

**IMPROVING CAPACITY FOR CRITICAL MINERAL
RECOVERY THROUGH ELECTRONIC WASTE
RECYCLING AND REUSE**

HEARING
BEFORE THE
**COMMITTEE ON
ENVIRONMENT AND PUBLIC WORKS**
UNITED STATES SENATE

ONE HUNDRED EIGHTEENTH CONGRESS

FIRST SESSION

JULY 26, 2023

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COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

ONE HUNDRED EIGHTEENTH CONGRESS

FIRST SESSION

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IMPROVING CAPACITY FOR CRITICAL MINERAL RECOVERY THROUGH ELECTRONIC WASTE RECYCLING AND REUSE

WEDNESDAY, JULY 26, 2023

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

The Committee met, pursuant to notice, at 10:06 a.m. in room 406, Dirksen Senate Office Building, Hon. Thomas R. Carper (Chairman of the Committee) presiding.

Present: Senators Carper, Capito, Kelly, Sullivan, and Ricketts.

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

Senator CARPER. Now let's proceed, if we could, to the morning's hearing.

Now I call up our panel of witnesses.

Please take your seats.

Good morning. Great to see you all. Thanks so much for joining us.

Ajay Kochhar, Craig Boswell, Kitty McIlroy, and Charles Pellicane. Thank you all for your willingness to join us today as we discuss what I think is an increasingly important topic, and that is electronic waste.

What do we mean by electronic waste? Electronic waste, or e-waste, as many call it, consists of various electronic products, including televisions, including home appliances, and batteries. These electronics are created using valuable materials, as you know, such as nickel, which can be and should be recycled.

As some of you also know, recycling has been a lifelong passion of a number of us on this Committee, including me. I think I have recycled just about everything from a Ford Explorer, we called it affectionately the Ford Exploder. It used to be my wife's vehicle, passed down to our son Christopher, passed down to Ben, and I finally took it without telling my wife one day, it was about 15 years old, took it to a place and had it recycled. They gave me a check for like \$900, and this was Martha's car. I never told her about the \$900. Please keep it quiet.

[Laughter.]

Senator CARPER. I have recycled just about everything, including a dehumidifier, which I thought was my all time favorite thing to recycle. Doing so benefits our environment as well as our economy, as well as our basement, providing some more extra room in our

basement and garage, and is a win-win for the Carper family and I suspect a win-win for a lot of other families, too.

Unfortunately, our current systems don't always make it easy to recycle e-waste. Each year, around 50 million tons of electronic waste are discarded in landfills globally, valued at an estimated, get this, an estimated \$62.5 billion. That is billion with a B.

These figures don't include the electronic waste, such as old smartphones and old computers, that often remain in our homes collecting dust long after we stop using them. In addition to their lost value, the electronics that end up in landfills often leach toxic chemicals into the soil, threatening the health and well being of nearby communities.

So, how did we get here, and what are we going to do about it? Several factors have contributed to the growing problem of pollution from e-waste. First, consumer demand, alongside rapid technological innovation, has led to a steady increase in the production of new electronics. Sadly, our ability to make use of the rare materials contained within discarded e-waste hasn't kept pace with this production.

In addition, insufficient domestic e-waste recycling standards, limited recycling infrastructure, and a lack of education have furthered our growing electronic waste dilemma. Many producers have contributed to this problem as well, creating barriers to repairing devices by limiting the availability of parts, tools, and information needed to keep things working. This forced scarcity drives up the consumption of new products.

Fortunately, the adversities of e-waste also present us with some clear opportunities. For example, recycling electronics at the end of their useful life allows for the recovery of critical minerals, such as nickel, such as cobalt. Both are important components, as you know, of electric vehicles, solar panels, and other clean energy technologies. Improving e-waste recycling would help us reach our climate goals, while also reducing our reliance on foreign sources for critical earth minerals.

In addition, taking proper care of our electronic waste is vital to national security, as it ensures adequate supply chains and prevents the loss of sensitive information through digital files.

Today, we are interested in learning more about the role that the Federal Government can and should play in e-waste recycling. This includes the creation of standards that shore up our supply chains and protect human health and our environment.

That being said, the companies that create electronic waste must also take greater responsibility for reducing waste and recycling their products. We are already beginning to see innovation in this space.

As we will hear today, Li-Cycle is pioneering battery recycling technology that allows us to recapture critical minerals. In addition, Human-I-T is employing refurbishment techniques that extend the life of electronic products.

From experience, we know that when industry, environmental groups, and all levels of government join forces to address our environmental challenges, we all benefit. As co-chair of the Senate Recycling Caucus with Senator Boozman and with Senator Capito and others, I know that most Americans want to do the right thing

when it comes to e-waste disposal. Still, they are often unsure of where to go, or frankly, how to do it.

Unfortunately, many municipalities either don't accept electronic waste through curbside recycling programs or they don't offer e-waste recycling at all. Consumers are limited to manufacturer take back programs or have no option but to put their waste electronics in the trash.

We now have an opportunity to improve e-waste recycling, and I believe we are. In the Bipartisan Infrastructure Law and the Inflation Reduction Act, we included funding to develop battery recycling technology and best practices, as well as to improve public education and recycling infrastructure. These investments are a starting point to help increase electronic recycling rates.

In addition, the Recycling and Composting Accountability Act, legislation that I introduced with Senator Capito and with Senator Boozman and that this Committee advanced unanimously in April, would take a close look at where materials are being lost from circularity. This critical information could help improve how we recycle electronics.

Let me close by again thanking our witnesses for joining us in our efforts to improve electronics recycling. Today, we hope to hear your thoughts on how we can improve our efforts to establish a circular economy for electronic waste. Together, I am confident that we can rise to the gravity of this challenge, and as we say in Delaware, seize the day, or *Carper diem*.

With that, let me turn it over to our Ranking Member, Senator Capito, for her opening remarks.

There is a lot going on in the Senate today, and there is a lot going on for members of this Committee. I am supposed to be in the Judiciary Committee introducing a guy running to be a Federal judge in just a few minutes, so I will be going back and forth. But I am leaving this Committee in very able hands, and I will rejoin you as quickly as I can.

Thank you all for coming in and for working with us on this very, very important issue.

Senator Capito.

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

Senator CAPITO. Thank you, Mr. Chairman.

And thank you all for being here with us today.

A lot of my statement is going to mirror a lot of what the Chairman has said in his statement, because I think most Americans who are listening to this are going to have the same kind of echoing, what are we going to do here, because we all have that issue. We are talking about end of life management of electronic waste in the United States.

Too often, we pay too little mind, we put it in the basement or in the attic, to the mounting volume of electronic waste generated in our lives. Whether it is the dusty boxes of old phones, laptops, and cords sitting in our closets, or improperly throwing electronic waste in our curbside trash bins, it is an issue we quickly dismiss for being out of sight, out of mind.

There are two misconceptions that I would like to highlight. The first is that managing our electronic waste is an issue for a later date. This is an outgrowth of the poorly developed collection infrastructure that we have in place. This often limits electronic waste disposal to only the most engaged people willing to visit a dump or a drop off facility.

The second misconception is that our electronic waste is somebody else's problem once we throw it away. This stems from the dismal state of consumer awareness and education.

For example, it is far too difficult for the average person to understand when a product is, or is not, considered electronic waste. I have actually run into this issue myself.

Further, many people are unaware that electronic waste should not be commingled with our usual household trash. This is an issue that has become too large to ignore.

The EPA determined that electronic waste is the fastest growing segment of the waste stream, both in the United States and around the world. Last year, some of the statistics the Chairman stated I will restate: An estimated 5.3 billion mobile phones were discarded worldwide, either thrown away, or taken out of service or shoveled into a drawer or box.

That tally helped contribute to the more than 50 million tons of electronic waste generated around the world last year. That number is expected to rise to 75 million tons by 2030.

Unsurprisingly, the end of life cycle management has failed to keep pace. Even the most optimistic estimates assume that less than 20 percent of electronic waste is properly collected and recycled. The harmful consequences if we continue on this current path will have a resounding impact on the future of this country. For example, improperly managing electronic waste exports contributes to intellectual property theft through microchip counterfeiting.

Further, China has recently threatened to curb exports of critical minerals abroad. That makes the dim reality of China's dominance in rare earth mineral extraction perfectly clear. Taken together, these developments threaten our Nation's military readiness and economic competitiveness.

Electronic waste also poses a challenge to public safety and the environment. Improperly disposed lithium-ion batteries are an increasing source of fires in landfills and garbage trucks. The landfill industry reports at least one fire per week in a vehicle caused by a lithium-ion battery, including one just a few weeks ago here in Washington, DC.

Electronic waste often contains toxic materials such as PCBs, lead, and mercury that we export to developing countries with lax environmental standards.

Despite the many challenges I have highlighted, there are plenty of reasons to be optimistic, and I see four of them right here. By reducing our reliance on overseas mineral production and enhancing our domestic recycling efforts, we can bolster our national security and reduce potential vulnerabilities.

Our capacity to refurbish and recover valuable materials from discarded electronic waste has greatly improved in the last few decades. Previously, electronic waste was just piled into a shredder to be sold as scrap. Now the industry is incorporating advanced tech-

nologies like robotics, optic scanning, and machine learning. These techniques allow discarded devices like a mobile phone to be surgically disassembled, maintaining the purity of high grade materials for reuse.

To illustrate just how far we have come, in 2020 institutional investors such as Morgan Stanley predicted that no lithium would be recycled commercially in the next decade. That was in 2020. To the contrary, this Committee will hear testimony from the CEO of a publicly traded company whose business is directly involved in recycling lithium. This is a testament to our ability to solve environmental issues with American innovation. It is time for us to realize that we are throwing valuable economic assets in the trash under our current system.

