycling MRFs, contamination rates found in glass commodity piles are among the highest of any recyclable materials, artificially deflating the true value of recycled glass, and increasing the costs for communities to continue providing glass recycling as an option for their residents.

Thank you for your consideration of our comments to both drafts. We look forward to continuing our work with the Committee, as the formal legislation is introduced.

Please contact me with any questions you may have.

Thank you,

Scott DeFife
President

Tetra Pak®
PROTECTS WHAT'S GOOD

January 31, 2022

The Honorable Tom Carper
Chairman
Senate Committee on Environment and Public Works
410 Dirksen Senate Office Building
Washington, DC 20510

Dear Chairman Carper:

I write on behalf of Tetra Pak U.S. and Canada to offer our support for draft legislation your Committee will consider this week. We are pleased that the Committee will be reviewing the *Recycling Infrastructure and Accessibility Act* and the *Recycling and Composting Accountability Act*, and we support further development of both through markup.

As you know, Tetra Pak has offered recommendations to the Committee on this subject in the past, and we are gratified to see many of them incorporated into these measures.

It is critical that we create federal standards for recycling, provide federal investment in recycling infrastructure, and incentivize domestic end markets for recycled material. These bills are largely aligned with what is necessary to realize these three objectives, and for that reason we are pleased to offer our support. Tetra Pak is a founding member of the Carton Council of North America in the United States, which allows us to collaborate with other carton manufacturers as we seek out ways to improve the recycling system in the U.S.

We encourage continued consideration of these measures and efforts to support and encourage carton recycling as the bills proceed to markup. We stand ready to serve as an additional resource and support as you continue your important work.

Sincerely,

Zerene Kahan

Zerene Kahan
Director of Public Affairs, Americas

Tetra Pak
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March 2, 2022

The Honorable Tom Carper
Chairman
Committee on Environment
and Public Works
United States Senate
Washington, DC 20510

The Honorable Shelley Moore Capito
Ranking Member
Committee on Environment
and Public Works
United States Senate
Washington, DC 20510

Dear Chairman Carper and Ranking Member Capito:

The undersigned organizations commend you and the Senate Committee on Environment and Public Works for the recent hearing on recycling and composting, in particular the Recycling and Composting Accountability Act and the Recycling Infrastructure and Accessibility Act. We agree that better understanding current recycling rates and accessibility of recycling infrastructure and solid waste collection in disadvantaged communities add important tools that can bolster the circular economy and increase recycling in communities across the United States.

These bills build on the recycling provisions contained in the Infrastructure Investment and Jobs Act, together with important actions in the new National Recycling Strategy.

We look forward working with you to advance this legislation and other policies that prioritize materials neutral, circular approaches.

Please feel free to contact us should you require additional information.

Sincerely,

The Aluminum Association
American Chemistry Council
American Forest & Paper Association
Consumer Brands Association
Flexible Packaging Association
Glass Packaging Institute
National Association of Manufacturers
Plastics Industry Association
U.S. Chamber of Commerce

cc: Members of the Senate Committee on Environment and Public Works

AmericanCoatings ASSOCIATION℠

February 15, 2022

The Honorable Tom Carper
Chair, Committee on Environment and Public Works
United States Senate

The Honorable Shelley Moore Capito
Ranking Member, Committee on Environment and Public Works
United States Senate

Re: Hearing on "Legislative Proposals to Improve Domestic Recycling and Composting Programs"

Dear Chairman Carper and Ranking Member Capito:

On behalf of the American Coatings Association (ACA) and the more than 315,000 employees in the paint and coatings industry, I write to express ACA's strong support for the continued focus on the need for a robust recycling infrastructure, and to commend the Committee for holding the February 2nd hearing on "Legislative Proposals to Improve Domestic Recycling and Composting Programs."

As you may know, ACA is the premier trade association dedicated to advancing the interests of the coatings industry and represents paint and coatings manufacturers, suppliers, distributors, and technical professionals. Many of today's paints and coatings may go unnoticed by the consumer, but they play increasingly valuable roles in delivering high-quality foodstuffs, durable goods, housing, furniture, and thousands of other products to market. Over the past several decades, paint manufacturers have advanced coatings technology to create more environmentally conscious and sustainable products. The results are myriad safer and easier-to-use paints that deliver top quality aesthetics and durability.

Leftover paint is often the largest volume product collected by municipal household hazardous waste (HHW) programs: an estimated 10% of the more than 800 million gallons of architectural paint — paint used to coat the interior and exterior of houses and other structures — sold each year in the United States goes unused. Much, if not most of this is latex-based paint — which is considered "non-hazardous," according to U.S. Environmental Protection Agency (EPA) testing protocols. This paint is typically managed along with other products in HHW programs as a hazardous waste, which can be very costly. In addition, management of latex paint poses a challenge for many municipalities and counties, because liquid latex paint cannot be disposed of as "mixed municipal solid waste" in the regular waste stream. However, latex paint has potential for recycling and diversion from landfills, and as such, the paint industry favors identifying leftover paint not as waste but, rather, as a product that is meant to be completely used or reused.

While leftover paint can be captured for reuse, recycling, energy recovery or safe disposal, doing so requires public awareness and a convenient and cost-effective local collection system. Many municipal,

locally operated HHW programs have been collecting paint for numerous years; but because paint collection is expensive, many have discontinued collecting latex-based paints, instead directing the consumer to dry out and dispose of it through their regular garbage. This approach has been embraced because post-consumer paint collection is currently beyond the capacity and budget of many local governments.

An innovative and tested approach to manage postconsumer paint championed by the U.S. paint industry is product stewardship. Under the moniker "PaintCare", ACA has developed a program that undertakes responsibility for ensuring an environmentally sound and cost-effective paint stewardship program, reducing the generation of post-consumer architectural paint; promoting its reuse; and providing for its collection, transport, and processing. It is currently operating in 11 states, including California, Colorado, Connecticut, District of Columbia, Maine, Minnesota, Oregon, Rode Island, Vermont, Washington, and New York. In these programs, PaintCare has collected over 54 million gallons of leftover paint and diverted more than 75% of it from landfills by re-using it, recycling it, or in the case of solvent-based paint, recovering the energy value from it.

While PaintCare is a very successful program focused on the wastestream of leftover household paint, our industry and many other industries confront systemic obstacles when attempting to handle other wastestreams in a similar manner. ACA looks forward to working with you and your staff on the Recycling and Composting Accountability Act and the Recycling Infrastructure and Accessibility Act as you advance these important bills. It is clear that our nation's recycling infrastructure needs significant investment in order to develop the systems necessary to improve recycling programs and appropriate waste management options for a myriad of products. We are hopeful that these two bills will lead to support for recycling projects that will complement efforts of the Infrastructure Investment and Jobs Act.

If you have any questions or if I may provide additional information, please do not hesitate to contact me directly at hmcauliffe@paint.org.

Best regards,

Heidi K. McAuliffe, Esq.
Vice President, Government Affairs

Ball Corporation
2111 Wilson Blvd., Suite 900
Arlington, VA 22201

March 2, 2022

Chairman Tom Carper
Environment and Public Works Committee
410 Dirksen Senate Office Building
Washington, DC 20510

Ranking Member Shelley Moore Capito
Environment and Public Works Committee
172 Russell Senate Office Building
Washington, DC 20510

Dear Chairman Carper and Ranking Member Capito,

I am writing on behalf of Ball Corporation in support of two discussion drafts of recycling legislation, the Recycling and Composting Accountability Act and the Recycling Infrastructure Accessibility Act.

Ball Corporation, headquartered in Westminster, Colorado, is the largest manufacturer of aluminum cans in the world. Founded in 1880, Ball Corporation supplies innovative, sustainable aluminum packaging solutions for beverage, personal care and household products customers, as well as aerospace and other technologies and services primarily for the U.S. government. Today, Ball employs over 24,300 people worldwide and serves as a leader on sustainable waste management policy.

Ball supports the Recycling and Composting Accountability Act announced by Senators Boozman, Capito, and Carper. The Environmental Protection Agency (EPA) cannot meaningfully improve national recycling infrastructure without accurate, reliable data. The Recycling and Composting Accountability Act will enhance the agency's data collection efforts, and the resulting report will assist Congressional efforts to develop an effective national waste management strategy.

We also support the language in the discussion draft of the Recycling Infrastructure Accessibility Act, as the provisions included will be instrumental in addressing recycling accessibility in underserved communities. The funding for the grant program in the bill will allow rural communities to develop a hub-and-spoke model of recycling, greatly increasing their ability to recycle in residential areas. Without substantial development of recycling programs throughout the country, underserved communities will continue to be at a significant disadvantage in this space.

We believe both bills will help increase the U.S. recycling rate for aluminum beverage cans which is currently at 46% and are grateful to the Environment and Public Works Committee for

holding a hearing on these two important pieces of legislation. We are encouraged by congressional efforts to build out the recycling industry in the United States. If we can be of assistance in this or any future endeavors in recycling legislation, please let us know.

Sincerely,

John Campbell
Vice President of Government Relations
Ball Corporation

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danimerscientific.com|229-243-7075

February 16, 2022

The Honorable Tom Carper
The Honorable Shelley Moore Capito
Senate Environment and Public Works Committee
410 Dirksen Senate Office Building
Washington, D.C. 20510

Dear Chairman Carper and Ranking Member Capito,

I am writing to you regarding the "Recycling and Composting Accountability Act" that was discussed before the Committee in a hearing on February 2, 2022. I ask that this letter be entered into the record.

Danimer Scientific is located in Bainbridge, Georgia with manufacturing in Winchester, Kentucky. We are a global leader in bio-based plastics research, development, and commercialization. We produce 100% certified biodegradable and compostable plastic resins that can replace many types of petroleum and gas-based plastics. Danimer is a USDA BioPreferred company and our PHA resin is listed in the BioPreferred Catalog. Our resins are renewable, sustainable and offer superior end-of-life scenarios for single-use plastics and other plastic applications. In particular, our PHA (polyhydroxyalkanoate) resins are FDA compliant for use in food-contact applications, making them ideally suited for the food packaging and food service items that enable a highly mobile "on-the-go" lifestyle, and that continue to be in high demand by consumers across the U.S. and the globe. Unlike petroleum-based plastics, products made from our resins do not need to be separated from food and other compostable waste prior to processing at a composting facility as PHA biopolymers are fully ASTM D 6400 compliant and will break down like other compostables.

Danimer supports the intent of this legislation, and we applaud the Committee's efforts to take on this complex issue. However, we're concerned that the definition of Compostable Material under Section 2 is ambiguous regarding biopolymers. Biopolymers are manufactured from renewable resources (canola oil in the case of PHA), are much less carbon-intensive across their life cycle than petroleum-based plastics and can be returned to the soil along with other composted organic waste. Accordingly, we strongly believe our biopolymers can make a major contribution to reducing plastic pollution as well as making progress toward a net zero economy, and we have built our entire business case around this proposition.

During the hearing, the Committee heard testimony from Mr. Rhodes Yepsen of the Biodegradable Products Institute. In his statement Mr. Yepsen suggested modifications to the definitions of compostables that we feel adequately address the need for inclusion of

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A Biotechnology Company

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biopolymers under this legislation. I understand the Committee has reviewed these suggested changes and is moving to adopt them in the final text of the proposed bill.

On behalf of Danimer and the biopolymer industry, I thank you for your consideration and for the hard work of the Committee in addressing this and other very complex environmental issues.

Sincerely,

Stephen Croskrey

CF:
Senator John Boozman
Senator Jon Ossoff
Senator Raphael G. Warnock
Senator Mitch McConnell
Senator Rand Paul

PLASTICS
INDUSTRY ASSOCIATION

March 2, 2022

The Honorable Tom Carper
The Honorable Shelley Moore Capito
Senate Environment and Public Works Committee
410 Dirksen Senate Office Building
Washington, D.C. 20510

Chairman Carper and Ranking Member Capito,

The Plastics Industry Association (PLASTICS) would like to again thank the committee for the February 2nd hearing to consider two draft proposals addressing recycling in this country. PLASTICS is pleased to support both the Recycling and Composting Accountability Act and the Recycling Infrastructure and Accessibility Act discussed at that hearing and we look forward to working with the committee and bill sponsors to see these measures ultimately enacted into law.

The hearing and the legislative proposals highlight two important needs for improving the recycling systems in this country: the need for better data on recycling and the need better infrastructure. The latest available data from the Environmental Protection Agency is from 2018. A lot has happened to the recycling and waste streams since that time, and it is imperative as policy proposals are being debated around the country that the most accurate and timely data be used to come to the most productive conclusions. Better data will tell us exactly where there are deficiencies that need the most attention.

Additionally, PLASTICS has for years championed federal investments in recycling infrastructure and we applaud this Congress' commitment to recycling infrastructure with the inclusion of funds in the Infrastructure Investment and Jobs Act passed last year. However, more can be done. Across this country the systems we use to collect, sort, and ultimately recycle the large variety of material types in the marketplace is inadequate, particularly in underserved communities. Our industry wants more plastic to recycle, the marketplace is demanding it and it is the right thing to do. Efforts such as this proposal and the RECOVER Act (H.R. 2357) in the House offer the kinds of investments in recycling infrastructure that would have an immediate and beneficial impact on the system.

The plastics industry knows we have a role to play and are committed to solving the complicated issues we face. Plastic recycling has not kept up with the growth in the industry. We know plastic is not currently recovered and recycled at the level it should be. This is why the industry has invested billions of dollars in finding solutions, whether in the design of our products or the collection, sortation, and processing of materials and ultimately in developing viable end markets to improve plastic recycling. One such example of a step industry is currently undertaking is our New End Market Opportunities (NEMO) project which is dedicated to helping to develop and prove new end markets for recovered plastics.

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PLASTICS
INDUSTRY ASSOCIATION

The Plastics Industry Association (PLASTICS) is the only organization that supports the entire plastics supply chain, representing nearly one million workers in the $395 billion U.S. industry. Since 1937, PLASTICS has been working to make its members and the industry more globally competitive while at the same time advancing recycling and sustainability. We want to be a resource to the committee and all members of Congress as you consider legislative proposals such as the ones discussed at the February 2nd hearing, and we look forward to continuing this important conversation.

Thank you,

John Grant
Director, Government Affairs

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Flexible Packaging Association
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February 8, 2022

The Honorable Thomas Carper
Chairman, Committee on
Environment and Public Works
United States Senate
Washington, DC 20510

The Honorable Shelley Moore Capito
Ranking Member, Committee on
Environment and Public Works
United States Senate
Washington, DC 20510

Dear Chairman Carper and Ranking Member Capito:

On behalf of the Flexible Packaging Association (FPA), who is the voice of U.S. manufacturers of flexible packaging and their suppliers, I write to commend the Committee on Environment and Public Works for its continued efforts to improve recycling across the U.S. including the February 2nd hearing on *Legislative Proposals to Improve Domestic Recycling and Composting Programs.* FPA and its members are committed to supporting the improvement and expansion of recycling and, therefore, provide our input on this important topic. FPA's mission is connecting, advancing, and leading the flexible packaging industry. Flexible packaging represents over $34.8 billion in annual sales in the U.S. and is the second largest, and fastest growing segment of the packaging industry. The industry employs approximately 78,000 workers in the United States. Flexible packaging is produced from paper, plastic, film, aluminum foil, or any combination of these materials, and includes bags, pouches, labels, liners, wraps, rollstock, and other flexible products.