Our witness panel today represents the full spectrum of interests within the electronic waste recycling industry. I look forward to hearing your valuable insights on the state of the innovation, best practices, and recommendations to help us realize the full potential of recycling electronic waste.

With that, I yield back, and we will start the hearing.

Senator CAPITO [presiding]. We will turn to our panel of witnesses, and again, thank you. We are grateful that you all are here.

First, we will hear from Ajay Kochhar, who is currently the President and CEO of Li-Cycle, a lithium-ion battery recycling company.

Mr. Kochhar, you may begin with your statement when you are ready. Thank you.

**STATEMENT OF AJAY KOCHHAR,
PRESIDENT, CEO, AND CO-FOUNDER, LI-CYCLE**

Mr. KOCHHAR. Ranking Member Capito, Chairman Carper, Senators, thank you. It is a privilege to be here to have the opportunity to share Li-Cycle's perspective on the topic of electronic waste.

Li-Cycle, as indicated, was founded to address a missing link in our electric future: Specifically, the lack of an economically and environmentally sustainable lithium-ion battery recycling solution. Li-Cycle's safe, sustainable, and scalable Spoke and Hub Technologies return battery grade materials to the supply chain with up to a 95 percent recycling efficiency rate.

Our patented technology involves two steps. The first step takes place at our spoke facilities, currently operating in Alabama, Arizona, New York, and Canada. And at our spoke facilities, we safely recycle lithium-ion batteries, including full electric vehicle battery packs, through a proprietary zero combustion process that produces an intermediate product known as black mass.

In the second step, our hub refining facilities will process black mass to recover fundamental building blocks in batteries again for reuse in our supply chains. We are currently in the process of constructing our flagship hub facility in Rochester, New York, which is expected to be the first source of recycled battery grade lithium carbonate in North America. The hub will also produce battery grade cobalt sulfate and nickel sulfate.

Earlier this year, the Department of Energy announced a conditional commit to Li-Cycle for a \$375 million loan to help finance

the construction of our hub via the ATVM loan program. We are incredibly excited to be partnering with the Federal Government on this first of its kind facility.

This facility, once completed, will be one of the largest sources of lithium in the U.S., whether from mining or recycling, processing roughly 300,000 EVs worth of batteries per year. I am particularly proud to share that during this project, we will be creating 1,000 American jobs during construction and approximately 270 permanent jobs once we are operational.

Today's hearing comes at a critical juncture, given the fact that lithium-ion batteries are now ubiquitous in our world. These batteries create an urban mine which have highly valuable finite materials, including lithium, nickel, and cobalt. No single mine includes all these critical battery materials. Our process is particularly exciting as we can recycle these batteries in an infinite loop without degrading the quality of the battery material.

I am also proud to share that relative to mining and refining, our process can reduce emissions. So we can reduce missions of CO₂ by up to 67 percent. We can also reduce water usage by up to 97 percent for every ton of battery that we recycle.

Despite their value and importance, lithium-ion batteries have challenges. They have challenges around environmental and safety related topics. This includes the increasingly important topic of e-waste. Lithium batteries will undoubtedly create a tsunami of e-waste today and into the future.

In the near and medium term, we need to address manufacturing scrap, which is the rejects in making batteries, which is being magnified by the clean energy transition. To support the growth of electrification, we need alternative, sustainable, domestic sources of supply, and we need these sources of supply to come online quickly.

So recycled content should undoubtedly be a part of that solution for a number of reasons. First, responsible recycling creates a more sustainable, long term supply of materials that adds to a diverse energy ecosystem. Also, by doing that, we reduce our dependence on unstable foreign supply chains and supporting a completely localized battery industry to create a made in America battery.

We help increase energy and economic independence in North America, and provide inherent benefits for national security concerns. And we mitigate risks associated with thermal events or fires as you spoke about.

In closing, to help support a domestic sustainable closed loop battery supply chain and help reduce e-waste, we believe Congress should consider the following. First, clearly defined responsibility for the end of life management of batteries, to help ensure all batteries are in the best position to be collected, recycled, and kept in our supply chain.

Second, create incentives to build and operate a network of battery collection centers for consumers, auto makers, dealerships, and more.

Third, strongly discourage landfilling of lithium-ion batteries. As we have shown at Li-Cycle, we can recycle all types of lithium-ion batteries today at scale.

Fourth, support and incentivize sustainable battery recycling. It is imperative that through recycling we don't lead to adverse environmental impacts. So it needs to be sustainable.

Fifth, explore a requirement for minimum content for recycled material and new batteries made in the United States. This is actually a step which the European Union has already taken, and something that could be considered in the United States.

Finally, Li-Cycle is supportive of clear and consistent guidance and regulations enabling the efficient movement of batteries and intermediate products. This is critical to our industry's ability to scale and address the growing amount of e-waste in the United States and globally.

Thank you again for giving myself and Li-Cycle the opportunity to provide our perspective on this increasingly important topic. Thank you.

[The prepared statement of Mr. Kochhar follows:]



Li-Cycle's Written Testimony Before the U.S. Senate Committee on Environment and Public Works

July 26, 2023

Ajay Kochhar, CEO, President and co-founder

Introduction

On the behalf of all of us at Li-Cycle, I would like to extend our gratitude and thanks to Chairman Tom Carper, Ranking Member Shelley Moore Capito, and the other members of the committee for this opportunity. It is a privilege and a honor to share with you our perspective on the topic of e-waste, or electronic waste.

Background on Li-Cycle

For background, Li-Cycle was founded in 2016 to address a missing link in the future of global electrification – the lack of an economically and environmentally sustainable lithium-ion battery recycling solution. Lithium-ion batteries are increasingly powering our world in automobiles, energy storage projects and consumer electronics. Back in 2016, Tim Johnston and I co-founded Li-Cycle after realizing that the world needed improved technology and supply chain innovations to better manage end-of-life batteries and manufacturing waste to meet the rapidly growing demand for battery-grade materials, such as lithium, nickel, and cobalt. We created Li-Cycle to directly address this global challenge by developing innovative technology to sustainably recover valuable resources from batteries and drive a cleaner transition to electrification.

Fast forward to today, Li-Cycle's safe, sustainable, and scalable Spoke & Hub Technologies™ return lithium-ion batteries and battery manufacturing scrap to the supply chain with up to an overall 95% recycling efficiency rate. As we scale our industry-leading technologies, our commitment to sustainability continues to be of paramount focus, as our processes have minimal solid waste streams, minimal wastewater discharge, and low impact air emissions.

Spoke & Hub Technologies™ - two-step sustainable process to recycle and recover critical battery materials

Our highly scalable two-stage Spoke & Hub business model enables us to safely receive and recycle all lithium-ion batteries regardless of condition, form factor, and state-of-charge. At our Spokes, the first stage of our vertically-integrated business model, we safely recycle battery materials through a proprietary submerged shredding process to produce 'black mass,' an intermediate product which contains highly valuable metals such as lithium, nickel, and cobalt.

Last year, we operationalized our 'Generation 3' Spoke technology at our facilities in Gilbert, Arizona and Tuscaloosa, Alabama. Our Generation 3 Spoke technology has the capability to directly process full electric vehicle (EV) and energy storage battery packs without any manual dismantling or discharging, which enhances safety and efficiency and is a significant value differentiator for Li-Cycle. Our Spoke technology is also one of the most energy efficient solutions commercially available.

Across our operational Spokes in North America, we have a total processing capacity of up to 51,000 metric tons of lithium-ion battery material per year. While we have predominantly been expanding and bolstering our presence in North America, with the majority of our recycling capacity within the U.S., we are also actively expanding in Europe. Our first European Spoke is expected to commence operations later this year in Germany, and will become our largest Spoke to date. We have other European Spokes planned in France and Norway, which will bring Li-Cycle's future planned capacity across our global Spoke network to more than 100,000 metric tons of lithium-ion battery material per year.

At our Hub facilities, the second stage of our vertically integrated process, we process black mass to produce the battery-grade materials that are the fundamental building blocks of new lithium-ion batteries, such as lithium carbonate, nickel sulphate, cobalt sulphate, manganese carbonate, and more. Our first commercial Hub is under construction in Rochester, New York and is on track to commence commissioning in late 2023, with ramp up of operations in 2024. The facility is expected to be the first source of recycled battery-grade lithium carbonate in North America. It is a flagship asset for our company, and we strongly believe that this first-of-its-kind clean-tech refining facility will play a key role in solving many challenges associated with e-waste in the U.S., and North America more broadly.

North America Hub: Rochester Hub On Track to Commence Commissioning in Late 2023



Once fully operational, the Rochester Hub is expected to deliver annual production of up to 7,500-8,500 metric tons of battery-grade lithium carbonate, 42,000-48,000 metric tons of battery-grade nickel sulphate, and 6,500-7,500 metric tons of battery-grade cobalt sulphate, in addition to other valuable materials. The Rochester Hub is expected to be one of the largest sources of lithium supply in North America and will be able to process up to 35,000 metric tons of black mass per year, the equivalent of

lithium-ion battery material to power up to approximately 300,000 EVs . The Rochester Hub is also creating approximately 1,000 American jobs during construction and 270 permanent jobs once the facility is operational.

The environmental benefits of Li-Cycle's recycling process

As demonstrated through a Life Cycle Assessment, compared to traditional mining and refining processes, our overall process provides emission reduction benefits of up to 67% for carbon dioxide or CO₂, 86% for sulfur oxides or SO_x, 89% for nitrogen oxides or NO_x, and reduces water usage by up to 97% per metric ton of battery input¹. To complement our environmentally friendly process, we continue to maintain our dedication to being a customer led organization and we have amassed a growing global network of more than 200 customers, which includes a range of the world's largest automakers.

Growing global presence

What started out as a visionary idea discussed by two engineers over a cup of coffee has now transformed into a leading global lithium-ion battery resource recovery company and North America's largest pure-play lithium-ion battery recycler, with a rapidly growing presence across Europe. To support our global growth, we now have more than 450 employees worldwide and have opened regional offices in Switzerland and Singapore. We believe we are just getting started.

As we continue to lead in innovation and recycling in North America, we also believe there are many key learnings from our experience that we can take to the European market. Working together, we can help reduce reliance on foreign battery ecosystems and help build a long-lasting, localized infrastructure in both North America and Europe. Of note, we recently expanded upon our strategic partnership with Glencore, a global leader in primary sources of battery metals and one of our key investors, with a view to developing our first Hub in Europe. Li-Cycle and Glencore are now studying the possible development of a new Hub in Portovesme, Italy, through a planned 50-50 joint venture. The Portovesme Hub would be a landmark project for Europe's battery recycling industry and would be the largest source of recycled battery-grade lithium, as well as recycled nickel and cobalt, on the European continent. To align with our recycling expertise, we plan to repurpose an existing Glencore metallurgical facility to enable a cost-efficient and expedited development plan. Once operational, the Portovesme Hub would be expected to have a processing capacity of 50,000-70,000 metric tons of black mass per year, or the equivalent of lithium-ion battery material to power up to approximately 600,000 EVs.

Lithium-ion Batteries and E-Waste

Lithium-ion batteries are now ubiquitous in today's world. There are many benefits to lithium-ion batteries as evident by their proliferation, but the bottom line is that if these batteries are not properly handled and recycled, they will lead to a mountain of potentially harmful e-waste. I would like to

¹ Based on independent Life-Cycle Assessments (LCA) completed on behalf of Li-Cycle in 2022. Environmental benefits are shown as emission offsets comparison for one metric ton of Battery Input. Mining & Refining baseline calculated by a third party, including external sources (GREET, Argonne National Laboratory). Li-Cycle's LCA results are fully loaded, i.e., inclusive of indirect emissions not directly associated with the Spoke & Hub process, including transportation of material. Li-Cycle's process offsets 40-67% of the CO₂ Profile of an EV Battery. The battery pack often accounts for over ~ 40-50% of an electric vehicle's total CO₂ emissions profile (Source: Volkswagen AG).

provide a quick overview of what Li-Cycle sees as the opportunities and the challenges of lithium-ion batteries.

The Opportunities

Lithium-ion batteries are an essential source of power to support the transition to clean energy, as many next-generation, cleaner applications depend on them – namely EVs. Lithium-ion batteries also create an “urban mine” with a wealth of highly valuable and finite materials, most notably nickel, cobalt, and – of course – lithium. For perspective of their value, an EV battery can contain 50 kgs of lithium carbonate (the chemical compound of lithium used in EV batteries), 40 kgs of nickel, and up to 15 kgs of cobalt². In December 2024, the estimated prices, per metric tonne, of lithium carbonate is expected to be \$47,699, \$19,319 for nickel and \$36,764 for cobalt³. This means that per average EV battery, there is upwards of \$3,700 of contained value in each EV battery, in lithium, nickel and cobalt alone. With more than 900,000 battery EVs projected to be sold within the US during 2023⁴, this is equivalent to more than \$3 billion of contained recoverable value within EV batteries – from this year’s projected sales alone and is growing continuously.

With a large amount of lithium-ion battery material in North America, there is extraordinary potential to turn e-waste into a key commodity given the valuable raw materials contained within the batteries. Importantly, the raw materials in lithium-ion batteries can be recycled infinitely without degrading. Their properties are as valuable and useful today in a battery as they would be if we recycled the materials 100 times or more.

Another clear opportunity is that all these materials are already here in the U.S., and North America more broadly. There is no single mine that contains these materials. We can recycle these batteries to recover and keep these valuable materials in the U.S. and put them back in the supply chain and close the loop to create a circular economy. The urban mine available in our backyards can be a driver in building a domestic supply chain that helps diminish our dependence on foreign countries, with the added benefits of being more environmentally friendly, and more cost effective, compared with mineral extraction.

The Challenges

Despite their value and importance to enabling our clean energy future, lithium-ion batteries create their own set of environmental challenges. Unsafe mining practices for these materials can be harmful, as certain methods of extraction can be associated with negative environmental and social impacts. At the end of their useful life, if not handled properly, batteries can also have negative environmental impacts. Furthermore, lithium-ion batteries can be dangerous if not handled properly, which can lead to thermal events or fires.

These batteries don’t last forever and if we don’t have recycling infrastructure established, they will create a tsunami of e-waste in the 2030s to 2040s. However, even before that happens, we have to deal with the significant increase in battery manufacturing scrap in the marketplace.

² Reuters, February 3, 2022 -- “[Explainer: Costs of nickel and cobalt used in electric vehicle batteries](#)”.

³ Projected prices for lithium carbonate, nickel and cobalt are forecasted period-end prices by Benchmark Mineral Intelligence as of March 2023.

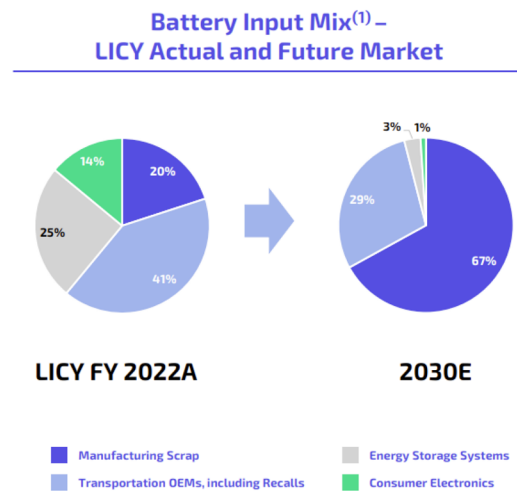
⁴ Statista – <https://www.statista.com/outlook/mmo/electric-vehicles/united-states#unit-sales>

The Overlooked Burgeoning Battery Manufacturing Scrap Segment

Despite all the benefits that lithium-ion battery power brings in today's clean industrial revolution era, one urgent and often overlooked near term challenge for lithium-ion battery manufacturing is the potential e-waste created by battery manufacturing scrap.

On average, Li-Cycle estimates at least 10% of battery production ends up as manufacturing scrap (e.g., quality rejects, off-cuts, etc.), and this proportion is typically much higher when a manufacturing facility first starts operations. As the industry continues to grow, and more battery manufacturing facilities come online, there is a significant amount of manufacturing scrap material that can create e-waste, if not recycled. In addition to battery manufacturing scrap – in the near-term – EV recalls happen from time to time, and it is important that valuable material from those batteries is returned into the supply chain in a safe and sustainable manner.

For reference, in 2022, approximately 20% of Li-Cycle's battery feedstock was from battery manufacturing scrap. By 2030, we expect more than two-thirds of available battery recycling feedstock in the market will be made of battery manufacturing scrap, which is in line with the substantial ramp up of proposed battery manufacturing in the U.S.



(1) Measured by weight of input battery materials.

For those closely following the industry, the true amount of battery manufacturing scrap might be underestimated, as all types of scrap might not be accounted for. Estimates can sometimes fail to incorporate the various aspects of cell scrap. There are both off-cuts (e.g., off-cuts of cathode foils) and rejects, depending on the stage of cell making, and not accounting for both can potentially under-

estimate the amount of mass created through the cell manufacturing process. Typically, manufacturing plants also have much higher scrap rates during the ramp-up years as processes are tuned and the plants drive to a steadier state of production. Estimates should take this dynamic into account, especially with the proliferation of new manufacturing plants in North America that are expected to come on-line that will take time to ramp up. Finally, some forecasts can exclude other types of manufacturing rejects – e.g., module scrap and pack scrap – which can further under-estimate the true level of the manufacturing scrap that needs to be addressed.

As a collective industry, it is desirable for manufacturing processes to be as efficient as possible for all participants, including Li-Cycle, in order to drive down battery costs and to proliferate more EVs and battery powered applications. However, the reality is that some processes have physical limitations. The end result is a growing amount of material that must be recycled in the near term.

In order to support the proliferation and growth of electrification in the U.S., there is no question that – at least in the short term – mining for these battery materials will play a key role. However, the accelerating demand for lithium-ion batteries requires a substantial number of mines to come online quickly. In order to help support the continued growth of electrification, we need alternative sources of supply, such as recycled material, and we need these sources to quickly come online.

Lithium-ion Battery Recycling Explained: Not All Recycling Processes Are Equal

A possible solution to these core challenges associated with the electrification of North America is lithium-ion battery recycling. Safe, efficient, and sustainable lithium-ion battery recycling can provide a secondary source of material on a shorter time frame to support the growth of industry while providing an environmentally friendly and long-term solution to deal with the mountains of e-waste that lithium-ion battery material can create. However, not all recycling processes are created equal.

One general misconception of the recycling industry is that all parts of the recycling process are considered one umbrella group of ‘recycling.’ This is important because public reporting often inaccurately groups recycling into a single activity without differentiating between each stage. Generally, there are two stages within the broader lithium-ion battery recycling value chain, ‘pre-processing’ (which would be analogous to our Spokes) and ‘post-processing’ (which would be analogous to our Hubs).

Pre-processing involves the processing of lithium-ion batteries into intermediate products (i.e., black mass). In North America, for pre-processing, most recyclers use mechanical techniques or pyrometallurgy which involves the burning of lithium-ion batteries. A great example of pre-processing is shredding of batteries, or, in Li-Cycle’s case, submerged shredding in a proprietary liquid solution. By leveraging submerged shredding, we enable a safer process by mitigating the risk of fires. It is also more environmentally friendly since there is zero combustion and no direct greenhouse gas emissions.