These are products that you and I use every day – including hermetically sealed food and beverage products such as cereal, bread, frozen meals, infant formula, and juice; as well as sterile health and beauty items and pharmaceuticals, such as aspirin, shampoo, feminine hygiene products, and disinfecting wipes. Even packaging for pet food uses flexible packaging

to deliver fresh and healthy meals to a variety of animals. Flexible packaging is also used for medical device packaging to ensure that the products packaged, diagnostic tests, IV solutions and sets, syringes, catheters, intubation tubes, isolation gowns, and other personal protective equipment maintain their sterility and efficacy at the time of use. Trash and medical waste receptacles use can liners to manage business, institutional, medical, and household waste. Carry-out and take-out food containers and e-commerce delivery, which are increasingly important during the COVID-19 pandemic, are also heavily supported by the flexible packaging industry. Thus, FPA and its members are particularly interested in solving the plastic pollution issue and increasing the recycling of solid waste from packaging.

End-of-Life Management

FPA understands the importance of reducing and recycling solid waste to minimize litter and optimize landfill space and truly achieve a circular economy. However, there is no single solution that can be applied to all communities when it comes to the best way to collect, sort, and process flexible packaging waste. Viability is influenced by existing equipment and infrastructure; material collection methods and rates; volume and mix; and demand for the recovered material. Single material flexible packaging, which is approximately half of the flexible packaging waste generated, can be mechanically recycled through store drop-off programs. The other half can be used to generate new feedstock, whether through pyrolysis, gasification, or fuel blending. Developing other end-of-life solutions is a work in progress and FPA is partnering with other manufacturers, recyclers, retailers, waste management companies, brand owners, and other organizations to continue making strides toward total packaging recovery. Some examples include the Materials Recovery for the Future or MRFF

project; the Hefty® EnergyBag® Program; and the University of Florida's Advanced Recycling Program.

The mission of the MRFF project is simple – flexible packaging material is recycled and the recovery community derives value from it. The project piloted tweaks to the current material recovery facility (MRF) infrastructure to help establish methods and equipment protocol for flexible packaging. The MRFF project "wrapped" up its full-scale pilot program for flexible packaging this year. The MRFF consortium, of which FPA was a founding partner, released the pilot research report demonstrating the successful collection, separation and preparation for recycling of flexible packaging. The pilot, the first of its kind in the United States, was performed in partnership with J.P. Mascaro & Sons at the TotalRecycle Facility in Birdsboro, Pennsylvania, and underwritten by MRFF partners. The project will now transition to The Recycling Partnership (TRP), of which, FPA is a member. TRP is a leading, national non-governmental organization that exists to improve recycling in the U.S. TRP puts private dollars to work in communities to invest in sustainable recycling systems. TRP works through grants, technical assistance, and tools, as well as research, measurement, and best practices. Thus, the results of this pilot can now be used by MRFs across the country to mechanically recycle flexible packaging, particularly multi-material laminates. The project also worked on downstream uses for the materials generated through recovery and TRP will continue this research. Analyzing the economics of recycling flexible packaging is just as important as proving the technical capacity to separate and process this material.

Another program that is successful, and supported by FPA, as well as a host of manufacturers and consumer product companies, is the Hefty® EnergyBag® program. This program is making

strides in the collection and recovery of flexibles and utilizing energy recovery and pyrolysis solutions for end-of-life management for hard to recycle multi-laminates. Energy recovery often has a negative connotation, when in reality, it should be an option for any sustainable recycling system. One of the primary goals of recycling is to eliminate litter and reduce solid waste going to landfills, thereby reducing greenhouse gas emissions, all while deriving benefit from collected materials. As such, energy recovery solutions could be an immediate answer to end-of-life solutions for hard to recycle packaging materials until appropriate investment in infrastructure for recovery, recycling, and composting of these materials is made.

The first EnergyBag® Program was a pilot in California. In Citrus Heights, CA, the pilot proved the theory, with 1/3 of targeted homeowners participating, approximately 8,000 EnergyBags® were collected in three months, and 512 gallons of synthetic crude oil was produced. The second program, in Omaha, NE, launched in 2016 for 6,000 local households and has expanded across the Omaha area (189,000 households) to Bellevue (15,600 households), Louisville (550 households), Ralston (3,400 households – included within the Omaha City program), Papillion (7,500 households), and La Vista (7,100 households). Retail programs are also available in each community. As of September 2018, the Hefty® EnergyBag® Program collected more than 82,174 bags in the Omaha area and diverted 47 tons of plastic, the equivalent of approximately 225 barrels of diesel fuel, from landfills. The program then expanded to Boise, ID, where the City began distributing the first year's supply of Hefty® EnergyBag® orange bags to 73,000 households in April 2018. For the first time in a major metropolitan area, Cobb County, GA (Atlanta) began a program in late 2018 with 9,000 households registering in December alone. Keep America Beautiful is now participating in a Phase 2 launch with a grant

to add more households. The hard-to-recycle packaging will go towards making low sulfur fuel, oils, and waxes.

The message is simple, if you can recycle plastic material in your regular curbside recycling program, then continue to do so. If you cannot, rather than throwing that material in the trash, put it in your Hefty® EnergyBag® orange bags to be recovered as an alternative energy resource. You can include many plastic and multi-material items that cannot be recycled in your existing recycling program, such as:

- Potato chip bags and other snack bags
- Candy wrappers
- Granola bar and energy bar wrappers
- Plastic and foam cups, plates, and bowls
- Shredded cheese packages
- Salad bags
- Plastic pet food bags
- Frozen fruit and vegetable bags
- Pudding cups
- Stand-up pouches
- Squeezable baby food pouches
- Foam to-go boxes
- Packing peanuts
- Plastic utensils
- Plastic straws and stirrers
- Cake mix liners and other dry powder mix liners
- Plastic toothpaste tubes
- Condiment packets

Not only does the program divert packaging from the landfill and as a potential litter source, but the program also cuts down on contamination of other material streams by separating out the flexibles and hard-to-recycle packaging from readily recyclable materials at curbside. The program is set to expand again with grants to new interested communities as well as guidance for municipalities to mimic its success on their own.

The University of Florida's Advanced Recycling program is in its infancy, but the goal of the program is to present a unique solution using plasma gasification to achieve a true circular economy for ALL packaging waste (sorting and traditional recycling optional, depending on demand for materials). To scale up this technology, which already exists for hazardous waste, selection and investment in infrastructure is needed. FPA supports this goal as the benefits of achieving such would include:

- Reduction/elimination of landfills and associated harmful emissions
- Reduced greenhouse gas (GHG) emissions
- Reduced reliance upon fossil fuel feedstocks
- Reduction/elimination of ocean and terrestrial litter
- Continued realization of benefits from packaging without compromise
- Simple household waste disposal that does not require sorting (single-stream waste collection and treatment

FPA believes that a suite of options is needed to address the lack of infrastructure for non-readily recyclable packaging materials, and investment in that infrastructure is necessary before new mandates and unrealistic goals are set for both manufacturers and consumers.

Sustainability

There is a reason why only about 50% of flexible packaging is mechanically recyclable – as 50% of flexible packaging is single material. The rest is multi-material laminates. Not all flexible packaging is created the same, just as not all plastics are created the same. Different products require different types of protection. Multiple materials are required to provide the appropriate barrier protection to prevent contamination, extend freshness, and ultimately protect the product by providing puncture, tear, and burst resistance and strength. When assessing sustainability or examining the full life cycle of packaging, flexible packaging wins

hands down. Flexible packaging uses fewer resources, generates fewer emissions, and creates less waste. This is because flexible packaging starts with using fewer materials and resources than other packaging types and can package the most product in the least amount of packaging possible, reducing energy use, water use, and greenhouse gas emissions in the manufacturing and transportation of the package and product.

For example, producing a flexible foodservice pouch requires 75% less energy and generates just 1/10 of CO_2 emissions during production than a metal can for the equivalent amount of product. 1.5 pounds of flexible packaging will package the same amount of beverage or liquid as 50 pounds of glass. Advancements in materials and production processes have reduced the weight of some flexible packaging by up to 50%. A recent study by the Natural Resources Defense Council shows that up to 40% of food in the U.S. is wasted; wasted food is the single biggest source of greenhouse gas emissions from solid waste in the U.S. Flexible packaging reduces this waste by preserving the shelf-life of food – bananas last 36 days in perforated polyethylene bags versus 5 days unpackaged and the shelf-life of beef is extended from 4 days to 30 days when vacuum packed in oxygen barrier film. These are just two of numerous examples where flexible packaging is helping to reduce food waste. Flexible packaging does the same for brick and mortar retail and e-commerce – by protecting and preserving the product during shipping and transportation with the least amount of packaging necessary, less waste and returns are generated.

Even when disposed of, flexible packaging has the advantage of having less waste than other packaging types. When comparing coffee in a steel can with a plastic lid versus a stand-up multi-material pouch, the recycling rate for the steel can (one of the most recycled products in

the U.S.) would need to increase from **71%** to **93%,** and the plastic (LDPE) lid would need to go from **21%** to **75%** for the steel coffee can to have the same amount of landfilled material as the stand-up flexible pouch (assuming a **0%** recycling rate for the pouch). This is just one of six case studies FPA commissioned using the Environmental Protection Agencies' EcoImpact-COMPASS® lifecycle assessment tool. These case studies can be found at flexpack.org.

If the coronavirus pandemic taught us anything, it is the need to preserve sterile packaging for food, health and hygiene products, personal protective equipment and medical and pharmaceutical goods. Therefore, all policy options must take into account the very real environmental and health benefits of today's packaging, outside of its potential for recycling and composting alone. Banning these products could have serious unintended negative environmental and health consequences as substitutions and alternatives used may have a much larger environmental footprint. The picking of winners and losers, like banning materials and packaging, or setting arbitrary fees based solely on recyclability, discounts climate change, food safety and security, and potential new innovations that could solve for both source reduction and recyclability/reuse.

Consumer Engagement

FPA also believes that all policy options must have a robust consumer engagement component. Ultimately, any program hinges on the consumer actually utilizing it and doing so correctly. Thus, consumer engagement, not just for flexible packaging, but for ready recyclable packaging materials as well, is needed before additional regulations and the addition of any mandates on municipal governments for recycling of new solid waste materials are put in place. For all

packaging types, we need consumer engagement and programs like the Sustainable Packaging Coalition's "How2Recycle" label to inform residents of the opportunities to recycle and where to recycle. We also need clear directions for consumers on what is not yet recyclable, to eliminate the significant contamination currently rendering many ready recyclable packaging formats unacceptable for recycling and instead destined for landfill disposal. The recent spade of recyclability labeling proposals, including AB343 that passed in California is particularly concerning as it purports to label for consumers per state and in some cases, municipal jurisdictions. Product producers and their packaging manufacturers cannot be expected to produce a 50+ state labeling solution. We manufacture goods for the entire U.S., and in some cases, North America and globally. The environmental impacts and excess waste created by labeling products for individual states and jurisdictions will be disastrous – we need a federal solution.

In addition, most grocery stores and other retailers provide receptacles where consumers can easily deposit plastic bags, dry cleaning bags, bread bags, protective pillows and films, and other product wrappings that most consumers do not know about. Educating and encouraging consumers to make environmentally-conscious decisions about single material flexible packaging is a practical solution and one that could make a big dent in reducing the amount of solid waste packaging material going to landfills and increasing the amount going for recycling before any new mandates are put in place. Similarly, any program must address the litter issue. Policies should provide incentives for consumers to utilize the existing infrastructure and any new infrastructure put in place. Putting all the onus on manufacturers and retailers to change consumer behavior is unrealistic. Any policies purporting to fix the problem of waste in the environment and plastic pollution, in particular, should contain provisions for fines and

enforcement of not only outright litter but of consumers not utilizing the recovery and recycling infrastructure at all or incorrectly.

Conclusion

Flexible packaging manufacturers are responding to key issues and industry pressures affecting their customers as well as the demands of consumers and retailers. Safety and product protection; prevention of food waste and contamination; freshness and extended shelf life; consumer convenience; ease of transportation, storage, and use; and source reduction and sustainability are all issues manufacturers are designing for. Policies for the reuse, reduction, recycling and ultimately the reform of the U.S. solid waste system for plastic pollution as well as all other types of pollution should recognize all of these issues and not only focus narrowly on recyclability. They should promote policies and programs that look at the entire life cycle of packaging and give credit to packaging with a lower environmental footprint (regardless of end-of-life management options); that recognize energy recovery and chemical recycling as viable options; and that promote 21st century infrastructures, such as store drop-off programs, MRFF, Hefty® EnergyBag®, and the Sustainable Packaging Coalition's consumer labeling program.

FPA looks forward to seeing the Recycling and Composting Accountability Act, which would improve EPA's ability to gather data on our nation's recycling systems and explore opportunities for implementing a national composting strategy as well as the Recycling Infrastructure and Accessibility Act, which would help improve recycling services in underserved areas. We believe these are important areas that will help modernize the U.S.

recycling infrastructure and assist in full packaging circularity for the future. We look forward to continuing our work with Congress to address these challenges and opportunities.

Sincerely,

Alison Keane, Esq., CAE, IOM
President & CEO

ISRI
Voice of the Recycling Industry

ISRI is the voice of the recycling industry, promoting safe, economically sustainable and environmentally responsible recycling through networking, advocacy and education.

RECYCLING IS ESSENTIAL

February 1, 2022

Thomas R. Carper, Chairman
Senate Environment and Public Works Committee
410 Dirksen Senate Office Building
Washington, D.C. 20510

Senator Shelly Moore Capito, Ranking Member
Senate Environment and Public Works Committee
410 Dirksen Senate Office Building
Washington, D.C. 20510

Dear Senators Carper and Capito:

The Institute of Scrap Recycling Industries, Inc. [i] are writing in support of the Recycling Infrastructure and Accessibility Act that would address barriers to rural and economically depressed communities face in accessing residential and municipal recycling programs as well as the challenges municipal recycling facilities face in providing these important services.

Residential recycling represents approximately 20% of U.S. recycling providing valuable materials for manufacturing. These materials that usually include paper and paperboard, glass and metals such as aluminum and steel are vital to our manufacturing supply chains. Using these materials in lieu of virgin materials saves tremendous amounts of energy, protects our environment, and improves our nation's sustainability and resiliency goals. These materials will also be vital towards providing the material feedstocks needed to restore our nation's infrastructure projects. For example, 70% of all U.S. steel production is derived from recycled steel.