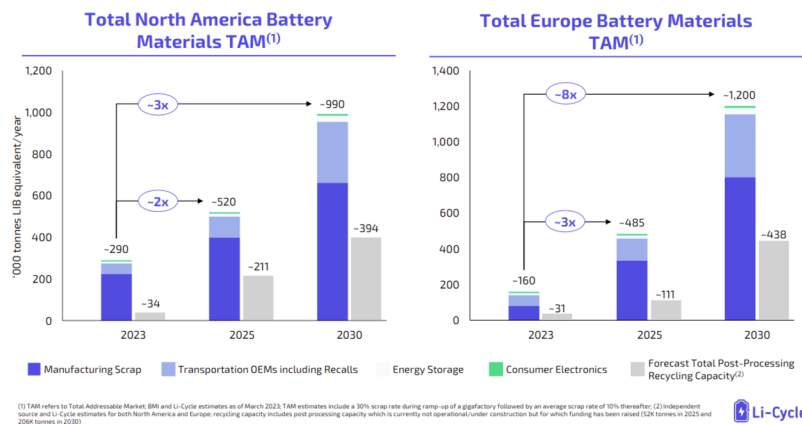
Post-processing involves the processing of intermediate products (i.e., black mass) into refined end-products. Li-Cycle’s Hub technology (our flagship Rochester Hub will leverage this technology) uses hydrometallurgy and is a great example of post-processing recycling. This process produces battery-grade materials with minimal wastewater and air emissions.

Li-Cycle sees the amount of material available for recycling occurring in the two ‘phases’ of growth. With respect to the ‘first phase’ of growth, manufacturing scrap is a predominate driver. As mentioned

earlier, on average, approximately 10% of battery production ends up as manufacturing scrap. In addition to battery manufacturing scrap, EV recalls occasionally happen and we have also seen an increased volume of large energy storage projects that require recycling.

The 'second phase' of growth will be predominantly driven by end-of-life batteries. Global EV sales were 10% of new cars in 2022 and currently, there are about 20 million passenger EVs on the road with the potential for 10 times that amount by the end of the decade⁵. Eventually, the vast amount of material (or 20 million EVs worth of batteries each year) that actually ends up in the EVs will need to be recycled. That is just the lithium-ion batteries dedicated to the EV industry and doesn't consider all battery-powered applications. There will be an eventual tsunami of end-of-life batteries – it's just a question of when.

The bottom line is that demand for post-processing recycling will continue to outstrip capacity in North America for quite some time. In 2023, Li-Cycle expects that approximately 290,000 metric tonnes of battery material will be available for recycling compared to only 34,000 metric tonnes of post-processing capacity in North America. By 2030, Li-Cycle expects that there will be approximately 1 million metric tonnes of material available for recycling, or a three-fold increase, compared to less than 400,000 metric tonnes of post-processing recycling capacity. This growth will predominantly be driven by manufacturing scrap.



How Recycling Can Lead to an Enhanced Domestic Battery Supply Chain

In Li-Cycle's view, sustainable lithium-ion battery recycling is essential for the future of North America's transition to clean energy, and its importance goes well beyond the inherent environmental benefits. Sustainable, safe, and efficient lithium-ion battery recycling can also:

Create a more sustainable and diverse energy system for the country

⁵ The Wall Street Journal, January 16, 2023 – [“EVs Made Up 10% of All New Cars Sold Last Year”](#).

Recycling can provide a long term, sustainable supply of materials that will continue to grow as the industry grows. This growth will continue to add to the diversity of clean energy sources and material sources needed to support many industries connected to the battery supply chain.

Reduce dependence on foreign supply chains

Recycling can help create a closed-loop domestic supply chain for critical battery materials, or in other words – old batteries can be used to make new batteries. This ability to support a completely localized, circular supply chain in North America further reduces the reliance on foreign supply chains for these key materials. We can have “Made in America” batteries through recycling. This also helps increase energy and economic independence in North America. Being less dependent on foreign supplies of critical materials will also have inherent benefits for national security concerns.

Enhance safety

Improper handling of lithium-ion batteries can present thermal event risk, which has led to an increase in news stories about fires associated with lithium batteries, especially given the wider use of lithium-ion batteries in today’s society. Recycling experts like Li-Cycle can help with the proper handling of end-of-life or damaged lithium-ion batteries. Furthermore, by having these batteries recycled, they no longer present a fire hazard by just lying dormant.

A Step in the Right Direction – the IRA was an Accelerator for the Industry

In Li-Cycle’s view, significant progress has been made to support domestic battery recycling in North America. In particular, awareness of the importance of a sustainable EV supply chain has changed 180 degrees with major players at the table looking to be part of the solution compared to a few years ago when this issue was not at the forefront.

Since our inception in 2016, building localized supply chains of battery-grade materials to support the production of lithium-ion batteries has been a key part of our vision. To that end, the Inflation Reduction Act (IRA) has provided benefits to Li-Cycle and the battery recycling industry both directly and indirectly. Some of these industry benefits include up to \$60 billion in five-year production tax credits, which provides for 10% of the cost of producing critical materials, including lithium, nickel and cobalt. The IRA also includes up to \$10 billion in advanced energy project tax credits, which allocates up to a 30% investment tax credit for developing clean energy facilities in the U.S. including recycling facilities. Additionally, the IRA is pushing for building EV batteries using material sourced in the U.S. or free trade agreement countries, as 40% of battery critical minerals are required to come domestically, or from free trade agreement countries. This threshold increases to 80% by 2027 in order to qualify for the clean vehicle tax credits.

Li-Cycle believes this push for domestically sourced battery-grade materials will incentivize automakers to incorporate a higher percentage of recycled material, which is generating further demand for our sustainable recycled material.

We believe the IRA helped recognize recycling as an accelerator for the domestic supply of battery materials to support the increasing demand for EVs and energy storage. The IRA initiatives will reduce the cost of building new facilities to produce domestic critical materials and help bring down manufacturing costs for batteries. Key policy initiatives such as the IRA help support battery manufacturers and automakers to source their recycling material domestically.

Key Initiatives to Support Battery-Recycling

While the IRA has provided benefits to the industry, there are some key policy initiatives that Li-Cycle believes are important to further support sustainable recyclers' efforts to address and manage e-waste problems:

Defined responsibility for end-of-life battery management

End-of-life lithium-ion battery management serves as an important part of ensuring that all batteries are collected and properly reused, repurposed, or recycled to create a sustainable and circular economy to meet global goals for carbon footprint reduction. Further definition of how we can best manage end-of-life batteries safely and efficiently to ensure they do not end up in landfills or lie dormant in homes around the country is paramount.

Incentivizing battery recycling centers

A frequently asked question Li-Cycle gets is – “how can I get my batteries to you?” Creating incentives for building and operating battery collection centers for consumers, automakers, dealerships, and more will further streamline the recycling process. Policy ideas, such as financial incentives to battery recyclers that establish and develop a system for the collection of batteries, or to communities to help create centers that can serve as battery aggregation points of collection, could further incentivize the collection of these batteries and prevent them from being discarded in landfills.

Landfilling of lithium-ion batteries should be strongly discouraged

Batteries no longer need to end up in landfills where critical materials are lost and surrounding environments are negatively impacted. Today, all types of lithium-ion batteries can and should be recycled. Li-Cycle is a great example of a commercial lithium-ion battery recycler with operations at scale. Encouraging industry-led or consumer-based programs to discourage landfilling of batteries should be prioritized.

Incentivize recycling that meets the highest environmental standards

It is essential that increased battery recycling in the U.S. does not lead to adverse environmental impacts created by the processes of battery recyclers. It is important to incentivize environmentally friendly and efficient lithium-ion battery recyclers, including those that have high recovery rates and processes that have minimal environmental footprints.

Requiring minimum recycled content in new batteries

Li-Cycle believes that to further incentivize recycling, there should be further exploration of regulatory requirements for a minimum amount of recycled content in every battery produced domestically. The new rules being proposed in the European Union, such as their requirements for new batteries to have certain minimum amounts of recycled material — 16% for cobalt, 6% for lithium and 6% for nickel in 2030 – are a positive step in the right direction. They accelerate efforts by automakers and battery manufacturers to incorporate recycling into their production processes. Li-Cycle believes that a similar policy or initiative should be explored in the U.S. By including recycled content, automakers can not only

ensure that batteries are made with sustainably sourced materials, but can also help further counter the narrative that EVs are less sustainable than internal combustion engines.

Clear and consistent regulations on the movement of batteries and black mass

Li-Cycle is also supportive of clear and consistent regulations to govern the safe and efficient movement of batteries to our Spokes, and black mass to our Hub, in order to provide a closed loop solution for lithium-ion batteries. Black mass is a critical ingredient into our industrial process for making the raw materials necessary for new battery production, and regulatory certainty that enables safe and efficient movement of batteries and black mass is vital to the industry's ability to address the growing amount of e-waste we face in the U.S. and globally.

Conclusion

Li-Cycle was founded to create domestic, closed-loop supply chains for key battery materials to support the sustainable growth of global electrification. As part of our vision to sustainably recycle batteries, we are part of the solution to the growing 'mountain' of e-waste that both end-of-life batteries and battery manufacturers are expected to produce. We will continue to scale to grow in lock step with our customers to solve these key challenges. We believe that establishing policies and incentives to support environmentally friendly recycling solutions and encouraging automakers and battery manufacturers to use recycled material are vitally important to support the clean energy transition. These actions will be critical to accelerating the successful future of this emerging industry, an industry which is essential to the future of our planet.

Senator CAPITO. Thank you, Mr. Kochhar.

Next, we are joined by Craig Boswell, the co-founder and President of HOBI International. He has served in the electronics recycling industry for over 30 years.

Mr. Boswell, welcome and thank you. You may proceed.

**STATEMENT OF CRAIG BOSWELL, P.E., PRESIDENT
AND CO-FOUNDER, HOBI INTERNATIONAL, INCORPORATED**

Mr. BOSWELL. Thank you, Ranking Member Capito. It is an honor to be here today.

I come here representing my company, HOBI International. I also represent thousands of electronics recycling companies in the United States. And I come representing the electronics recycling companies and the ITAD companies that are members of the Institute of Scrap Recycling Industries, ISRI.

My company, HOBI International, has been in this business for nearly 30 years. We have seen tremendous change in the market over those 30 years. When we started, it was mainframes. Then it moved on to desktops, and now the explosion of mobile devices.

One constant in that market through that whole time is the vital importance that electronics recycling plays in the information technology economy. Companies in the U.S. employ over 600,000 people recycling electronics, and globally, it is considered to be more than a \$40 billion market.

I would like to spend just a few minutes talking about what we do, why it matters, and then I would like to close with some challenges the industry is facing.

Electronics recycling companies help make the electronic manufacturing supply chain more sustainable. We do this by testing, refurbishing, recovering, and erasing electronics for both consumers and companies.

We also help companies meet their ESG goals. We do this by allowing them to reuse and recycle electronics. We also help with the social aspect. We run donation programs that take products off of their floors and put them into schools and homeless shelters.

Electronics recycling companies also protect the personal data of millions of Americans every year. We have made tremendous investment and strides in data eradication technology. We have also developed certification standards like the R2 standard that allow both consumers and companies to validate that their processor has the right type of state of the art processes and procedures to take their equipment.

And the industry is helping to bridge the digital divide. It is estimated that 460 million cell phones alone are put into reuse every year. Those products represent a low cost way for those in need or those in underdeveloped countries to become members of the global electronics marketplace.

But we are experiencing some significant challenges. We have already mentioned this, but one of the growing challenges is embedded lithium-ion batteries. They are in everything from airpods to automobiles. What that has done is, gone are the days when these reach end of life, we just put them in a shredder for material recovery. Now those products have to be disassembled, largely manually,

to extract the batteries before the critical materials that are in those products can be recovered.

Dovetailing with that is the need for design for recycling. Our ability to recover these critical materials is largely determined when the product design leaves the R&D phase. It is critical that in designing these products sustainably that we look at the end of life of the product during the design phase. We have found that this is not only good for the bottom line of these companies, but it helps us recover these critical materials.

Finally, changes in international trade law are a looming problem for the industry, especially here in the U.S. Starting January 1st, 2025, changes in the Basel Convention will take products that have been traditionally considered non-hazardous and move them into a hazardous category. This will force companies, when they try to move these materials internationally, to meet certain pre-determined requirements. It also requires you to be a party to the convention to trade with other parties internationally.

What this is going to result in, the U.S. being a non-party to the convention, is a de facto trade ban for companies here in the U.S. This is a looming issue because the global market for electronics is what we depend on. This will isolate electronics recyclers in the U.S. from the remainder of the global market.

So in summary, the electronics recycling industry is an essential part of the global market for sustainability going forward. We feel it is critical as you discuss policies for the future that we be involved in those discussions.

Thank you for your time, and I look forward to your questions.
[The prepared statement of Mr. Boswell follows:]

Good morning, Chairman Carper, Ranking Member Capito and the other members of the Committee.

I would like to thank you for the opportunity to speak to you today representing my company HOB International, Inc. and the thousands of other American companies that make up the electronics recycling industry. I also speak for the electronics recyclers and ITAD companies that are members of the Institute of Scrap Recycling Industries or ISRI.

My company, HOB International, has been in the electronics recycling industry for more than 30 years. During those years, we have seen tremendous changes in the computing landscape, moving from mainframes to desktop computers to the booming and continually changing mobile device market. The evolution and constantly shifting information technology market has been truly breathtaking during the past few years.

I'm glad to say that one constant during these changing times has been the vital role that electronics recycling companies play in the information technology economy. Each business day, thousands of computing and storage devices are collected, erased, tested, redeployed, reused, and recycled. Each business day the EPA estimates that more than 600,000 people are employed in the U.S. by companies participating in the electronics recycling space and the worldwide marketplace for these services has grown to more than \$40 billion.

With that perspective in mind, I'd like to tell you more specifically about what we do, why this matters, and what some of the challenges are we are facing in our industry.

Electronics recycling companies help make the electronics manufacturing supply chain more sustainable. This includes testing and refurbishing products for redeployment and recovering the critical materials used to manufacture new products including everything from cellphones to servers. It also includes helping corporations throughout the economy enhance their ESG performance by meeting environmental goals by reusing and recycling their end of use electronics products and helping expand their social programs through initiatives such as equipment donation programs.

Electronics recycling companies also ensure that the personal data of millions of Americans stays protected each and every year. The industry has made tremendous investments in data cleansing technologies, as well as certifications such as the R2 certification, to create transparency for consumers and corporations to validate the companies they select to recycle their products have state-of-the-art tools and processes.

The industry is also critical in bridging the digital divide domestically and internationally. It is estimated that over 460 million cellphones alone in a single year could be collected and redeployed worldwide. These reused devices represent a more affordable alternative means for people in need or individuals in underdeveloped countries to join the global digital marketplace.

The industry is facing significant and growing challenges here in the United States. These challenges could see even more dramatic shifts in the industry in the upcoming years and impede the ability of the industry to grow to meet the ever-increasing demand.

First, the expansion of the use of embedded Lithium Ion and Lithium primary batteries in everything from AirPods to automobiles represents a significant challenge for the industry. Gone are the days when true end-of-life products could just be dropped in a shredder for automated material recovery. Now equipment processors must carefully and primarily manually remove these batteries as a first step in the material recovery process. This has markedly increased the labor cost of recycling devices and has resulted in the industry taking costly and extensive steps to make sure batteries can be removed and recycled safely.

Second, it is vital that manufacturers increase their focus on sustainability of their products by incorporating Design for Recycling[®] concepts at the earliest part of research and development to ensure these innovative products that improve our lives are easily disassembled, reused, and ultimately recycled. Designing these products for sustainability and recycling is both good for the bottom-line and for the environment and is essential in realizing the tremendous benefit that recovered products represent in the critical mineral supply chain.

Finally, changes in international trade law, specifically in the Basel Convention could upend the economics of the electronics recycling industry in the United

States starting on January 1, 2025. The Basel Convention recently incorporated new language that will take large portions of the products that were traditionally traded internationally as non-hazardous and now classify them as hazardous. As a result, parties of the convention that want to trade these products will have to follow new procedures to document the movement of electronics destined for recycling and reuse. More importantly, parties of the convention, which represent almost every country in the world, will not be able to trade with countries that are non-parties. This will become a de facto ban on trade electronics recycling companies based in the United States. The electronics refurbishment and recycling market is a global market, and isolation from this market will significantly economically disadvantage U.S.-based companies that recycle these products.

In summary, the electronics recycling industry is an essential part of the global efforts toward sustainability in the technology and communications sector. This is an exciting time for technological innovation, but it is not without its challenges. It is essential as policies are discussed to address these increasing challenges that the recycling community be an active participant in these discussions. Thank you for the opportunity to tell you my story.

I look forward to taking your questions.



The Future Is Made of Recycled Materials

Recycled Materials are helping us build a secure and sustainable supply chain

Recycled materials provide a renewable source of high-quality materials for the everyday items and essential infrastructure people depend on. Today, more of the roads we drive on and the cars we drive in, the wires and beams in our homes and offices, and the boxes that bring consumer goods and food to households all come from recycled materials. The recycled materials industry is helping us source more materials locally and sustainably, making our supply chain more secure and our manufacturing more self-sufficient.

ISSUES FOR ACTION

1 Recognition of the Recycled Materials Industry as Essential

ACTION: Sign bipartisan letter requesting the Department of Homeland Security and the Chair of the National Economic Council reinstate the recycled materials industry as an essential industry. [contact: Offices of Representatives Joyce and Pallone]

WHY: Every piece of recycled material is one less that would have to be mined, drilled, cut down, or extracted from the earth. By providing a resilient source of renewable resources, we make the global supply chain more secure and sustainable, a priority recognized as part of the bipartisan commitment to create a secure supply of critical minerals, and to achieve our nation's decarbonization and electrification goals.

2 Extend PFAS Liability Protections

ACTION: Extend liability protections to the recycled materials industry as passive receivers of PFAS/PFOs substances that do not design or produce the substances.

WHY: The EPA's designation of PFAS/PFOS as hazardous substances under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) has caused concerns within the recycled materials industry that companies will now be held liable when receiving materials that may contain these substances as part of normal operations.

3 Maintaining a Stable & Safe Supply Chain for Batteries and EVs

ACTION: Inclusion of the Recycled Materials Industry in all conversations related to policy and consumer education surrounding lithium-ion batteries, found in consumer products, as well as electric vehicles and their batteries, to maintain a safe and stable manufacturing supply chain.

WHY: Batteries can be found in many consumer devices that are used daily, so it is critical the public is educated about the safety risks these can pose during their use as well as when they enter the recycling stream. In addition, electric vehicles and their batteries need to be properly managed to reduce safety risks and to ensure that they remain part of a secure and sustainable supply chain as we transition to a decarbonized economy.

4 Passage of RCAA-RIAA

ACTION: Support the passage of both The Recycling and Composting Accountability Act (RCAA) and the Recycling Infrastructure and Investment Act (RIAA).

WHY: Both work to properly define what is—and is not—recycling.