It is important to note that effective recycling requires long-term, reliable and sustainable markets for these materials. Having the proper infrastructure to collect, sort and separate are vital towards these goals. Americans overwhelming want to recycle their household items but often do not have the necessary infrastructure to easily recycle. We hope that this legislation will help develop improve residential recycling by developing pilot projects through awarding grants on a competitive basis to eligible entities to improve accessibility to recycling systems for underserved communities and serve as a model for recycling infrastructure development.

Thank you for your continued interest in supporting and helping to improve our nation's recycling programs.

Best regards,

William Harrison Johnson

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[i] ***The Voice of the Recycling Industry*** - The Institute of Scrap Recycling Industries, Inc. (ISRI), represents 1,300 private, for-profit companies operating at more than 4,000 facilities in the United States and 34 countries worldwide. ISRI members are processors, brokers, and industrial consumers of scrap commodities, including ferrous and nonferrous metals, paper, electronics, rubber, plastics, glass and textiles. www.isri.org

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January 31, 2022

The Honorable Tom Carper
Chairman
Committee on Environment and Public Works
United State Senate
410 Dirksen Senate Office Building
Washington, DC 20510

The Honorable John Boozman
Member
Committee on Environment and Public Works
United State Senate
456 Dirksen Senate Office Building
Washington, D.C. 20510

RE: Support for the Recycling and Composting Accountability Act of 2022

Dear Chairman Carper and Senator Boozman:

The Can Manufacturers Institute (CMI) thanks you for your proposal, "Recycling and Composting Accountability Act." Your proposal offers much needed direction for recycling data collection and harmonization, an assessment of the U.S. recycling infrastructure needs and material specific data for how much packaging is recycled versus disposed of in landfills. CMI supports the U.S. Environmental Protection Agency's (EPA) role in these activities to provide guidance for states to follow. These are critical elements in helping the U.S. develop and sustain a domestic circular economy for recycled consumer packaging.

CMI is the trade association representing U.S. metal can makers and suppliers. The metal can industry accounts for the annual domestic production of approximately 130.7 billion food, beverage, aerosol and general line cans; employs more than 28,000 people with plants in 33 states, Puerto Rico and American Samoa; and generates about $15.7 billion in direct economic activity.

The can manufacturing industry is proud to produce the most sustainable, circular packaging available for food, beverage and household goods. Unlike other material types, metal cans are accepted in recycling programs across the country and have healthy and robust end markets, allowing metal cans can be remade into packaging and other recyclable products over and over again. Metal recycles forever and as Chairman Carper noted in his opening statement during last September's hearing on the circular economy, 75 percent of all aluminum ever produced is still in use today. The chairman also mentioned that aluminum products made from recycled aluminum use 75 percent less energy (the actual number is greater than 90 percent, according to the Aluminum Association), a significant benefit to the planet. In the case of steel, 75

percent of all steel ever produced is still in circulation. Metal cans are truly representative of the circular economy, where waste is minimized and resources are circulated. Encouraging robust collection and reuse of materials is shrewd domestic manufacturing and national security policy as it creates jobs and ensures a resilient supply of raw material.

Recycling and Composting Accountability Act

CMI supports the role that EPA would play in conducting a survey of all public and private material recovery facilities (MRFs) operating in the country to ascertain the materials they collect. This will help both the public and private sectors in identifying the need for recycling infrastructure investment. The metal can industry asks that this list of "aluminum and scrap metal" is Section 6(a)(1)(B)(iv), be as specific as possible, so CMI members know if a particular metal product is accepted in recycling programs. For example, not all MRFs accept aerosol cans. These details will create an understand of where to make the necessary investments, so consumers have access to recycling programs that accept all empty metal cans.

CMI welcomes three other important roles for EPA: 1) establishing a comprehensive baseline of data for the U.S. recycling system, 2) standardizing recycling reporting rates (Section 6, subsections (b) and (c) respectively) and 3) reporting what the materials are being recycled into, as a way to determine what the percentage of materials being recycled into their highest and best use, versus the percentage which are downcycled. While CMI understands that rates will vary between states, there is a lack of uniformity on what information states collect and report as well as how they measure certain metrics. The data that will be collected in Section 6 on MRFs and community recycling programs will help the public and private sector identify investment opportunities. CMI asks that in both cases, we want to see data on specific kinds of cans. It is an appropriate role for EPA to provide clear guidance for states in these two activities.

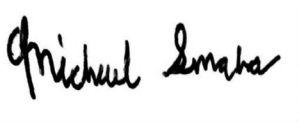
CMI asks that aluminum and steel packaging be included in the list of materials for data collection in Section 7 (c), "Study on the Diversion of Recyclable Materials from a Circular Market." Related to the previously stated point, there are real information gaps when it comes to recycling and reuse of certain metal cans products. EPA providing insights in these areas would allow the public and private sector to identify appropriate areas for investment to increase metal can recycling and reduce any missortation of valuable cans at MRFs. Once cans enter the recycling system, the largest material losses occur in the sorting stage at material recovery facilities (MRFs), where up to 25% of UBCs can be missorted into other material streams or lost in the sorting process.[1] Some facilities and downstream recyclers have additional eddy currents installed to capture this lost value from missorted UBCs, which represent one of the most valuable commodities in the recycling system.

[1] Recycling Unpacked: Assessing the Circular Potential of Beverage Containers in the U.S.

The domestic can manufacturing industry appreciates your interest in collecting and recycling more packaging material. CMI is proud to represent a circular and sustainable material. Congress plays a vital role in supporting a robust domestic manufacturing sector based on reusing materials for feedstock. We welcome the opportunity to participate in on-going stakeholder discussions and would welcome an opportunity to meet with the committee to discuss CMI's recommendations.

If I can answer any questions, please do not hesitate to contact me.

Best regards,



Michael Smaha
Vice President, Government Relations
Can Manufacturers Institute

February 10, 2022

The Honorable Tom Carper
Chairman
Senate Environment and Public Works
Committee Building
410 Dirksen Senate Office Building
Washington, D.C. 20510

The Honorable John Boozman
U.S. Senator
141 Hart Senate Office
Washington, D.C. 20510

Dear Chairman Carper and Senator Boozman:

Thank you for demonstrating your commitment to assess the needs and capabilities of America's recycling infrastructure, including improved data reporting and transparency through introduction of the Recycling and Composting Accountability Act. Novelis is supportive of this draft legislation and encourages the Committee to continue to advance policies that ensure a strong recycling infrastructure and increase recycling rates, especially for aluminum beverage cans.

Novelis is the largest, most technologically advanced aluminum recycler in the world. We have 16 facilities and over 5,000 employees in the U.S. Through recycling, we preserve the value of aluminum alloys to maximize their environmental benefits. Our aluminum is used to make passenger and commercial vehicles, beverage cans, buildings and many other sustainable products.

There is tremendous opportunity to improve recycling rates in the U.S. For example, around half of aluminum beverage cans that should be recovered and recycled to make new cans are buried in landfills. Not only is this outcome detrimental to the environment, it's bad for business. Since used beverage cans are worth nearly $1,000 per ton when recycled, the Aluminum Association estimates that $800 million worth of cans are lost each year to landfills. These cans are a key input for new can production during a period of record demand for sustainable beverage packaging.

Further, your draft bill will help improve reporting on recycling rates, materials and programs, which will help us better understand the gaps and potential solutions for recycling across the U.S. The data available today is insufficient and inconsistent. According to The Recycling Partnership 2020 State of Curbside Recycling Report, "Despite investing substantial public dollars in curbside services, many local programs do not collect data that allows them to effectively calculate key performance indicators such as pound-per-household served. Very few communities have data on the potential amount of curbside recyclable material that is available to collect in their communities. . . Some communities cannot account for how many households they serve with their programs. . ."

Overall, we believe this is a step in the right direction to enable more informed decision making on recycling programs. Thank you for your bipartisan leadership and we look forward to working with you and your staff as this moves through the legislative process.

Sincerely,

Chris Cerone, VP, Public Affairs and Communications, Novelis Inc.

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February 24, 2022

The Honorable Tom Carper, Chairman
The Honorable Shelley Moore Capito, Ranking Member
The Honorable John Boozman
Senate Committee on Environment and Public Works
410 Dirksen Senate Office Building
Washington, D.C. 20510

Dear Senators Carper, Capito, and Boozman:

The undersigned organizations and companies are working to promote the expansion of all facets of composting infrastructure throughout the U.S. As such, we express our support for your work on the following legislative proposals to improve domestic recycling and composting programs, and offer our recommendations on modifications to strengthen the legislation.

The Recycling and Composting Accountability Act would provide much needed national-level support to quantifying and qualifying recycling and composting programs, such as access, processing infrastructure, end markets, and labeling/education. This data and reporting is critical for advancing a national strategy to recover products and packaging, and to realize the climate benefits associated with widespread composting. We have a few definitional corrections:

1. Definition of "compost" – We request the use of the American Association of Plant and Food Control Officials (AAPFCO)'s definition.
    a. *Compost – is the product manufactured through the controlled aerobic, biological decomposition of biodegradable materials. The product has undergone mesophilic and thermophilic temperatures, which significantly reduces the viability of pathogens and weed seeds, and stabilizes the carbon such that it is beneficial to plant growth. Compost is typically used as a soil amendment, but may also contribute plant nutrients.*
2. Strike "residential" – While residential access to recycling and composting are critical, so are commercially generated materials at businesses. For composting, estimates put commercial organics at roughly 50% of materials collected (or landfilled), and some composting facilities may only accept commercial materials, which might be missed with the current focus.
3. Definition of "compostable material" – We request amending the definition to include certified compostable products beyond just paper.
    a. COMPOSTABLE MATERIAL.—The term "compostable material" means material that is ~~composed of biomass that can be continually and safely replenished or renewed~~ **a feedstock for a composting process, such as including, but not limited to**—

        (A) wood;
        (B) agricultural crops;
        (C) paper **and certified compostable products associated with organic waste**;
        (D) other organic plant material;
        (E) marine products;
        (F) organic waste, including food waste and yard waste; ~~**and**~~ **or**

(G) such other material that is composed of biomass that can be continually replenished or renewed, as determined by the Administrator.

The Recycling Infrastructure and Accessibility Act complements the Recycling and Composting Accountability Act (RCAA) by providing funding to do something about the lack of access to recycling in underserved communities. However, we request that its scope be expanded to include composting. According to the US EPA roughly 40% of material headed to landfills and incinerators is organic (e.g. food scraps, yard trimmings, and wood), and that's before we look at food-soiled paper and certified compostable packaging. We need composting alongside recycling to make a difference.

Again, we support both of these legislative proposals, and are excited to see the federal government working on composting. The US Composting Infrastructure Coalition (USCIC) is a network of associations representing many of the undersigned, and is at your disposal to answer questions or provide support, including a tour of composting facilities in the DC area for committee members and their staff, or an educational workshop.[1]

Sincerely,

[signatories]

Cc: Members of the Senate Environment and Public Works Committee

[1] https://compostinfrastructure.com

The Aluminum Association

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February 28, 2022

The Honorable Thomas Carper
United States Senate
513 Hart Senate Office Building
Washington, D.C. 20510

The Honorable Shelley Moore Capito
United States Senate
172 Russel Senate Office Building
Washington, D.C. 20510

The Honorable John Boozman
United States Senate
141 Hart Senate Office Building
Washington, D.C. 20510

Dear Senators Carper, Capito, and Boozman,

On behalf of the Aluminum Association and its member companies, I am writing to express our support for the *Recycling and Composting Accountability Act* in addition to the *Recycling Infrastructure and Accessibility Act*.

The Aluminum Association represents the U.S. aluminum industry across the entire value chain. Recycling, or secondary production, is a critical part of that value chain with 80% of U.S. production today coming from recycled aluminum. Aluminum is the most profitable item in the recycling bin and often makes the collection of less-valuable materials possible. While aluminum cans are recycled at far higher rates than glass or plastic, these rates have fallen below 50% in recent years. In industrial markets, aluminum recycling rates remain over 90%.

The *Recycling and Composting Accountability Act* will provide a comprehensive and uniform dataset on material recovery facilities that will allow for the targeting of future investments in our nation's recycling system. Having more information about the facilities, what type of aluminum products they accept, and material diversion from the circular economy will help with decision-making that can make the difference in saving our critical feedstock from landfills.

The *Recycling Infrastructure and Accessibility Act* will make crucial recycling infrastructure investments in communities that have long been underserved. As Senator Carper pointed out in his remarks, 75% of all aluminum ever produced is still in use today – but more work must be done. In order to reduce our energy use, improve our environment, and reduce the over $800 million of aluminum sent to landfills each year, we must utilize innovative policy solutions like those put forward in this bill for improving the collection of recyclables in underserved areas to drive a true circular economy for aluminum.

We appreciate the leadership you and your staff have shown in crafting this legislation and welcome the opportunity to assist you in advancing these bipartisan priorities.

Respectfully submitted,

Virginia Gum Hamisevicz
Vice President Government Relations & International Programs
The Aluminum Association

AMERICAN BEVERAGE
DRIVING SOLUTIONS TOGETHER

February 2, 2022

The Honorable Tom Carper
Chairman, Senate Committee on Environment and Public Works
513 Hart Senate Office Building
Washington, DC 20510

The Honorable Shelley Moore Capito
Ranking Member, Senate Committee on Environment and Public Works
172 Russell Senate Office Building
Washington, DC 20510

The Honorable John Boozman
Member, Senate Committee on Environment and Public Works
141 Hart Senate Office Building
Washington, DC 20510

Dear Chairman Carper, Ranking Member Capito, and Sen. Boozman:

On behalf of American Beverage, representing the unified voice of America's non-alcoholic beverage industry, thank you for holding today's hearing on "Legislative Proposals to Improve Domestic Recycling and Composting Programs."

American Beverage and its members have long been active proponents of ensuring our carefully designed, fully recyclable bottles and cans are collected so they can be remade into new bottles and cans, as intended, and do not wind up in in the environment or wasted in landfills. Thus, we are encouraged by today's important hearing dedicated to improving our nation's recycling infrastructure and composting systems. Your leadership is essential and appreciated in pursing pragmatic and impactful solutions to this complex issue.

The *Recycling and Composting Accountability Act* and the *Recycling Infrastructure and Accessibility Act* represent positive steps forward in helping achieve a more circular economy. We look forward to the formal introduction of both bills and continuing our collaboration with the EPW Committee in the coming months.

Sincerely,

Kevin Keane
Executive Vice President, Government & Public Affairs

1275 Pennsylvania Avenue NW, Suite 1100 | Washington, DC 20004 | Tel 202.463.6732 | Fax 202.463.8277 | www.americanbeverage.org

March 1, 2022

The Honorable Tom R. Carper
United States Senate
513 Hart Senate Office Building
Washington, DC 20510

The Honorable Shelley Moore Capito
United States Senate
172 Russell Senate Office Building
Washington, DC 20510

The Honorable John N. Boozman
United States Senate
141 Hart Senate Office Building
Washington, DC 20510

Dear Chairman Carper, Ranking Member Capito, and Ranking Member Boozman:

On behalf of the Paper Recycling Coalition (PRC) – an organization of eight domestic manufacturers of 100% recycled paper products – we write in support of the "Recycling and Composting Accountability Act" (RCAA) and the "Recycling Infrastructure and Accessibility Act." These bills would, among other things, establish essential baseline data on recycling in the United States, study the amount of recyclable material that is being diverted to incinerators or landfills, and provide funding to communities to improve recycling access.