ABOUT US: As the Voice of the Recycling Industry™, ISRI promotes safe, economically sustainable and environmentally responsible recycling through networking, advocacy, and education.

Web: ISRI.org | Twitter: [@ISRI](https://twitter.com/ISRI) | LinkedIn/Facebook: [Institute of Secondary Recycling Industries, Inc.](https://www.linkedin.com/company/institute-of-secondary-recycling-industries-inc) | Instagram: [@ISRInews](https://www.instagram.com/ISRInews)



ISRI is the voice of the recycling industry, promoting safe, economically sustainable and environmentally responsible recycling through networking, advocacy and education.



ISRI's Position on Design for Recycling – Promoting Environmental Sustainability¹

Overview

Design For Recycling® (DfR) embodies the concept that while products are in the design stage serious efforts should be made to eliminate or reduce the use of hazardous substances and any substances or materials that might impede the recycling process (such as adhesives or materials for which there exists no economically feasible means of recycling). Design for Recycling® also envisions products designed to produce, at the end of their useful lives, the highest percentage of recyclables possible.

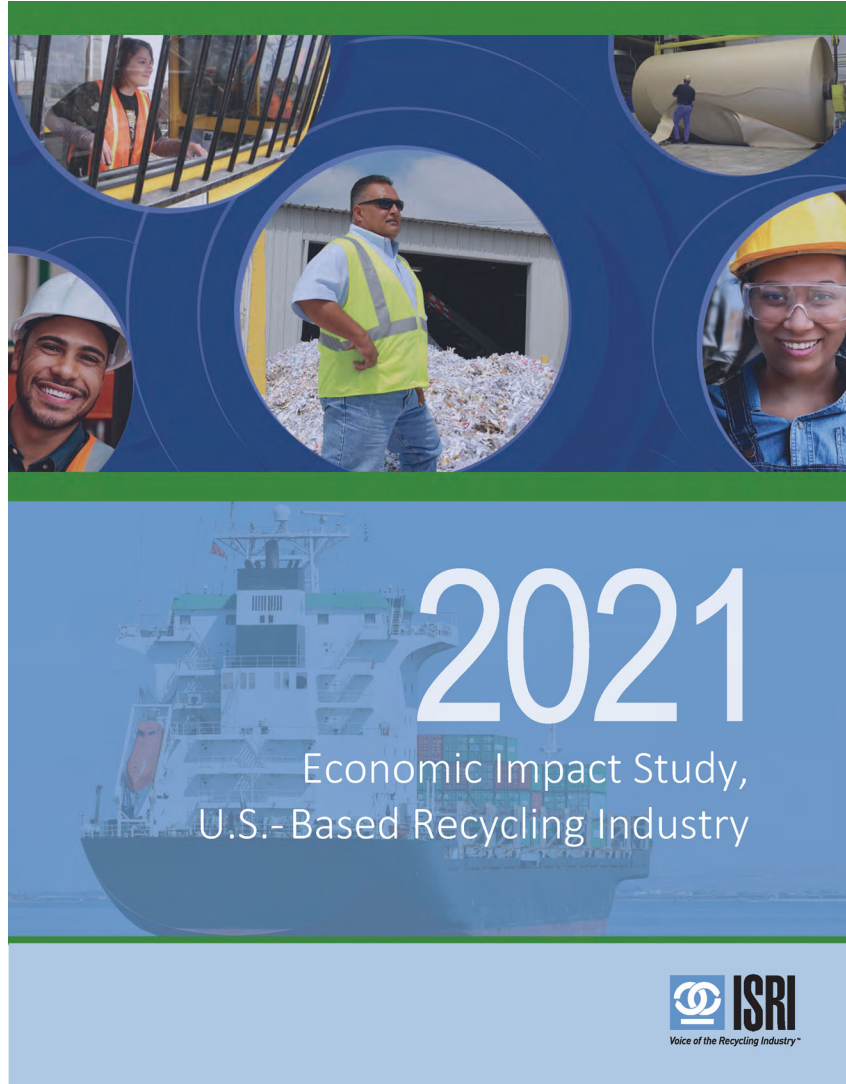
When manufacturers consider all aspects of a product's total life cycle during the design stage the result is a product that contains the highest possible proportion of recyclables in the manufacture of new products, contains fewer hazardous substances and yields the highest possible percentage of valuable recovered materials at its end of life.

Design for Recycling® relies upon a market-based approach to enhance product design by creating a competitive environment among manufacturers to utilize the greatest possible amount of recycled materials in their manufacturing processes and to eliminate or reduce the use of hazardous materials and other materials that impede recycling.

- To the extent practicable, products should not be produced with hazardous materials.
- Promote the concepts of producing products that are more easily recycled and increasing the recycled content of all products whenever practicable.
- Establish coalitions of stakeholders whose purposes will be to:
 - a) develop and promote the principles of Design for Recycling®; and
 - b) explore all options to promote and foster the design and manufacturing of products suitable for recycling using currently available recycling technology and best management practices.

¹ As Adopted by the ISRI Board of Directors on February 10, 2017.







Executive Summary¹

Recycling in the United States is a critically essential industry dedicated to transforming end-of-life products and industrially generated recyclables into new commodity grade materials, and driving sustainable economic growth. Recognized as one of the world's first green industries, recycling plays an essential role in the creation and support of jobs, and has a positive impact on the environment by reducing greenhouse gas emissions, saving energy, and protecting our natural resources. In 2021, the Institute of Scrap Recycling Industries, Inc. (ISRI) retained the independent economic consulting firm of John Dunham & Associates to perform an economic impact analysis to document the size and scope of the recycling industry in the United States and document its significant contribution to the U.S. economy, in terms of employment, tax generation, and overall economic benefit.

The U.S. recycling industry is not only a thriving economic engine, it is also a fundamental player in environmental protection, resource conservation, and sustainability. In recent years, the industry has annually recycled more than 130 million metric tons of materials, although the 2020 COVID-induced recession negatively impacted U.S. recycling volumes overall. Recycling reduces greenhouse gas emissions by significantly saving the amount of energy needed to manufacture the products that we buy, build, and use every day. The energy saved by recycling may then be used for other purposes, such as heating our homes and powering our automobiles.

In addition to its environmental stewardship, the study confirmed the U.S. recycling industry plays a prominent role as an economic leader, job creator, and major exporter. Specifically, the study found that the people and firms that purchase, process, and broker recyclables to be manufactured into new products in America provide 506,139 adults with good jobs in the U.S.² and generate approximately \$116.84 billion in annual economic activity.



The industry recycled **130 million** metric tons of materials in 2020.

	Direct	Supplier	Induced	Total
Jobs	159,640	153,983	192,516	506,139
Wages	\$12,334,813,000	\$11,011,191,900	\$11,046,238,200	\$34,392,243,100
Economic Impact	\$46,386,125,000	\$35,354,441,800	\$35,094,954,500	\$116,835,521,300

- 1- The study defines the recycling industry as firms in the private sector involved in the processing and brokerage of recycled metals, plastics, rubber, paper, textiles, glass, and electronics.
- 2- Based on the Economic Impact of the Scrap Recycling Industry in the U.S. (2021), produced for the Institute of Scrap Recycling Industries, Inc. by John Dunham & Associates, 2021.



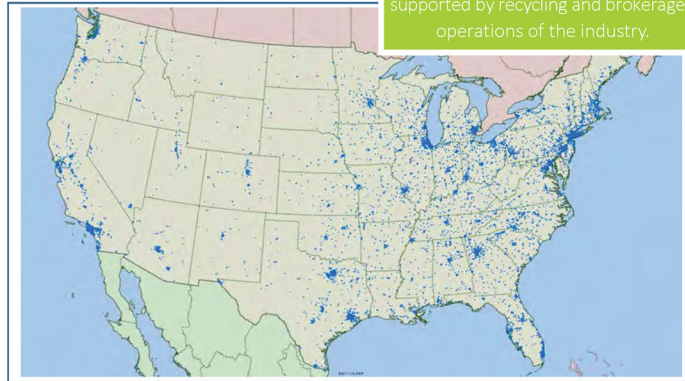
Summary of Findings

Employment: Source of Green Jobs

While many in the public policy world talk about the need for more green jobs, the recycling industry has been creating these environmentally friendly jobs and other opportunities in the U.S. for decades. The study found that in 2021, 159,640 jobs are being directly supported by processing and brokerage operations of the recycling industry in the U.S.³ These are good jobs paying an average of \$77,300 in wages and benefits to American workers. In addition to this, 346,499 jobs throughout the U.S. economy are indirectly supported by the recycling industry through suppliers and the indirect impact of the industry's expenditures.⁴

U.S. Recycling Industry Facilities

159,640 jobs are being directly supported by recycling and brokerage operations of the industry.



These are real people with real jobs—not only in firms that process recycled materials into new, usable commodity inputs, but also companies that supply the industry with recycled materials, like auto yards, as well as firms that supply machinery, trucks, and services to processors. In addition, thousands of people in industries seemingly unrelated to recycling—from servers in restaurants to construction workers to teachers in local schools, depend on the re-spending of the wages and taxes the recycling industry pays to its workers and suppliers.

3.- This includes firms involved in the purchasing, processing, and brokering of recycled materials including ferrous and nonferrous metals, paper, electronics, rubber, plastics, glass, and textiles.

4.- Direct impacts are those associated with processors and brokers. Supplier impacts are associated with firms providing goods and services to recyclers and brokers, and induced impacts are those resulting from the re-spending of wages by workers in the direct and supplier sectors.





The economic benefits generated by the recycling industry are far reaching. Not only are recycling facilities located in every state throughout the country, in urban and rural communities. The firms that supply materials as well as goods and services to processors and brokers are also located in every part of the country. This means that the U.S. recycling industry provides good-paying jobs in every state in the union. The study results are broken down by state, congressional districts, state legislative districts, and cities at <http://www.isri.org/recycling-commodities/economy>.