From cereal boxes to beverage containers to e-commerce shipping, 100 percent recycled paperboard and containerboard products are a ubiquitous and integral component of the nation's economy and the daily lives of all Americans. Indeed, paper recycling is an American success story with significant environmental benefits. We can recycle fiber up to seven times, putting it to work in our economy, providing good paying jobs, and adding value to the material each step of the way until it is turned into new paper products. We are proud of the fact that in 2020, over 66 percent of all paper consumed by Americans was recovered to be recycled into new products.

The PRC believes the RCAA will fill an important gap that is currently lacking in federal recycling policy discussions: data, especially as it relates to recycling rates, material recovery facilities (MRFs), federal recycled product procurement, and the diversion of recyclable materials to energy uses. Similarly, the PRC supports the RIAA's objective of expanding access to recycling in communities that have been historically had limited access to recycling collection programs.

There are several proposed legislative "solutions" circulating in Congress to "fix" the state of recycling in the United States. However, these bills are not based on factual data, mainly because there is insufficient information on the recycling landscape to inform these policy choices. The RCAA, in particular, would provide an important step to filling this data gap and providing important baseline data by which narrowly tailored, workable policy solutions may be developed in the future.

We applaud and support your efforts on the RCAA and RIAA and look forward to continuing our work on these bills as they move through the Committee process.

Thank you for your vision and leadership.

Sincerely,

Brian McPheely
Chairman, Paper Recycling Coalition, Inc.
Global CEO, Pratt Industries

Michael P. Doss
Vice Chairman, Paper Recycling Coalition, Inc.
President/CEO, Graphic Packaging Int'l, LLC

Terese Colling
President, Paper Recycling Coalition, Inc.

March 2, 2022

The Honorable Tom Carper, Chairman
The Honorable Shelley Moore Capito, Ranking Member
The Honorable John Boozman
Senate Committee on Environment and Public Works
410 Dirksen Senate Office Building
Washington, D.C. 20510

Dear Senators Carper, Capito, and Boozman:

The undersigned organizations and companies are working to promote the expansion of all facets of composting infrastructure throughout the U.S. As such, we express our support for your work on the following legislative proposals to improve domestic recycling and composting programs, and offer our recommendations on modifications to strengthen the legislation.

The Recycling and Composting Accountability Act would provide much needed national-level support to quantifying and qualifying recycling and composting programs, such as access, processing infrastructure, end markets, and labeling/education. This data and reporting is critical for advancing a national strategy to recover products and packaging, and to realize the climate benefits associated with widespread composting. We have a few definitional corrections:

1. Definition of "compost" – We request the use of the American Association of Plant and Food Control Officials (AAPFCO)'s definition.
    a. *Compost – is the product manufactured through the controlled aerobic, biological decomposition of biodegradable materials. The product has undergone mesophilic and thermophilic temperatures, which significantly reduces the viability of pathogens and weed seeds, and stabilizes the carbon such that it is beneficial to plant growth. Compost is typically used as a soil amendment, but may also contribute plant nutrients.*
2. Strike "residential" – While residential access to recycling and composting are critical, so are commercially generated materials at businesses. For composting, estimates put commercial organics at roughly 50% of materials collected (or landfilled), and some composting facilities may only accept commercial materials, which might be missed with the current focus.
3. Definition of "compostable material" – We request amending the definition to include certified compostable products beyond just paper.
    a. COMPOSTABLE MATERIAL.—The term "compostable material" means material that is ~~composed of biomass that can be continually and safely replenished or renewed~~ **a feedstock for a composting process, such as including, but not limited to**—

(A) wood;
(B) agricultural crops;
(C) paper **and certified compostable products associated with organic waste**;
(D) other organic plant material;
(E) marine products;
(F) organic waste, including food waste and yard waste; ~~**and**~~ **or**
(G) such other material that is composed of biomass that can be continually replenished or renewed, as determined by the Administrator.

The Recycling Infrastructure and Accessibility Act complements the Recycling and Composting Accountability Act (RCAA) by providing funding to do something about the lack of access to recycling in underserved communities. However, we request that its scope be expanded to include composting. According to the US EPA roughly 40% of material headed to landfills and incinerators is organic (e.g. food scraps, yard trimmings, and wood), and that's before we look at food-soiled paper and certified compostable packaging. We need composting alongside recycling to make a difference.

Again, we support both of these legislative proposals, and are excited to see the federal government working on composting. The US Composting Infrastructure Coalition (USCIC) is a network of associations representing many of the undersigned, and is at your disposal to answer questions or provide support, including a tour of composting facilities in the DC area for committee members and their staff, or an educational workshop.[1]

Sincerely,

3M
Agri Organics
Appalachian State University
BASF Corporation
Black Bear Composting
BPI
Cal Poly State University, Agricultural Operations
CHANG CHUN PLASTICS CO., LTD.
Chickadee Compost
Clemson University
Danimer Scientific
Dart Container Corporation
Davidson College
Earth Matter NY Inc.
Elk Packaging
Epic Renewal
Foreg AG
Georgia College & State University
HAY! Straws
Hoffmaster
Inno-Pak, LLC
Lunchskins
McGill Environmental Systems
Mid Valley Recycling LLC
Mother Compost
NatureWorks
NC State University
New York University
Northern Technologies International Corporation
Northland College
Ohio State University
Olympic Organics LLC
Pactiv Evergreen
Penn State
PepsiCo
Plant Based Products Council
Pod Pack International
Printpack, Inc
Reotemp Instrument Corp.
Rexius Forest By-Products, Inc.

Roymal, Inc.
Rust Belt Riders Composting
S-One LP
Sabert Corporation
Smile Beverage Werks, P.B.C.
Southeastern Connecticut Regional Resources Recovery Authority
TC Packaging
University of Alabama at Birmingham
University of Kentucky
University of Maryland
University of North Carolina at Chapel Hill
UNNI Corporation
US Composting Council
Virginia Tech
World Centric

Cc: Members of the Senate Environment and Public Works Committee

[1] https://compostinfrastructure.com

AMP ROBOTICS®

1500 Cherry Street, Suite A
Louisville, CO 80027
amprobotics.com
(888) 402-1686

February 25, 2022

The Honorable Tom Carper
513 Hart Senate Office Building
Washington, DC 20510

The Honorable John Boozman
141 Hart Senate Office Building
Washington, DC 20510

The Honorable Shelley Moore Capito
172 Russell Senate Office Building
Washington, DC 20510

Dear Senators Carper, Boozman, and Capito,

AMP Robotics would like to thank Chairman Carper, Senator Boozman, and Senator Capito for sponsoring the "Recycling and Composting Accountability Act" and to express support for this bipartisan and innovative legislation.

AMP Robotics fully subscribes to one of the principal goals of this legislation: improving the reporting of data collected at materials recovery facilities (MRF). We believe the standardization of this data and the ability to provide accurate and verifiable reports to the appropriate regulatory authorities is a critical step in creating a mechanism to improve the purity of the recycling stream in the United States.

With deployments across North America, Asia, and Europe, AMP Robotics is a pioneer and leader in recycling technology and manufacturing. AMP Robotics specializes in the industrial application of artificial intelligence and computer vision. AMP's robots are used to identify, sort, and recover materials from residential recycling programs, precious commodities from electronic scrap, and high-value materials from construction and demolition debris. Located in Louisville, Colorado the company is dedicated to reinventing recycling and bringing the world closer to one without waste. As of this writing, approximately 60 facilities in the U.S. and worldwide are utilizing over 175 robots to recognize and categorize over 1.3 billion and recycle close to 82 million pieces of material per month.

We believe that leveraging advanced technology such as artificial intelligence can significantly improve the ability for municipal recovery facilities to identify, sort and process the materials that come into the facility. The technology provides a revolutionary solution for MRF operators who can now capture key data on the types and amounts of materials that are being processed.

Traditionally, MRFs must employ hand-sorting methods to capture data through periodic manual bale audits that take time and are inaccurate. These manual waste audits are useful but only evaluate small samples of the overall waste stream. Audits are expensive to undertake frequently enough to be statistically relevant. Constant sampling requires MRFs to dedicate space, time, labor, equipment, and other resources which drive up operational costs. Additionally, increased sampling exposes workers to

safety risks, is cumbersome and time consuming, and are becoming outdated compared to the pace of market changes.

Automated, anonymous, and consistent real time monitoring of material flowing through the MRF can give an exact and accurate picture of the types of materials that are being recycled. This process will provide the data needed to ensure the program is working as designed, while eliminating the use of manual audits thereby reducing the MRFs overall operational costs.

AMP Robotics has developed vision systems powered by artificial intelligence that can provide real-time data collection. AMP Neuron™ is our core AI platform which applies the latest computer vision technology to visually recognize materials for recovery by 'seeing' different colors, textures, shapes, sizes, patterns, and even brand labels to identify the materials coming down a belt. When paired with AMP Clarity™, a web-based data portal that provides real-time material characterization and performance measurement, MRFs have the tools they need to not only characterize the materials flowing across their conveyors, but the ability to analyze and process that data to make key decisions on the operation of their facility.

At AMP Robotics, we stand ready to help advance the goals of the "Recycling and Composting Accountability Act" and believe technology that provides anonymous, consistent, real-time data is critical to the legislation's mission.

Thank you once again for your leadership and vision and we look forward to discussing further how technology and artificial intelligence can provide the recycling solutions of the future.

Sincerely,

Christopher Wirth

Chris Wirth
Vice President
Marketing, Business Development & Government Relations

Jonathan Levy

Jonathan Levy
Director
Government Relations

ASSOCIATION of OREGON RECYCLERS

PO BOX 1264
Tualatin, OR 97062
503-233-3056
www.oregonrecyclers.org

March 2nd, 2022

United States Committee on Environment and Public Works
Attn: U.S. Senators Boozman (R-Arkansas), Capito (R-West Virginia), and Carper (D-Delaware)
410 Dirksen Senate Office Building
Washington, D.C. 20510

Chairman Senator Carper,

The Association of Oregon Recyclers (AOR) strongly supports the Recycling and Composting Accountability Act. National support for recycling and composting infrastructure supports economic development and job opportunities, while managing our natural resources responsibility. Based on our experience in Oregon, there are a few aspects, focused on the composting system, that we would strongly consider for implementation shall the bill pass:

Hierarchy of Food Waste

Legislation to support compost infrastructure is recommended to be supported by a hierarchy of action that follows these priorities:

1) Identifying opportunities to reduce the unnecessary production of wasted food,
2) Get uneaten edible food to people in need,
3) Feed farm animals,
4) Industrial and commercial food mechanical digestion and composting,
5) Residential food mixed with yard debris composting.

Market Development for Compost

Markets for organic materials have direct impacts on greenhouse gas reduction. The success of composting depends on the economic independence of market products such as compost and soil amendments to enhance soil health and increase water absorption, biogas for vehicles and infrastructure fuel.

For these markets to thrive, legislation is recommended to focus on:

- Securing demand for these products through government contracts and state and local policies that require building and infrastructure developments.
- Creating incentives for feedstocks by making it cheaper to dispose of organic materials at a compost facility, compared to landfilling.
- Providing incentives for farmers and land managers to purchase compost through grants, tax incentives and awareness.

High Quality Compost Products

A variety of products are produced by composting organic materials and each market uses a variety of processes to create the product. High quality product specifications are recommended to be prioritized over landfill diversion.

If legislation is focused on achieving higher landfill diversion rates, the unintended consequence is a lower quality product and increases in plastic pollution. For example, compostable plastic food and beverage packaging has been

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touted as a key tool to diverting more material from the landfill, but strong evidence shows that these materials are more problematic and result in customers mistakenly adding plastic packaging that is not compostable. Rather than landfill diversion rates as focus of legislation, suggest a focus on developing markets for best uses for high impact wastes (GHG, chemical use, energy use and other pollution impacts), such as food waste.

To support compost product quality, the EPA can examine potential end markets for finished compost and available infrastructure for delivery to market. This strategy would be helpful for emerging businesses developing techniques for identifying soil depletion and needs when building up healthy soils with compost will be a new technique for end users.

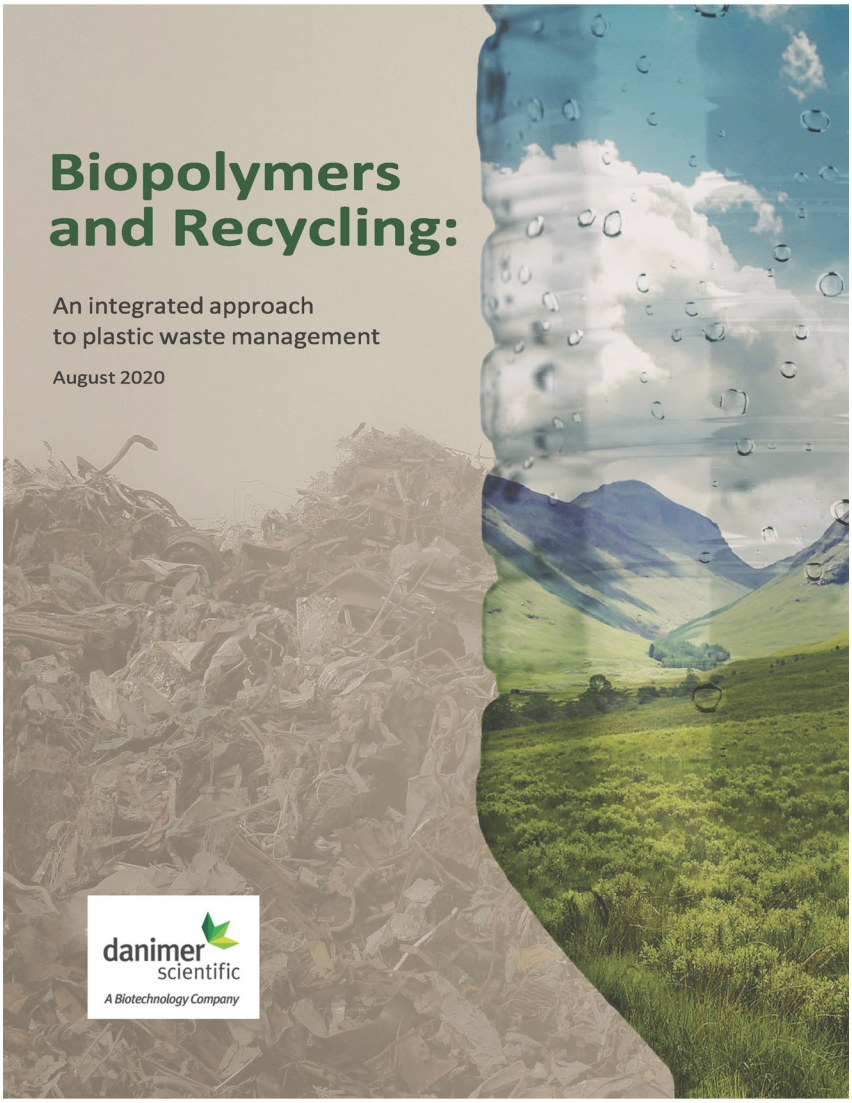
Technology

Anerobic digestion (at farms and wastewater treatment facilities) and food liquid extraction technologies have been developed to use the beneficial qualities of food waste and remove unwanted plastics from the process. These new technologies can create opportunities for food manufacturing and some large commercial sources but are not recommended for all compost programs, as they lose much of the organic material in the process. An ideal feedstock for anerobic digestion and composting includes food only.

AOR believes the Recycling and Composting Accountability Act is the type of national policy we need to support a more robust system of recycling and composting across the country. We urge you to move it forward.

Sincerely,

Kristin Leichner
Chair, Association of Oregon Recyclers


Biopolymers
and Recycling:
An integrated approach
to plastic waste management
August 2020
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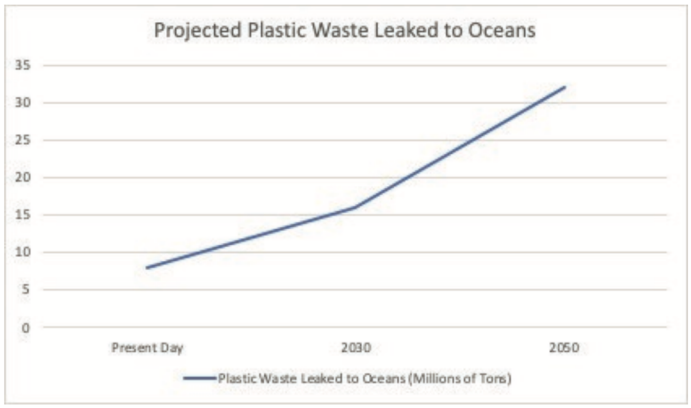
scientific
A Biotechnology Company

The State of Plastic Waste

It is no secret that the world has a plastic waste problem, but the best solution for the issue is still up for debate. The argument has coalesced around two distinct approaches for handling plastic products when they reach the end of their lifecycle – one focuses on recycling while the other centers on biodegradability. Determining the best solution is critical as the amount of plastic waste building up in landfills and marine environments grows exponentially.

Millions of pounds of plastic waste that flow into the oceans every year from coastal regions, and that amount is slated to intensify in the years ahead. The primary cause for concern is that plastic production has seen unprecedented growth in the last 20 years. Nearly half of all plastic worldwide that has ever been manufactured was created after the year 2000, and the yearly production volume of plastic nearly doubled from 2000 to 2015.

The Ellen MacArthur Foundation reported that of the total volume of plastics used globally, 26 percent is used for packaging, a vast majority of which is disposed of after a short first use. The unfortunate reality is that much of this plastic packaging ends up as waste in the environment. Oceans have been particularly impacted by this plastic waste. At least 8 million tons of plastic waste leaked into an ocean every year in 2016, and that volume is expected to double by 2030 and quadruple by 2050.

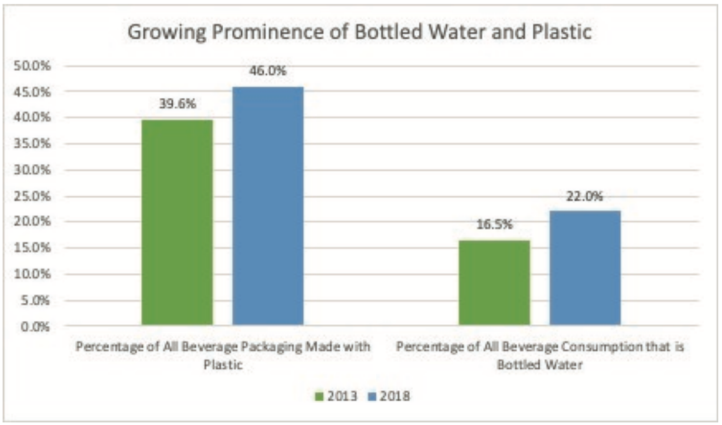


Source: The Ellen MacArthur Foundation – The New Plastics Economy: Rethinking the future of plastics & catalyzing action

Environmental groups have been campaigning for solutions to the issue of plastic waste for decades, and the conversation has become more prevalent at the government and corporate level within the last few years. In particular, bans of single-use plastic straws captured headlines in 2018 and 2019. The city of Seattle became one of the biggest cities in the United States to ban plastic straws after it passed legislation requiring all food service businesses to use recyclable or compostable material in all disposable service items, from containers and straws to cups and

utensils. Moreover, The Walt Disney Company is eliminating single-use plastic straws and plastic stirrers at all Disney-owned locations, including its signature theme park attractions.

The focus on plastic straw bans still leaves the environmental impacts of other types of plastic packaging unattended, and it is here where the majority of the problem exists. Beverage Marketing Corp. reported that plastic was used for 46 percent of beverage packaging in 2018, up from 39.6 percent in 2013. This increase was in part fueled by the rapid growth of the bottled water industry.



Source: Beverage Marketing Corp. – data cited in "Bottled water use continues to climb" from *Plastics News*

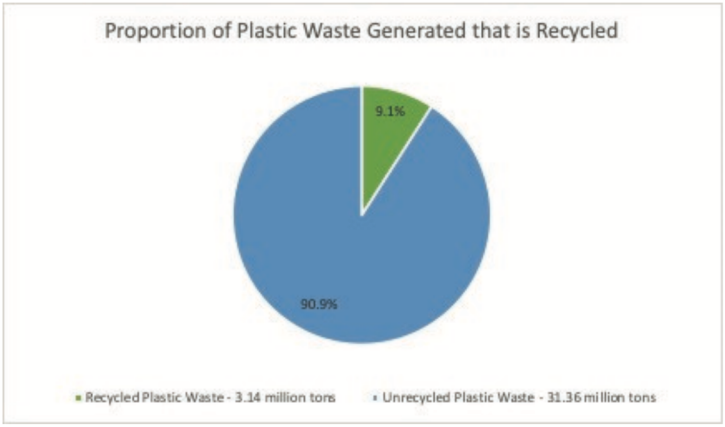
Bottled water consumption's share of all beverage consumption in the U.S. rose from 16.5 percent in 2013 to 22 percent in 2018. The biggest benefactor of this growth has been polyethylene terephthalate (PET) plastic. The single-serve PET bottle market accounted for 69.7 percent of bottled water sales in 2018, up from 66.9 percent in 2013.

It is too early to determine the results and impacts of outright bans of plastic products, but they will undoubtedly find it difficult to alter the course of this massive volume of plastics manufacturing. This brings the conversation back to the recycling vs. biopolymer debate in the search for a long-term solution to reducing plastic waste.

These two approaches are both viable solutions given the extensive infrastructure already in place between recycling facilities and biopolymer production plants, and while the prevailing concern is that they cannot co-exist, the reality may be that there is room for both. A closer look at the latest trends and developments in the biopolymer production industry reveals that the material may be able to complement the recycling industry by filling the gaps in plastic waste management that the latter is unable to address on its own.

The Gaps in Recycled Plastic Waste

The recycling industry saw impressive growth throughout the latter half of the twentieth century, yet there is still a significant portion of plastic waste that goes unrecycled. The Environmental Protection Agency's annual "Advancing Sustainable Materials Management" survey captures the industry's recent performance, reporting that the United States generated 34.5 million tons of plastic waste in 2015, 3.14 million tons of which were recycled.



Source: Environmental Protection Agency – "Advancing Sustainable Materials Management"

This amount of recycled plastic only accounts for 9.1 percent of all plastic waste that was generated in 2015. This presents a significant opportunity for the recycling and waste management industries to grow and further reduce the approximately 90 percent of plastic waste that ends up in a landfill or in the environment.

However, several recent shifts in global market forces will make this a difficult gap to close.

For several decades, China has been one of the largest importers of recycled materials from the United States and several other global markets. This swiftly changed in 2017 after the country announced a new policy permanently banning the import of nonindustrial plastic waste. China now only purchases loads of recycled waste that are guaranteed to be 99.5 percent free of contaminants. The vast majority of U.S.-based recycling operations are designed to produce plastic waste that is up to 97 percent pure, which means China's new standard will be unattainable for the foreseeable future.

Industry research estimates that the impact of China's policy shift will displace 111 million metric tons of plastic waste by 2030. Unless the world's recycling industry can adjust its operations, or find a new home for this displaced material, that waste will likely end up in landfills or an ocean.

The stymied growth of the recycling industry has significantly compounded the challenge of reducing the environmental impacts of plastic waste. As plastic manufacturing continues to increase exponentially, the most effective path forward may require an additional solution to complement the recycling industry – biodegradable plastics.

Growth in Biopolymer Development

One of the greatest challenges presented by traditional petrochemical plastic is that it will not biodegrade in natural environments – instead, it fragments into microplastic pieces that can have severely detrimental effects on both wildlife and the broader ecosystem. The plastics industry has explored developing biopolymers that will create biodegradable plastic products, yet in the past this has yielded mixed results.

Biopolymers, such as polylactic acid (PLA), have shown promise and will effectively biodegrade in industrial composts, but their decomposition rate is much less reliable in home composts and marine environments. Similar to the challenges faced with recycling streams, products manufactured from these biopolymers must be properly processed at the end of their lifecycle to reduce their environmental impacts.

Despite these historical challenges, the plastics industry has continued investing in the development of more effective biopolymers. The manufacture of biodegradable plastics is forecasted to increase 19.3 percent from 2018 to 2026, and the quality of these materials is steadily growing.

One of the most promising biopolymers today is polyhydroxyalkanoate (PHA). In a 2018 study, University of Georgia researchers tested the biodegradation rates of PHA materials in a variety of conditions simulating potential environments where plastic waste typically accumulates. The study results found that PHA effectively biodegrades in both anaerobic environments, such as a waste treatment facility, and aerobic environments, such as an ocean.

Researchers evaluated how PHA biodegrades in a proper waste management system by placing samples of the material in anaerobic sludge. After allowing the PHA to incubate for a period of 40 – 60 days, the team compared its degradation levels to cellulose powder that was left in a similar setting, while also comparing PHA's methane yield to that of food waste. The researchers concluded that the PHA degradation was not significantly different from the cellulose powder. Additionally, PHA's methane yields were statistically similar to the food waste.

The fact that PHA biodegrades at nearly the same pace as organic waste suggests that the materials could be reliably processed in a landfill or waste treatment facility. Perhaps more importantly, researchers also confirmed that PHA will effectively biodegrade in seawater over the course of six months, while polypropylene pellets remained unchanged in the same environment.

The results of the University of Georgia study have precipitated several other promising developments related to biodegradable plastic manufacturing. Georgia-based Danimer Scientific opened the world's first commercial production facility for PHA in 2019, and the company is actively working with global brands to create biodegradable packaging – including collaborations with PepsiCo to create next-generation compostable snack bags and Nestle to create biodegradable water bottles for the brand's global water business.

Collaborating to Reduce Plastic Waste

As the recycling industry explores potential strategies for re-aligning with changing global markets, the integration of biopolymers such as PHA into plastic production can help fill the gaps in reducing the environmental impacts of plastic waste.

With plastic production showing no signs of slowing down, and global markets adjusting to the fallout of China's new import policy for plastic materials, a cooperative approach between the recycling industry and biopolymer manufacturers may be the most effective strategy for the future. An example of this type of approach is a joint public awareness campaign that educates policy makers and consumers on how all petrochemical and bioplastic materials should be properly disposed at the end of their lifecycle. The goal of such a campaign would be to ensure every user of a plastic product understands the difference between terms such as "recyclable," "biodegradable," "industrial compostable" and "home compostable."

The right combination of infrastructure, consumer education and industry collaboration may be an effective solution that contributes to eliminating the global issue of plastic waste.

Statement

For Immediate Release **February 2, 2022**

Contact: Matthew Kastner (202) 249-6623
Email: matthew_kastner@americanchemistry.com

SENATE HEARING ON RECYCLING FINDS CONSENSUS, IDENTIFIES AREAS TO IMPROVE

Dialogue must lead to legislation

WASHINGTON, DC (February 2, 2022) – *Today the Senate Environment and Public Works Committee held a hearing on improving and expanding domestic recycling. The following statement may be attributed to Joshua Baca, American Chemistry Council's (ACC) vice president of plastics:*

"ACC appreciates the continued work by Chairman Carper, Ranking Member Capito, Senator Boozman and members of the committee to accelerate a circular economy, improve recycling across the country, and engage recycling advocates. Improving and expanding domestic recycling requires an "all of the-above" strategy that leverages many of the ideas and policies discussed at today's hearing on two important legislative draft proposals.

"Increasing recycling access and rates, and collecting better data is a bipartisan issue, and America's plastic makers are ready to partner in providing sustainable solutions. In 2021 we released 5 Actions for Sustainable Change, which sets forth concrete steps for the industry and Congress to adopt that will accelerate a circular economy for plastics. In today's committee hearing, there was significant alignment between what plastics makers, the Senate, and the witnesses all want to accomplish.

"Specifically, access to recycling, particularly in rural areas, must be improved. We believe a producer responsibility system is essential to build out the necessary recycling infrastructure. That infrastructure must be modernized by expanding mechanical recycling and leveraging the proven technologies of advanced recycling. Advanced recycling projects announced in the United States have the potential to recover nearly 11 billion pounds of hard-to-recycle plastics and remake them into new plastics. This will help keep plastics out of landfills and meet the growing market demand for recycled plastics as well as EPA's goal to grow the U.S. recycling rate to 50% by 2030.

"The industry also supports creating national recycling standards to better harmonize the approximately 9,000 recycling jurisdictions across the country, so people in Arkansas, Delaware, West Virginia and other states all have one understandable minimum set of recycling criteria. Standards also would ensure that data collection and reporting procedures across the country are consistent. Lastly, plastic makers have asked Congress to require all plastic packaging to contain at least 30% recycled plastic by 2030 and hold companies accountable.

"From reducing food waste through efficient, lightweight packaging to enabling wind and solar energy technologies, plastics are an essential material for achieving a lower carbon future. We will continue to work with Congress and other stakeholders to expand recycling and improve the sustainability of plastics."

# # #

www.americanchemistry.com/newsroom

The American Chemistry Council (ACC) represents the leading companies engaged in the business of chemistry. ACC members apply the science of chemistry to make innovative products and services that make people's lives better, healthier and safer. ACC is committed to improved environmental, health and safety performance through Responsible Care®; common sense advocacy designed to address major public policy issues; and health and environmental research and product testing. The business of chemistry is a $486 billion enterprise and a key element of the nation's economy. It is among the largest exporters in the nation, accounting for nine percent of all U.S. goods exports. Chemistry companies are among the largest investors in research and development. Safety and security have always been primary concerns of ACC members, and they have intensified their efforts, working closely with government agencies to improve security and to defend against any threat to the nation's critical infrastructure.