Overall Economic Activity

The activities of the recycling industry in the United States generate nearly \$116.84 billion annually in economic benefits here at home. All told, the U.S. recycling industry accounts for 0.53 percent of the nation's total economic activity,⁵ making it similar in size to the warehousing and storage industry.

Tax Revenues to Federal, State, and Local Governments

The recycling industry generates substantial revenues for federal, state and local governments throughout the U.S.

- The industry generates about \$4.97 billion in state and local revenues annually, money are used to help communities and people throughout the country.
- The industry and its employees pay another \$7.33 billion in federal taxes per year.

Export Activities: Creating Thousands of Jobs Here at Home

Recycled commodities are among the nation's largest exports by quantity. Overall, exports account for 31.26 percent of the industry's economic activity. These exports create approximately 155,662 good green jobs in the U.S., and help strengthen the national economy. According to the study, in 2021, 50,360 jobs are directly supported by export activities associated with the processing and brokerage operations of recyclers operating in the U.S.⁶

This is because recycled materials that are intended for export must be collected, separated, and prepared for transport out of the U.S. The steps in this process provide well-paying U.S. jobs. In fact, were it not for these export markets, some materials would probably not be recycled at all simply because there is insufficient demand for them in the United States. By opening up new markets, the nation's recyclers create demand for materials that might otherwise end up in landfills.

The recycling industry is the first link in the global supply chain for the growing demand of all manner of commodities ranging from iron and steel to nonferrous metals such as aluminum, copper, and zinc; paper; plastics; electronics; rubber; and more. The result is economic and environmental sustainability for our nation and our world through the supply of high quality, environmentally friendly and energy saving raw materials to the global marketplace.



The activities of the recycling industry in the United States generate nearly **\$116.84 billion** annually in economic benefits.

5- Bureau of Economic Analysis. GDP based on 2021 First Quarter GDP of 22.06 trillion, see: U.S. Bureau of Economic Analysis, Gross Domestic Product (GDP), retrieved from FRED, Federal Reserve Bank of St. Louis: <https://fred.stlouisfed.org/series/GDP>, May 27, 2021.
6- This includes firms involved in the purchasing, processing and brokering of recycled materials including ferrous and nonferrous metals, paper, electronics, rubber, plastics, glass, and textiles.



Summary Table: Economic Impact of U.S. Recycling Exports

	Direct	Supplier	Induced	Total
Jobs	50,360	45,908	59,394	155,662
Wages	\$3,960,822,400	\$3,488,210,500	\$3,622,530,200	\$11,071,563,100
Economic Impact	\$14,500,419,300	\$10,634,739,100	\$10,564,643,400	\$35,699,801,800

In 2020, the industry exported 35.1 million metric tons of recycled commodities valued at \$20.8 billion, significantly helping the U.S. balance of trade.⁷ In terms of volume, recycled materials are among the nation's largest commodity exports, in line with other important products like grain and corn, cotton, timber, and petroleum. Recycled materials processed in the U.S. are exported to other countries for manufacture into new products. America's recycled materials help reduce global energy demand and greenhouse gases as well as the need to mine and harvest virgin materials.

Economic Benefits of Exporting Recycled Commodities Are No Different Than Those of Any Other Product

International trade is an important part of the American economy. In 2020, over \$2.13 trillion in goods and services were exported from the U.S., and about \$2.81 trillion were imported.⁸ Over 40 million Americans work for companies that engage in international trade, according to the U.S. Chamber of Commerce, and one in five jobs depend on exports.⁹ To suggest that the export of recycled commodities would somehow destroy jobs in the United States is no different than maintaining that the export of corn, coal, or cotton somehow takes away American jobs. The study also calculated the U.S. recycling industry's state-by-state economic impact (as well as its effect on congressional and state legislative districts, and cities). The table summarizes those impacts. More detailed information tables – by state, congressional district and state legislative districts as well as cities can be accessed at <http://www.isri.org/recycling-commodities/economy>.



In 2020, the industry exported
35.1 million metric tons of
recycled commodities

7- U.S. Census Bureau/U.S. International Trade Commission.

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Study Methodology

The U.S. Recycling Industry Economic Impact Study estimates the economic contributions made by the various components of the recycling industry to the U.S. economy in 2021. John Dunham & Associates conducted this research, which was funded by the Institute of Scrap Recycling Industries, Inc. (ISRI). This work used standard econometric models maintained by the IMPLAN Group LLC.¹⁰ Data came from industry sources, government publications, and Data Axle.

The study defines the recycling industry as firms in the private sector involved in the processing and brokerage of recycled metals, plastics, rubber, paper, textiles, glass, and electronics. The study measures the number of jobs in the sector, the wages paid to employees, the value added, and total output.

The study also estimates taxes paid by the industry and its employees. Federal taxes include industry-specific excise and sales taxes; business and personal income taxes; FICA, and unemployment insurance. State and local tax systems vary widely. Direct retail taxes include state and local sales taxes, license fees, and applicable gross receipt taxes. Processors pay real estate and personal property taxes, business income taxes, and other business levies that vary by state and municipality. All entities engaged in business activity generated by the industry pay similar taxes.

The economic impact study begins with an accounting of the direct employment in the processing of recycled materials and the materials brokerage sectors. The data come from a variety of government and private sources. It is sometimes mistakenly thought that initial spending accounts for all of the impact of an economic activity or a product. For example, at first glance it may appear that consumer expenditures for a product are the sum total of the impact on the local economy. However, one economic activity always leads to a ripple effect whereby other sectors and industries benefit from this initial spending. This inter-industry effect of an economic activity can be assessed using multipliers from regional input-output models.

Industries are linked to each other when one industry buys from another to produce its own products. Each industry in turn makes purchases from a different mix of other industries, and so on. Employees in all industries extend the economic impact when they spend their earnings. Thus, economic activity started by recycling is linked to other industries in the state and national economies. The activities required to process one ton of recycled steel—from sorting, cutting, and baling to shipping—generate direct effects on the economy. Regional (or indirect) effects occur when these activities require purchases of goods and services, such as machinery or electricity, from local or regional suppliers. Additional induced effects occur when workers involved in direct and indirect activities spend their wages. The ratio between induced economic and direct effects is termed the multiplier.

Once the direct impact of the industry has been calculated, the impact of supplier firms and the “induced impact” of re-spending by employees of industry and supplier firms is calculated using an input-output model of the U.S. The study calculates the impact on a national basis, by state, by congressional and state legislative districts, and by city. This method of analysis allows the impact of local production activities to be quantified in terms of final demand, earnings, and employment in the states and the nation. In the case of the ISRI model, only the most conservative estimate of the induced effects has been used.

10.- The model uses 2018 input/output accounts.