Statement for the Record

Senate Environment and Public Works Committee

Hearing on Federal Recycling Legislation

March 2, 2022

The American Chemistry Council (ACC) and its plastics producing members remain encouraged by Congress's continued progress in improving recycling in America. The collection and recycling of materials remain woefully short. Americans deserve better than our current efforts – we can and must do better.

In this vein, ACC greatly appreciates Congress's substantive work on two important pieces of recycling legislation: The "Recycling and Composting Accountability Act," sponsored by Chairman Carper and Senators Boozman and Capito; and the "Recycling Infrastructure and Accessibility Act," sponsored by Senator Capito, Chairman Carper, and Senator Boozman. We commend the sponsors' ongoing dedication to necessary improvements in recycling accessibility, collection, sortation, research, and federal funding – all critical areas necessary to enhance and expand recycling and contribute to a circular economy in which materials remain in productive use.

Improving and expanding domestic recycling requires an "all of the-above" strategy that leverages many of the ideas and policies included in these two important legislative proposals. As the 117th Congress continues to address and debate federal recycling priorities, important alignment continues to be driven between various stakeholders and their goals. For example, access to recycling, particularly in rural areas, must be improved. Materials-neutral collection and sortation technology must be improved. Education and research must be improved. The continued growth and scaling of advanced technologies that address hard-to-recycle and mixed plastics must be improved if we are to achieve national recycling targets.

Indeed, the ACC believes that increasing recycling access and rates and collecting reliable data is a bipartisan issue, and America's plastic makers are helping to provide sustainable solutions. In 2021, we released 5 Actions for Sustainable Change, which sets forth concrete steps for our industry and Congress to adopt that would accelerate a circular economy for plastics.

That includes an American producer responsibility system that would marshal the resources needed to build out our nation's recycling infrastructure. And that infrastructure must be modernized by furthering use of mechanical recycling and leveraging the proven technologies of advanced recycling. Advanced recycling projects announced in the United States have the potential to recover more than 12 billion pounds of hard-to-recycle plastics per year and remake them into new plastics. This will help keep plastics out of landfills, meet the growing market

demand for recycled plastics, and achieve EPA's goal to grow the U.S. recycling rate to 50% by 2030.

The industry also supports creating national recycling standards to better harmonize the approximately 9,000 recycling jurisdictions across the country, so people in Arkansas, Delaware, West Virginia, and all states have one understandable minimum set of recycling criteria. Standards also would help ensure that data collection and reporting procedures across the country are consistent. And significantly, plastic makers have asked Congress to require all plastic packaging in the U.S. to contain at least 30% recycled plastic by 2030 and to hold companies accountable.

From reducing food waste through efficient, lightweight packaging to enabling wind and solar energy technologies, plastics are an essential material for achieving a lower carbon future. We will continue to work with Congress and all stakeholders to expand recycling and build on the sustainability of plastics.

We applaud the great work that Chairman Carper, Senator Capito, and Senator Boozman have done to positively contribute to a greater understanding of what can be recycled, how collection can be improved, how the government can help fund and grow markets for valuable recyclable materials, and how we all can contribute to greater recycling rates that can create cleaner communities for future generations. The American Chemistry Council looks forward to continuing to work with these bills' sponsors, other Members of Congress, and all stakeholders to advance recycling and sustainability in our communities.

American Forest & Paper Association

Statement for the Record
Senate Committee on Environment and Public Works
Hearing on Legislative Proposals to Improve Domestic Recycling and Composting Programs
February 2, 2022

The American Forest & Paper Association (AF&PA) is pleased to submit for the record the following statement of support for the Recycling and Composting Accountability Act and the Recycling Infrastructure and Accessibility Act.

AF&PA serves to advance U.S. paper and wood products manufacturers through fact-based public policy and marketplace advocacy. The forest products industry is circular by nature. AF&PA member companies make essential products from renewable and recycled resources, generate renewable bioenergy, and are committed to continuous improvement through the industry's sustainability initiative — *Better Practices, Better Planet 2030: Sustainable Products for a Sustainable Future.* The forest products industry accounts for approximately 4 percent of the total U.S. manufacturing GDP, manufactures nearly $300 billion in products annually and employs approximately 950,000 people. The industry meets a payroll of approximately $60 billion annually and is among the top 10 manufacturing sector employers in 45 states.

The paper industry is a leader in recycling. In 2020, two-thirds of the paper used in the U.S. was recycled and used to make essential new paper products. Paper recycling rates have continuously grown over recent decades and remain consistently high, meeting or exceeding 63 percent since 2009. The paper industry recycles about 50 million tons of recovered paper every year — totaling more than 1 billion tons over the past 20 years. According to the EPA, more paper by weight is recovered for recycling than plastic, glass, steel, and aluminum combined. Our industry has an ownership stake in the recycling system and 80 percent of paper mills use some amount of recycled fiber. The paper industry has planned or announced around $5 billion in manufacturing infrastructure investments by 2023 to continue the best use of recycled fiber in our products. These investments will increase the amount of recovered paper used by U.S. paper and paperboard mills by approximately 8 million tons – a 25 percent increase over 2020 levels.

Our industry prioritizes data collection to improve recycling rates and we have long invested in research into the current state of paper recycling and how we can improve. Last week, AF&PA released the *2021 AF&PA Access to Recycling Study*, showing most Americans, 94 percent, have access to community paper and paperboard recycling programs. In addition, AF&PA released *The Design Guidance for Recyclability* in 2021 to provide data for packaging designers and consumer brands to better understand how non-fiber elements, including coatings and additives, impact the recyclability of paper-based packaging.

AF&PA is pleased to support the Recycling and Composting Accountability Act and we applaud the leadership of U.S. Senators Carper and Boozman. The bill will help further increase and improve recycling and composting in the United States by helping the Environmental Protection Agency improve measurement, data, and reporting tools. AF&PA is also pleased to support the Recycling Infrastructure and Accessibility Act and we applaud the leadership of U.S. Senator Capito. The bill will improve recycling accessibility in communities, including historically underserved communities.

Senator CARPER. Additionally, I would say to my colleagues on the Committee, you will be allowed to submit questions for the record through the close of business on Wednesday, February the 16th. That is a couple of weeks. We will compile those questions, send them out to our witnesses, and ask that you reply by Wednesday, March the 2nd. I believe that is 2 weeks, if I am not mistaken.

With that, in the Navy, when people do an especially good job on important issues, we have a saying, and that is bravo zulu. Bravo zulu, I would say to each of you, to our Committee members, to those who helped, staff, Committee members, bravo zulu all around.

With that, I think, it is a wrap. I am going to run and vote again.

Thanks, everybody.

[Whereupon, at 12:12 p.m., the hearing was adjourned.]

[Additional material submitted for the record follows:]

117TH CONGRESS
2D SESSION

S. _____

To establish a pilot grant program to improve recycling accessibility, and for other purposes.

IN THE SENATE OF THE UNITED STATES

_____ introduced the following bill; which was read twice and referred to the Committee on _____

A BILL

To establish a pilot grant program to improve recycling accessibility, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "Recycling Infrastructure and Accessibility Act of 2022".

SEC. 2. RECYCLING INFRASTRUCTURE AND ACCESSIBILITY PROGRAM.

(a) DEFINITIONS.—In this section:

(1) ADMINISTRATOR.—The term "Administrator" means the Administrator of the Environmental Protection Agency.

(2) CURBSIDE RECYCLING.—The term "curbside recycling" means the process by which residential recyclable materials are picked up curbside.

(3) ELIGIBLE ENTITY.—The term "eligible entity" means—

(A) a State (as defined in section 1004 of the Solid Waste Disposal Act (42 U.S.C. 6903));

(B) a unit of local government;

(C) an Indian Tribe; and

(D) a public-private partnership.

(4) INDIAN TRIBE.—The term "Indian Tribe" has the meaning given the term in section 4 of the Indian Self-Determination and Education Assistance Act (25 U.S.C. 5304).

(5) MATERIALS RECOVERY FACILITY.—

(A) IN GENERAL.—The term "materials recovery facility" means a recycling facility where primarily residential recyclables, which are diverted from disposal by a generator and collected separately from municipal solid waste,

are mechanically or manually sorted into commodities for further processing into specification-grade commodities for sale to end users.

(B) EXCLUSION.—The term "materials recovery facility" does not include a solid waste management facility that may process municipal solid waste to remove recyclable materials.

(6) PILOT GRANT PROGRAM.—The term "pilot grant program" means the Recycling Infrastructure and Accessibility Program established under subsection (b).

(7) RECYCLABLE MATERIAL.—The term "recyclable material" means obsolete, previously used, off-specification, surplus, or incidentally produced material for processing into a specification-grade commodity for which a market exists.

(8) TRANSFER STATION.—The term "transfer station" means a facility that—

(A) receives and consolidates recyclable material from curbside recycling or drop-off facilities; and

(B) loads the recyclable material onto tractor trailers, railcars, or barges for transport to a distant materials recovery facility or another recycling-related facility.

(9) UNDERSERVED COMMUNITY.—The term "underserved community" means a community without access to full recycling services because—

(A) the community is too geographically remote to receive services from the nearest materials recovery facility; or

(B) the processing capacity of an existing materials recovery facility is insufficient to manage the volume of recyclable materials produced by that community.

(b) ESTABLISHMENT.—Not later than 18 months after the date of enactment of this Act, the Administrator shall establish a pilot grant program, to be known as the "Recycling Infrastructure and Accessibility Program", to award grants, on a competitive basis, to eligible entities to improve recycling accessibility in a community or communities within the same geographic area.

(c) GOAL.—The goal of the pilot grant program is to fund eligible projects that will significantly improve accessibility to recycling systems through investments in infrastructure in underserved communities through the use of a hub-and-spoke model for recycling infrastructure development.

(d) APPLICATIONS.—To be eligible to receive a grant under the pilot grant program, an eligible entity shall sub-

mit to the Administrator an application at such time, in such manner, and containing such information as the Administrator may require.

(e) CONSIDERATIONS.—In selecting eligible entities to receive a grant under the pilot grant program, the Administrator shall consider—

(1) whether the community or communities in which the eligible entity is seeking to carry out a proposed project has curbside recycling;

(2) whether the proposed project of the eligible entity will improve accessibility to recycling services in a single underserved community or multiple underserved communities; and

(3) if the eligible entity is a public-private partnership, the financial health of the private entity seeking to enter into that public-private partnership.

(f) PRIORITY.—In selecting eligible entities to receive a grant under the pilot grant program, the Administrator shall give priority to eligible entities seeking to carry out a proposed project in a community in which there is not more than 1 materials recovery facility within a 150-mile radius of that community.

(g) USE OF FUNDS.—An eligible entity awarded a grant under the pilot grant program may use the grant

funds for projects to improve recycling accessibility in communities, including in underserved communities, by—

(1) increasing the number of transfer stations;

(2) expanding curbside recycling collection programs where appropriate; and

(3) leveraging public-private partnerships to reduce the costs associated with collecting and transporting recyclable materials in underserved communities.

(h) PROHIBITION ON USE OF FUNDS.—An eligible entity awarded a grant under the pilot grant program may not use the grant funds for projects relating to recycling education programs.

(i) MINIMUM AND MAXIMUM GRANT AMOUNT.—A grant awarded to an eligible entity under the pilot grant program shall be in an amount—

(1) not less than $1,000,000; and

(2) not more than $15,000,000.

(j) SET-ASIDE.—The Administrator shall set aside not less than 70 percent of the amounts made available to carry out the pilot grant program for each fiscal year to award grants to eligible entities to carry out a proposed project or program in a single underserved community or multiple underserved communities.

(k) FEDERAL SHARE.—

(1) IN GENERAL.—Subject to paragraph (2), the Federal share of the cost of a project or program carried out by an eligible entity using grant funds shall be not more than 90 percent.

(2) WAIVER.—The Administrator may waive the Federal share requirement under paragraph (1) if the Administrator determines that an eligible entity would experience significant financial hardship as a result of that requirement.

(l) REPORT.—Not later than 2 years after the date on which the first grant is awarded under the pilot grant program, the Administrator shall submit to Congress a report describing the implementation of the pilot grant program, which shall include—

(1) a list of eligible entities that have received a grant under the pilot grant program; and

(2) the actions taken by each eligible entity that received a grant under the pilot grant program to improve recycling accessibility with grant funds.

(m) AUTHORIZATION OF APPROPRIATIONS.—

(1) IN GENERAL.—There are authorized to be appropriated to the Administrator to carry out the pilot grant program such sums as may be necessary for each of fiscal years 2023 through 2027, to remain available until expended.

(2) ADMINISTRATIVE COSTS AND TECHNICAL ASSISTANCE.—Of the amounts made available under paragraph (1), the Administrator may use up to 5 percent—

(A) for administrative costs relating to carrying out the pilot grant program; and

(B) to provide technical assistance to eligible entities applying for a grant under the pilot grant program.

117TH CONGRESS
2D SESSION

S. _____

To require the Administrator of the Environmental Protection Agency to carry out certain activities to improve recycling and composting programs in the United States, and for other purposes.

IN THE SENATE OF THE UNITED STATES

Mr. CARPER (for himself and Mr. BOOZMAN) introduced the following bill; which was read twice and referred to the Committee on

---

A BILL

To require the Administrator of the Environmental Protection Agency to carry out certain activities to improve recycling and composting programs in the United States, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "Recycling and Composting Accountability Act".

SEC. 2. DEFINITIONS.

In this Act:

(1) ADMINISTRATOR.—The term "Administrator" means the Administrator of the Environmental Protection Agency.

(2) CIRCULAR MARKET.—The term "circular market" means a market that utilizes industrial processes and economic activities to enable post-industrial and post-consumer materials used in those processes and activities to maintain their highest values for as long as possible.

(3) COMPOST.—The term "compost" means a product that—

(A) is manufactured through the controlled aerobic, biological decomposition of biodegradable materials;

(B) has been subjected to medium and high temperature organisms, which—

(i) significantly reduce the viability of pathogens and weed seeds; and

(ii) stabilize carbon in the product such that the product is beneficial to plant growth; and

(C) is typically used as a soil amendment, but may also contribute plant nutrients.

(4) COMPOSTABLE MATERIAL.—The term "compostable material" means material that is com-

posed of biomass that can be continually and safely replenished or renewed, such as—

(A) wood;

(B) agricultural crops;

(C) paper;

(D) other organic plant material;

(E) marine products;

(F) organic waste, including food waste and yard waste; and

(G) such other material that is composed of biomass that can be continually replenished or renewed, as determined by the Administrator.

(5) COMPOSTING FACILITY.—The term "composting facility" means a location, structure, or device that transforms compostable materials into compost.

(6) INDIAN TRIBE.—The term "Indian Tribe" has the meaning given the term in section 4 of the Indian Self-Determination and Education Assistance Act (25 U.S.C. 5304).

(7) MATERIALS RECOVERY FACILITY.—

(A) IN GENERAL.—The term "materials recovery facility" means a dedicated recycling facility where primarily residential recyclables,

which are diverted from disposal by the generator and collected separately from municipal solid waste, are mechanically or manually sorted into commodities for further processing into specification-grade commodities for sale to end users.

(B) EXCLUSION.—The term "materials recovery facility" does not include a solid waste management facility that may process municipal solid waste to remove recyclable materials.

(8) PROCESSING.—The term "processing" means any mechanical, manual, or other method that—

(A) transforms a recyclable material into a specification-grade commodity; and

(B) may occur in multiple steps, with different steps, including sorting, occurring at different locations.

(9) RECYCLABLE MATERIAL.—The term "recyclable material" means a material that is obsolete, previously used, off-specification, surplus, or incidentally produced for processing into a specification-grade commodity for which a circular market currently exists or is being developed.

(10) RECYCLING.—The term "recycling" means the series of activities—

(A) during which recyclable materials are processed into specification-grade commodities, and consumed as raw-material feedstock, in lieu of virgin materials, in the manufacturing of new products;

(B) that may include sorting, collection, processing, and brokering; and

(C) that result in subsequent consumption by a materials manufacturer, including for the manufacturing of new products.

(11) STATE.—The term "State" has the meaning given the term in section 1004 of the Solid Waste Disposal Act (42 U.S.C. 6903).

SEC. 3. SENSE OF CONGRESS.

It is the sense of Congress that—

(1) recycling conserves resources, protects the environment, and is important to the United States economy;

(2) the United States recycling infrastructure encompasses each of the entities that collect, process, broker, and consume recyclable materials sourced from commercial, industrial, and residential sources;

(3) the residential segment of the United States recycling infrastructure is facing challenges from—

(A) confusion over what materials are recyclable materials;

(B) reduced export markets;

(C) growing, but still limited, domestic end markets;

(D) an ever-changing and heterogeneous supply stream; and

(E) in some areas, a recycling infrastructure in need of revitalization; and

(4) in an effort to address those challenges, the United States must use a combination of tactics to improve recycling and composting in the United States.

SEC. 4. REPORT ON COMPOSTING INFRASTRUCTURE CAPABILITIES.

The Administrator, in consultation with States, units of local government, and Indian Tribes, shall—

(1) prepare a report describing the capability of the United States to implement a national residential composting strategy for compostable materials for the purposes of reducing contamination rates for residential recycling, including—

(A) an evaluation of existing Federal, State, and local laws that may present barriers to implementation of a national residential composting strategy;

(B)(i) an evaluation of existing composting programs of States, units of local government, and Indian Tribes; and

(ii) a description of best practices based on those programs;

(C) an evaluation of existing composting infrastructure in States, units of local government, and Indian Tribes for the purposes of estimating cost and approximate land needed to expand composting programs; and

(D) a study of the practices of manufacturers and companies that are moving to using compostable packaging and food service ware for the purpose of making the composting process the end-of-life use of those products; and

(2) not later than 1 year after the date of enactment of this Act, submit the report prepared under paragraph (1) to Congress.

SEC. 5. REPORT ON FEDERAL AGENCY RECYCLING PRACTICES.

Not later than 1 year after the date of enactment of this Act, and annually thereafter, the Comptroller General of the United States, in consultation with the Administrator, shall make publicly available a report describing—

(1) the total annual recycling and composting rates reported by all Federal agencies;

(2) the total annual percentage of products containing recyclable material, compostable material, or recovered materials purchased by all Federal agencies, including—

(A) the total quantity of procured products containing recyclable material or recovered materials listed in the comprehensive procurement guidelines published under section 6002(e) of the Solid Waste Disposal Act (42 U.S.C. 6962(e)); and

(B) the total quantity of compostable material purchased;

(3) recommendations for updating—

(A) the comprehensive procurement guidelines published under section 6002(e) of the Solid Waste Disposal Act (42 U.S.C. 6962(e)); and

(B) the environmentally preferable purchasing program established under section 6604(b)(11) of the Pollution Prevention Act of 1990 (42 U.S.C. 13103(b)(11)); and

(4) the activities of each Federal agency that promote recycling or composting.

SEC. 6. IMPROVING DATA AND REPORTING.

(a) INVENTORY OF MATERIALS RECOVERY FACILITIES.—Not later than 1 year after the date of enactment of this Act, and biannually thereafter, the Administrator, in consultation with States, units of local government, and Indian Tribes, shall—

(1) prepare an inventory of public and private materials recovery facilities in the United States, including—

(A) the number of materials recovery facilities in each unit of local government in each State; and

(B) a description of the materials that each materials recovery facility can process, including—

(i) in the case of plastic, a description of—

(I) the types of accepted resin, if applicable; and

(II) the container type, such as a jug, a carton, or film;

(ii) food packaging and service ware, such as a bottle, cutlery, or a cup;

(iii) paper;

(iv) aluminum or scrap metal; or

(v) any other material not described in any of clauses (i) through (iv) that a materials recovery facility can process; and

(2) submit the inventory prepared under paragraph (1) to Congress.

(b) ESTABLISHMENT OF A COMPREHENSIVE BASELINE OF DATA FOR THE UNITED STATES RECYCLING SYSTEM.—The Administrator, in consultation with States, units of local government, and Indian Tribes, shall determine, with respect to the United States—

(1) the number of community curbside recycling and composting programs;

(2) the number of community drop-off recycling and composting programs;

(3) the types of materials accepted by each community curbside recycling, drop-off recycling, or composting program;

(4) the number of individuals with access to recycling and composting services to at least the extent of access to disposal services;

(5) the number of individuals with barriers to accessing recycling and composting services to at least the extent of access to disposal services;

(6) the inbound contamination and capture rates of community curbside recycling, drop-off recycling, or composting programs; and

(7) where applicable, other available recycling or composting programs within a community, including store drop-offs.

(c) STANDARDIZATION OF RECYCLING REPORTING RATES.—

(1) COLLECTION OF RATES.—

(A) IN GENERAL.—The Administrator may use amounts made available under section 9 to biannually collect from each State the nationally standardized rate of recyclable materials in that State that have been successfully diverted from the waste stream and brought to a materials recovery facility or composting facility.

(B) CONFIDENTIAL OR PROPRIETARY BUSINESS INFORMATION.—Information collected under subparagraph (A) shall not include

any confidential or proprietary business information, as determined by the Administrator.

(2) USE.—Using amounts made available under section 9, the Administrator may use the rates collected under paragraph (1) to further assist States, units of local government, and Indian Tribes—

(A) to reduce the overall waste produced by the States and units of local government; and

(B) to increase recycling and composting rates.

(d) REPORT ON END MARKETS.—

(1) IN GENERAL.—The Administrator, in consultation with States, units of local government, and Indian Tribes, shall—

(A) provide an update to the report submitted under section 306 of the Save Our Seas 2.0 Act (Public Law 116–224; 134 Stat. 1096) to include an addendum on the end-market sale of all recyclable materials, in addition to recycled plastics as described in that section, from materials recovery facilities that process recyclable materials collected from households and publicly available recyclable materials drop-off centers, including—

(i) the total, in dollars per ton, domestic sales of bales of recyclable materials; and

(ii) the total, in dollars per ton, international sales of bales of recyclable materials;

(B) prepare a report on the end-market sale of all compostable materials collected from households and publicly available compost drop-off centers, including the total, in dollars per ton, of domestic sales of compostable materials; and

(C) not later than 1 year after the date of enactment of this Act, submit to Congress the update to the report prepared under subparagraph (A) and the report prepared under subparagraph (B).

(2) CONFIDENTIAL OR PROPRIETARY BUSINESS INFORMATION.—Information collected under subparagraphs (A) and (B) of paragraph (1) shall not include any confidential or proprietary business information, as determined by the Administrator.

SEC. 7. STUDY ON THE DIVERSION OF RECYCLABLE MATERIALS FROM A CIRCULAR MARKET.

(a) IN GENERAL.—Not later than 1 year after the date of enactment of this Act, the Administrator shall develop a metric for determining the proportion of recyclable materials in commercial and municipal waste streams that are being diverted from a circular market.

(b) STUDY; REPORT.—Not later than 1 year after the development of a metric under subsection (a), the Administrator shall conduct a study of, and submit to Congress a report on, the proportion of recyclable materials in commercial and municipal waste streams that, during each of the 10 calendar years preceding the year of submission of the report, were diverted from a circular market.

(c) DATA.—The report under subsection (b) shall provide data on specific recyclable materials, including plastics, paper and paperboard, and glass, that were prevented from remaining in a circular market through disposal or elimination, and to what use those specific recyclable materials were lost.

(d) EVALUATION.—The report under subsection (b) shall include an evaluation of whether the establishment or improvement of recycling programs would—

(1) improve recycling rates; or

(2) reduce the quantity of recyclable materials being unutilized in a circular market.

SEC. 8. VOLUNTARY GUIDELINES.

The Administrator shall—

(1) in consultation with States, units of local government, and Indian Tribes, develop, based on the results of the studies, reports, inventory, and data determined under sections 4 through 7, and provide to States, units of local government, and Indian Tribes best practices that the States, units of local government, and Indian Tribes may use to enhance recycling and composting, including—

(A) labeling techniques for containers of waste, compost, and recycling, with the goal of creating consistent, readily available, and understandable labeling across jurisdictions;

(B) pamphlets or other literature readily available to constituents;

(C) primary and secondary school educational resources on recycling;

(D) web and media-based campaigns; and

(E) guidance for the labeling of recyclable materials and compostable materials that minimizes contamination and diversion of those materials from waste streams; and

(2) not later than 2 years after the date of enactment of this Act, submit to Congress a report de-

scribing the best practices developed under paragraph (1).

SEC. 9. AUTHORIZATION OF APPROPRIATIONS.

There are authorized to be appropriated to the Administrator such sums as are necessary to carry out this Act for each fiscal year.

PLASTICS
INDUSTRY ASSOCIATION

February 2, 2022

The Honorable Tom Carper
The Honorable Shelley Moore Capito
Senate Environment and Public Works Committee
410 Dirksen Senate Office Building
Washington, D.C. 20510

Chairman Carper and Ranking Member Capito,

The Plastics Industry Association (PLASTICS) would like to commend the bipartisan efforts of the Senate Environment and Public Works Committee to advance the issue of recycling. It has never been clearer that the numerous recycling systems in this country are overly complicated and are falling short on what the market demands. We welcome the discussion the committee is planning to have on this topic.

Without the proper data and understanding of how recycling works or does not work in this country, we cannot accurately craft the best approach to solving this complicated issue. Improved and increased information will allow for more thoughtful policies leading to greater success when implemented. We are pleased to support such efforts contained in the draft Recycling and Composting Accountability Act.

PLASTICS has for years championed federal investment in recycling infrastructure. This Congress has shown a commitment to recycling infrastructure with the inclusion of funds in the Infrastructure Investment and Jobs Act passed last year, but more certainly can be done. Across this country the systems we use to collect, sort, and ultimately recycle the large variety of material types in the marketplace is inadequate, particularly in underserved communities. The program established in the draft Recycling Infrastructure and Accessibility Act of 2022 would help correct this unfortunate circumstance. Our industry wants more plastic to recycle, the marketplace is demanding it and it is the right thing to do.

We look forward to the discussion on both proposed measures Wednesday with the committee and want to be a resource for your offices should you have any questions before or after the hearing. Additionally, we look forward to providing comments for the committee record after the hearing.

Thank you,

John Grant
Director, Government Affairs

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February 8, 2022

The Honorable Thomas Carper
Chairman, Committee on
Environment and Public Works
United States Senate
Washington, DC 20510

The Honorable Shelley Moore Capito
Ranking Member, Committee on
Environment and Public Works
United States Senate
Washington, DC 20510

Dear Chairman Carper and Ranking Member Capito:

On behalf of the Flexible Packaging Association (FPA), who is the voice of U.S. manufacturers of flexible packaging and their suppliers, I write to commend the Committee on Environment and Public Works for its continued efforts to improve recycling across the U.S. including the February 2nd hearing on *Legislative Proposals to Improve Domestic Recycling and Composting Programs.* FPA and its members are committed to supporting the improvement and expansion of recycling and, therefore, provide our input on this important topic. FPA's mission is connecting, advancing, and leading the flexible packaging industry. Flexible packaging represents over $34.8 billion in annual sales in the U.S. and is the second largest, and fastest growing segment of the packaging industry. The industry employs approximately 78,000 workers in the United States. Flexible packaging is produced from paper, plastic, film, aluminum foil, or any combination of these materials, and includes bags, pouches, labels, liners, wraps, rollstock, and other flexible products.

These are products that you and I use every day – including hermetically sealed food and beverage products such as cereal, bread, frozen meals, infant formula, and juice; as well as sterile health and beauty items and pharmaceuticals, such as aspirin, shampoo, feminine hygiene products, and disinfecting wipes. Even packaging for pet food uses flexible packaging

source reduction
less waste in the first place®

to deliver fresh and healthy meals to a variety of animals. Flexible packaging is also used for medical device packaging to ensure that the products packaged, diagnostic tests, IV solutions and sets, syringes, catheters, intubation tubes, isolation gowns, and other personal protective equipment maintain their sterility and efficacy at the time of use. Trash and medical waste receptacles use can liners to manage business, institutional, medical, and household waste. Carry-out and take-out food containers and e-commerce delivery, which are increasingly important during the COVID-19 pandemic, are also heavily supported by the flexible packaging industry. Thus, FPA and its members are particularly interested in solving the plastic pollution issue and increasing the recycling of solid waste from packaging.

End-of-Life Management

FPA understands the importance of reducing and recycling solid waste to minimize litter and optimize landfill space and truly achieve a circular economy. However, there is no single solution that can be applied to all communities when it comes to the best way to collect, sort, and process flexible packaging waste. Viability is influenced by existing equipment and infrastructure; material collection methods and rates; volume and mix; and demand for the recovered material. Single material flexible packaging, which is approximately half of the flexible packaging waste generated, can be mechanically recycled through store drop-off programs. The other half can be used to generate new feedstock, whether through pyrolysis, gasification, or fuel blending. Developing other end-of-life solutions is a work in progress and FPA is partnering with other manufacturers, recyclers, retailers, waste management companies, brand owners, and other organizations to continue making strides toward total packaging recovery. Some examples include the Materials Recovery for the Future or MRFF

project; the Hefty® EnergyBag® Program; and the University of Florida's Advanced Recycling Program.

The mission of the MRFF project is simple – flexible packaging material is recycled and the recovery community derives value from it. The project piloted tweaks to the current material recovery facility (MRF) infrastructure to help establish methods and equipment protocol for flexible packaging. The MRFF project "wrapped" up its full-scale pilot program for flexible packaging this year. The MRFF consortium, of which FPA was a founding partner, released the pilot research report demonstrating the successful collection, separation and preparation for recycling of flexible packaging. The pilot, the first of its kind in the United States, was performed in partnership with J.P. Mascaro & Sons at the TotalRecycle Facility in Birdsboro, Pennsylvania, and underwritten by MRFF partners. The project will now transition to The Recycling Partnership (TRP), of which, FPA is a member. TRP is a leading, national non-governmental organization that exists to improve recycling in the U.S. TRP puts private dollars to work in communities to invest in sustainable recycling systems. TRP works through grants, technical assistance, and tools, as well as research, measurement, and best practices. Thus, the results of this pilot can now be used by MRFs across the country to mechanically recycle flexible packaging, particularly multi-material laminates. The project also worked on downstream uses for the materials generated through recovery and TRP will continue this research. Analyzing the economics of recycling flexible packaging is just as important as proving the technical capacity to separate and process this material.

Another program that is successful, and supported by FPA, as well as a host of manufacturers and consumer product companies, is the Hefty® EnergyBag® program. This program is making

strides in the collection and recovery of flexibles and utilizing energy recovery and pyrolysis solutions for end-of-life management for hard to recycle multi-laminates. Energy recovery often has a negative connotation, when in reality, it should be an option for any sustainable recycling system. One of the primary goals of recycling is to eliminate litter and reduce solid waste going to landfills, thereby reducing greenhouse gas emissions, all while deriving benefit from collected materials. As such, energy recovery solutions could be an immediate answer to end-of-life solutions for hard to recycle packaging materials until appropriate investment in infrastructure for recovery, recycling, and composting of these materials is made.

The first EnergyBag® Program was a pilot in California. In Citrus Heights, CA, the pilot proved the theory, with 1/3 of targeted homeowners participating, approximately 8,000 EnergyBags® were collected in three months, and 512 gallons of synthetic crude oil was produced. The second program, in Omaha, NE, launched in 2016 for 6,000 local households and has expanded across the Omaha area (189,000 households) to Bellevue (15,600 households), Louisville (550 households), Ralston (3,400 households – included within the Omaha City program), Papillion (7,500 households), and La Vista (7,100 households). Retail programs are also available in each community. As of September 2018, the Hefty® EnergyBag® Program collected more than 82,174 bags in the Omaha area and diverted 47 tons of plastic, the equivalent of approximately 225 barrels of diesel fuel, from landfills. The program then expanded to Boise, ID, where the City began distributing the first year's supply of Hefty® EnergyBag® orange bags to 73,000 households in April 2018. For the first time in a major metropolitan area, Cobb County, GA (Atlanta) began a program in late 2018 with 9,000 households registering in December alone. Keep America Beautiful is now participating in a Phase 2 launch with a grant

to add more households. The hard-to-recycle packaging will go towards making low sulfur fuel, oils, and waxes.

The message is simple, if you can recycle plastic material in your regular curbside recycling program, then continue to do so. If you cannot, rather than throwing that material in the trash, put it in your Hefty® EnergyBag® orange bags to be recovered as an alternative energy resource. You can include many plastic and multi-material items that cannot be recycled in your existing recycling program, such as:

- Potato chip bags and other snack bags
- Candy wrappers
- Granola bar and energy bar wrappers
- Plastic and foam cups, plates, and bowls
- Shredded cheese packages
- Salad bags
- Plastic pet food bags
- Frozen fruit and vegetable bags
- Pudding cups
- Stand-up pouches
- Squeezable baby food pouches
- Foam to-go boxes
- Packing peanuts
- Plastic utensils
- Plastic straws and stirrers
- Cake mix liners and other dry powder mix liners
- Plastic toothpaste tubes
- Condiment packets

Not only does the program divert packaging from the landfill and as a potential litter source, but the program also cuts down on contamination of other material streams by separating out the flexibles and hard-to-recycle packaging from readily recyclable materials at curbside. The program is set to expand again with grants to new interested communities as well as guidance for municipalities to mimic its success on their own.

The University of Florida's Advanced Recycling program is in its infancy, but the goal of the program is to present a unique solution using plasma gasification to achieve a true circular economy for ALL packaging waste (sorting and traditional recycling optional, depending on demand for materials). To scale up this technology, which already exists for hazardous waste, selection and investment in infrastructure is needed. FPA supports this goal as the benefits of achieving such would include:

- Reduction/elimination of landfills and associated harmful emissions
- Reduced greenhouse gas (GHG) emissions
- Reduced reliance upon fossil fuel feedstocks
- Reduction/elimination of ocean and terrestrial litter
- Continued realization of benefits from packaging without compromise
- Simple household waste disposal that does not require sorting (single-stream waste collection and treatment

FPA believes that a suite of options is needed to address the lack of infrastructure for non-readily recyclable packaging materials, and investment in that infrastructure is necessary before new mandates and unrealistic goals are set for both manufacturers and consumers.

Sustainability

There is a reason why only about 50% of flexible packaging is mechanically recyclable – as 50% of flexible packaging is single material. The rest is multi-material laminates. Not all flexible packaging is created the same, just as not all plastics are created the same. Different products require different types of protection. Multiple materials are required to provide the appropriate barrier protection to prevent contamination, extend freshness, and ultimately protect the product by providing puncture, tear, and burst resistance and strength. When assessing sustainability or examining the full life cycle of packaging, flexible packaging wins

hands down. Flexible packaging uses fewer resources, generates fewer emissions, and creates less waste. This is because flexible packaging starts with using fewer materials and resources than other packaging types and can package the most product in the least amount of packaging possible, reducing energy use, water use, and greenhouse gas emissions in the manufacturing and transportation of the package and product.

For example, producing a flexible foodservice pouch requires 75% less energy and generates just 1/10 of CO_2 emissions during production than a metal can for the equivalent amount of product. 1.5 pounds of flexible packaging will package the same amount of beverage or liquid as 50 pounds of glass. Advancements in materials and production processes have reduced the weight of some flexible packaging by up to 50%. A recent study by the Natural Resources Defense Council shows that up to 40% of food in the U.S. is wasted; wasted food is the single biggest source of greenhouse gas emissions from solid waste in the U.S. Flexible packaging reduces this waste by preserving the shelf-life of food – bananas last 36 days in perforated polyethylene bags versus 5 days unpackaged and the shelf-life of beef is extended from 4 days to 30 days when vacuum packed in oxygen barrier film. These are just two of numerous examples where flexible packaging is helping to reduce food waste. Flexible packaging does the same for brick and mortar retail and e-commerce – by protecting and preserving the product during shipping and transportation with the least amount of packaging necessary, less waste and returns are generated.

Even when disposed of, flexible packaging has the advantage of having less waste than other packaging types. When comparing coffee in a steel can with a plastic lid versus a stand-up multi-material pouch, the recycling rate for the steel can (one of the most recycled products in

the U.S.) would need to increase from **71%** to **93%,** and the plastic (LDPE) lid would need to go from **21%** to **75%** for the steel coffee can to have the same amount of landfilled material as the stand-up flexible pouch (assuming a **0%** recycling rate for the pouch). This is just one of six case studies FPA commissioned using the Environmental Protection Agencies' EcoImpact-COMPASS® lifecycle assessment tool. These case studies can be found at flexpack.org.

If the coronavirus pandemic taught us anything, it is the need to preserve sterile packaging for food, health and hygiene products, personal protective equipment and medical and pharmaceutical goods. Therefore, all policy options must take into account the very real environmental and health benefits of today's packaging, outside of its potential for recycling and composting alone. Banning these products could have serious unintended negative environmental and health consequences as substitutions and alternatives used may have a much larger environmental footprint. The picking of winners and losers, like banning materials and packaging, or setting arbitrary fees based solely on recyclability, discounts climate change, food safety and security, and potential new innovations that could solve for both source reduction and recyclability/reuse.

Consumer Engagement

FPA also believes that all policy options must have a robust consumer engagement component. Ultimately, any program hinges on the consumer actually utilizing it and doing so correctly. Thus, consumer engagement, not just for flexible packaging, but for ready recyclable packaging materials as well, is needed before additional regulations and the addition of any mandates on municipal governments for recycling of new solid waste materials are put in place. For all

packaging types, we need consumer engagement and programs like the Sustainable Packaging Coalition's "How2Recycle" label to inform residents of the opportunities to recycle and where to recycle. We also need clear directions for consumers on what is not yet recyclable, to eliminate the significant contamination currently rendering many ready recyclable packaging formats unacceptable for recycling and instead destined for landfill disposal. The recent spade of recyclability labeling proposals, including AB343 that passed in California is particularly concerning as it purports to label for consumers per state and in some cases, municipal jurisdictions. Product producers and their packaging manufacturers cannot be expected to produce a 50+ state labeling solution. We manufacture goods for the entire U.S., and in some cases, North America and globally. The environmental impacts and excess waste created by labeling products for individual states and jurisdictions will be disastrous – we need a federal solution.

In addition, most grocery stores and other retailers provide receptacles where consumers can easily deposit plastic bags, dry cleaning bags, bread bags, protective pillows and films, and other product wrappings that most consumers do not know about. Educating and encouraging consumers to make environmentally-conscious decisions about single material flexible packaging is a practical solution and one that could make a big dent in reducing the amount of solid waste packaging material going to landfills and increasing the amount going for recycling before any new mandates are put in place. Similarly, any program must address the litter issue. Policies should provide incentives for consumers to utilize the existing infrastructure and any new infrastructure put in place. Putting all the onus on manufacturers and retailers to change consumer behavior is unrealistic. Any policies purporting to fix the problem of waste in the environment and plastic pollution, in particular, should contain provisions for fines and

enforcement of not only outright litter but of consumers not utilizing the recovery and recycling infrastructure at all or incorrectly.

Conclusion

Flexible packaging manufacturers are responding to key issues and industry pressures affecting their customers as well as the demands of consumers and retailers. Safety and product protection; prevention of food waste and contamination; freshness and extended shelf life; consumer convenience; ease of transportation, storage, and use; and source reduction and sustainability are all issues manufacturers are designing for. Policies for the reuse, reduction, recycling and ultimately the reform of the U.S. solid waste system for plastic pollution as well as all other types of pollution should recognize all of these issues and not only focus narrowly on recyclability. They should promote policies and programs that look at the entire life cycle of packaging and give credit to packaging with a lower environmental footprint (regardless of end-of-life management options); that recognize energy recovery and chemical recycling as viable options; and that promote 21st century infrastructures, such as store drop-off programs, MRFF, Hefty® EnergyBag®, and the Sustainable Packaging Coalition's consumer labeling program.

FPA looks forward to seeing the Recycling and Composting Accountability Act, which would improve EPA's ability to gather data on our nation's recycling systems and explore opportunities for implementing a national composting strategy as well as the Recycling Infrastructure and Accessibility Act, which would help improve recycling services in underserved areas. We believe these are important areas that will help modernize the U.S.

recycling infrastructure and assist in full packaging circularity for the future. We look forward to continuing our work with Congress to address these challenges and opportunities.

Sincerely,

Alison Keane, Esq., CAE, IOM
President & CEO

February 10, 2022

The Honorable Shelley Moore Capito
Ranking Member
Senate Environment and Public Works Committee
456 Dirksen Senate Office Building
Washington, D.C. 20510

Dear Ranking Member Capito:

Thank you for demonstrating your strong commitment to improving access to recycling for all Americans through the introduction of the Recycling Infrastructure and Accessibility Act (RIAA) of 2022. Novelis is supportive of this draft legislation and we believe it is a step in the right direction to enable more aluminum recovery and recycling.

Novelis is the largest, most technologically advanced aluminum recycler in the world. Through recycling, we preserve the value of aluminum alloys to maximize their environmental benefits. Our aluminum is used to make passenger and commercial vehicles, beverage cans, buildings and many other sustainable products. We are proud to employ approximately 260 West Virginians in our Buckhannon and Fairmont manufacturing facilities.

First, we applaud your focus on underserved recycling communities in RIAA. According to The Recycling Partnership, only half of Americans have equitable access to curbside recycling. Recycling is not currently a convenient nor realistic option for many rural communities. As a result, aluminum beverage cans that should be recovered and recycled to make new cans are buried in landfills instead. Not only is this outcome detrimental to the environment, it's bad for business. Since used beverage cans are worth nearly $1,000 per ton when recycled, the Aluminum Association estimates that $800 million worth of cans are lost each year to landfills. These cans are a key input for new can production during a period of record demand for sustainable beverage packaging.

Second, we appreciate the proposed criteria for grants, including increasing the number of transfer stations, expanding curbside recycling access and leveraging public-private partnerships to support recycling infrastructure. A variety of efforts including but not limited to these are required to improve consumer recycling rates and expand the circular economy. The draft bill's focus on assessing the implementation of these partnerships and pilot programs is important. It will help ensure continuous improvements and support expansion of our nation's recycling efforts.

Thank you for your leadership on this important matter and we look forward to working with you and your staff as this moves through the legislative process.

Sincerely,

Chris Cerone
VP, Public Affairs and Communications
Novelis Inc.

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ISRI
Voice of the Recycling Industry™

ISRI is the voice of the recycling industry, promoting safe, economically sustainable and environmentally responsible recycling through networking, advocacy and education.

RECYCLING IS ESSENTIAL™

March 1, 2022

The Honorable Tom R. Carper
United States Senate
513 Hart Senate Office Building
Washington, DC 20510

The Honorable Shelley Moore Capito
United States Senate
172 Russell Senate Office Building
Washington, DC 20510

The Honorable John N. Boozman
United States Senate
141 Hart Senate Office Building
Washington, DC 20510

Re: The Recycling and Composting Accountability Act

Dear Chairman Carper, Ranking Member Capito, and Ranking Member Boozman:

The Institute of Scrap Recycling Industries, Inc. (ISRI) [i]supports the introduction of the Recycling and Composting Accountability Act (RCAA) that would establish baseline data on recycling and composting in the United States and collect data on the amounts of materials that are being diverted to landfills or incineration. This data is essential to fill the existing data gaps and provide policymakers a better understanding of our nation's recycling programs as we discuss policy prescriptions.

Recycling is one of the most important activities that all of us can do every day to help protect our environment, conserve natural materials, reduce energy use, and help combat climate change because recycled materials are important building blocks in the global manufacturing chain. For example, using recycled aluminum saves 95% of the energy needed to make virgin aluminum.

Over the past several years, there have been anecdotal claims that our nation's residential recycling streams are broken. These claims are simply not based on data nor are the proposed solutions data driven. Only accurate recycling data will enable the public and policymakers to understand the markets for recycled materials and make informed decisions towards improving our nation's recycling programs.

The RCAA will provide the necessary data to illustrate the strengths and weaknesses in our nation's residential recycling systems and facilitate data driven public policy conversations resulting in substantial and durable improvements.

ISRI supports your efforts and welcomes the opportunities working with you as this important legislation advances towards enactment.

Sincerely,

William H. Johnson
Chief Lobbyist

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[1] ***The Voice of the Recycling Industry*** - The Institute of Scrap Recycling Industries, Inc. (ISRI), represents 1,300 private, for-profit companies operating at more than 4,000 facilities in the United States and 34 countries worldwide. ISRI members are processors, brokers, and industrial consumers of scrap commodities, including ferrous and nonferrous metals, paper, electronics, rubber, plastics, glass and textiles. www.isri.org