Economic and Job Impacts on a State-by-State Level

	Direct			Suppliers			Induced			Total		
	Jobs	Wages	Output	Jobs	Wages	Output	Jobs	Wages	Output	Jobs	Wages	Output
AL	3,736	\$252,288,800	\$1,192,402,200	4,128	\$251,762,700	\$890,181,300	4,204	\$205,576,900	\$684,952,600	12,068	\$709,658,400	\$2,747,436,100
AK	212	\$19,174,700	\$54,178,000	154	\$12,219,000	\$60,120,300	211	\$13,175,600	\$46,395,200	577	\$44,569,300	\$160,693,500
AZ	2,500	\$193,913,600	\$625,697,000	2,163	\$147,846,100	\$558,069,300	2,929	\$160,860,700	\$523,903,700	7,592	\$501,820,400	\$1,707,599,000
AR	1,638	\$87,225,000	\$413,492,400	1,490	\$72,580,500	\$329,792,900	1,511	\$57,086,800	\$265,596,100	4,639	\$216,952,300	\$1,008,881,400
CA	16,684	\$1,381,572,600	\$4,748,571,900	15,069	\$1,227,826,800	\$3,521,983,700	19,676	\$1,293,131,900	\$3,955,296,200	51,429	\$3,902,631,300	\$12,225,851,800
CO	1,410	\$106,935,100	\$335,496,800	1,298	\$93,338,000	\$299,385,000	1,770	\$96,867,000	\$350,617,300	4,478	\$299,895,100	\$985,499,100
CT	2,940	\$173,890,900	\$599,846,500	1,461	\$126,687,300	\$346,153,300	2,124	\$147,568,300	\$411,967,600	5,634	\$448,105,100	\$1,357,967,400
DE	222	\$16,535,400	\$51,343,000	173	\$13,558,800	\$53,908,800	298	\$16,416,100	\$67,172,200	693	\$46,481,300	\$172,424,000
DC	32	\$1,803,000	\$6,484,400	27	\$2,704,900	\$7,942,400	48	\$4,727,300	\$16,357,800	107	\$9,235,200	\$30,784,600
FL	7,229	\$515,634,800	\$2,078,457,100	7,960	\$476,522,600	\$1,505,023,800	9,734	\$484,459,200	\$1,644,997,100	24,923	\$1,477,067,600	\$5,239,478,000
GA	4,298	\$245,360,400	\$1,217,735,500	4,927	\$303,186,300	\$1,033,962,900	5,220	\$251,886,900	\$820,828,100	14,445	\$800,413,600	\$3,172,526,500
HI	664	\$51,422,300	\$159,032,700	423	\$28,020,200	\$84,478,100	632	\$34,687,800	\$115,021,500	1,719	\$114,140,300	\$358,732,300
ID	507	\$48,703,500	\$140,148,000	523	\$32,662,600	\$106,842,400	661	\$36,115,300	\$124,159,700	1,691	\$117,801,400	\$371,151,100
IL	9,385	\$818,903,300	\$2,578,380,000	7,314	\$683,153,600	\$1,729,397,600	11,049	\$689,772,800	\$2,069,094,300	27,748	\$2,091,829,700	\$6,376,871,900
IN	7,382	\$522,218,200	\$2,256,137,100	6,611	\$456,081,700	\$1,524,749,800	8,128	\$442,358,000	\$1,376,420,600	22,121	\$1,420,637,900	\$5,157,307,500
IA	1,894	\$117,696,300	\$507,154,100	1,574	\$102,108,000	\$382,417,600	1,990	\$100,380,200	\$379,728,600	5,458	\$320,074,500	\$1,248,300,600
KS	1,143	\$17,197,800	\$52,721,000	890	\$56,293,500	\$221,962,100	1,155	\$58,343,000	\$239,194,000	3,188	\$187,834,300	\$713,877,700
KY	2,351	\$164,720,100	\$641,674,300	2,949	\$192,718,800	\$647,447,300	3,088	\$181,149,600	\$518,597,700	8,388	\$518,597,700	\$2,034,719,300
LA	1,586	\$109,750,800	\$397,351,800	1,593	\$100,855,200	\$552,066,300	1,704	\$85,469,900	\$365,943,600	4,773	\$295,875,900	\$1,315,062,000
ME	580	\$33,586,300	\$119,177,100	582	\$26,181,900	\$100,551,100	594	\$28,005,900	\$97,386,400	1,756	\$96,777,100	\$317,116,600
MD	1,778	\$130,899,500	\$426,364,200	1,295	\$97,962,200	\$274,373,800	1,828	\$111,523,700	\$380,659,200	4,901	\$340,695,400	\$1,061,397,700
MA	3,694	\$317,746,000	\$931,953,900	2,448	\$209,256,900	\$551,895,900	3,962	\$277,311,400	\$760,409,800	10,084	\$804,316,300	\$2,244,259,600
MI	4,778	\$366,314,500	\$1,309,359,500	4,770	\$340,063,700	\$1,081,761,900	5,910	\$327,187,500	\$1,033,885,300	15,458	\$1,033,505,700	\$3,425,066,700
MN	3,365	\$266,104,000	\$940,588,100	2,980	\$225,303,700	\$672,300,000	4,268	\$259,675,200	\$771,143,600	10,613	\$742,083,500	\$2,384,031,700
MS	911	\$58,868,200	\$284,330,000	1,028	\$56,024,900	\$227,314,000	1,011	\$47,597,400	\$193,348,800	2,950	\$162,460,500	\$684,962,800
MO	2,878	\$193,840,300	\$778,496,300	2,663	\$173,648,000	\$572,049,600	3,374	\$172,881,800	\$680,083,900	8,915	\$540,370,100	\$1,936,426,800
MT	337	\$20,462,100	\$71,580,000	344	\$21,402,500	\$85,409,900	353	\$15,274,800	\$63,243,000	1,034	\$57,136,400	\$230,633,800
NE	775	\$46,687,700	\$177,306,400	618	\$38,426,500	\$139,213,400	825	\$42,845,600	\$178,662,900	2,218	\$127,959,800	\$466,182,700
NV	743	\$62,672,300	\$190,615,400	677	\$40,249,000	\$177,397,700	810	\$43,068,300	\$154,406,400	2,230	\$153,989,600	\$522,419,500
NH	809	\$68,458,200	\$213,176,100	601	\$43,628,600	\$125,610,700	848	\$51,697,600	\$153,123,400	2,258	\$163,784,400	\$461,910,200
NJ	5,143	\$446,557,100	\$1,653,631,900	4,035	\$338,579,700	\$911,865,600	5,953	\$381,767,400	\$1,101,083,000	15,051	\$1,166,934,200	\$3,666,589,500
NM	484	\$39,263,500	\$121,299,900	348	\$21,460,400	\$97,931,600	511	\$25,598,000	\$97,523,700	1,344	\$96,371,900	\$316,755,100
NY	7,024	\$557,372,200	\$1,857,707,900	5,212	\$468,927,500	\$1,252,837,500	7,455	\$570,520,200	\$1,582,565,700	19,691	\$1,596,819,900	\$4,703,051,100
NC	4,547	\$310,917,700	\$1,234,537,400	4,846	\$303,932,900	\$996,026,100	5,424	\$285,151,500	\$979,437,000	14,817	\$999,902,100	\$3,210,002,500
ND	283	\$20,123,700	\$72,211,800	213	\$13,800,000	\$55,538,500	305	\$15,086,800	\$61,614,000	801	\$49,010,500	\$189,364,300
OH	8,460	\$652,284,200	\$2,387,020,000	7,847	\$551,532,300	\$1,816,890,400	10,287	\$557,385,900	\$1,794,271,300	26,594	\$1,761,181,500	\$5,996,171,700
OK	1,171	\$72,336,100	\$292,222,000	1,078	\$64,941,900	\$262,887,200	1,230	\$56,917,300	\$227,192,000	3,476	\$194,195,300	\$782,301,200
OR	3,839	\$279,882,100	\$1,173,283,600	4,416	\$295,124,100	\$881,872,600	4,950	\$249,478,800	\$768,469,700	13,105	\$824,485,000	\$2,823,626,200
PA	7,176	\$537,021,300	\$1,835,434,800	5,904	\$445,077,700	\$1,378,014,700	8,187	\$476,881,900	\$1,461,122,800	21,267	\$1,458,980,900	\$4,674,572,300
RI	753	\$53,347,800	\$176,945,100	511	\$33,928,500	\$102,201,500	724	\$39,284,000	\$122,847,900	1,988	\$126,560,300	\$401,734,500
SC	2,742	\$238,426,700	\$721,399,400	2,486	\$166,138,600	\$552,237,700	3,077	\$189,933,700	\$517,844,700	8,305	\$574,469,000	\$1,791,581,800
SD	452	\$23,035,900	\$126,172,300	350	\$20,652,500	\$76,937,000	451	\$20,614,800	\$82,915,100	1,253	\$64,303,100	\$289,024,400
TN	4,757	\$372,319,200	\$1,468,529,800	4,580	\$323,432,900	\$1,011,468,300	5,511	\$326,623,000	\$963,369,000	14,828	\$1,025,375,100	\$3,430,367,100
TX	12,650	\$940,102,800	\$3,470,230,800	12,113	\$878,985,500	\$3,254,369,000	15,476	\$962,406,900	\$3,945,198,100	39,639	\$2,690,694,300	\$9,773,967,900
UT	1,299	\$89,706,900	\$334,126,500	1,237	\$76,028,400	\$297,253,600	1,518	\$74,222,600	\$276,119,600	4,054	\$240,039,900	\$907,501,700
VT	233	\$13,357,900	\$50,703,700	206	\$10,512,400	\$37,952,400	231	\$10,973,300	\$42,176,100	670	\$34,843,600	\$130,626,200
VA	2,478	\$167,014,000	\$680,469,900	2,176	\$145,870,400	\$472,884,200	2,698	\$139,254,200	\$511,195,600	7,352	\$452,139,200	\$1,664,649,700
WA	5,386	\$570,417,100	\$2,707,096,500	5,762	\$761,465,100	\$2,238,172,400	9,863	\$594,491,400	\$1,796,724,500	25,011	\$1,926,373,600	\$5,651,995,400
WV	659	\$42,291,100	\$169,089,700	681	\$41,996,700	\$176,187,300	692	\$31,870,600	\$118,710,300	2,032	\$116,158,400	\$468,987,300
WI	4,305	\$416,848,800	\$1,874,027,000	7,171	\$471,623,000	\$1,432,359,300	8,053	\$431,962,100	\$1,294,263,800	20,129	\$1,320,463,900	\$4,600,650,100
WY	270	\$17,723,500	\$77,217,800	207	\$13,229,900	\$60,440,400	245	\$11,358,700	\$48,387,600	722	\$42,312,100	\$186,045,800
Total	159,448	\$12,134,613,000	\$46,386,125,000	153,883	\$11,911,191,800	\$35,354,441,800	192,816	\$11,046,234,200	\$35,694,954,500	506,131	\$34,362,242,100	\$114,635,521,300

The study also calculated the impact of the U.S.-based recycling industry on a state-by-state basis (as well as by congressional and state legislative districts and cities). The table above summarizes those impacts. Specific tables—by state, congressional district, and state legislative districts, as well as cities—can be accessed at isr.org/economy.



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2021 Economic Impact Study, U.S.-Based Recycling Industry,
 John Dunham & Associates (guerrillaeconomics.com)



Senate Committee on Environment and Public Works
Hearing Entitled, “Improving Capacity for Critical Mineral Recovery through Electronic Waste Recycling and Reuse”
July 26, 2023
Questions for the Record for Craig Boswell

Chairman Carper:

1. Are there any updates or clarifications to the Resource Conservation and Recovery Act or other federal statutes or regulations you recommend to improve the safety and reliability of the interstate movement of electronic waste?

A significant issue for the industry is a lack of clarity in the application of the DDR requirements for the movement of LiIon batteries under DOT guidelines. The evaluation of batteries as DDR moves them from universal waste to hazardous waste classification and significantly impacts the cost and complexity of transporting the batteries. It is unclear in the current regulations to what extent damage must be incurred to require this reclassification. For instance, does a slightly swollen cellphone pouch battery or laptop battery require reclassification as DDR?

2. How does having clear and consistent regulations benefit the United States’ domestic electronic waste management sector and promote private investments and job creation?

A major challenge to the industry is the need for additional capital investment in companies, both for-profit and not-for-profit, to expand the recycling capacity and recycling efficiency for electronics in the United States. An unclear regulatory future (both domestically with respect to EPR and internationally with respect to transboundary movement) creates business risk and either increases the cost of capital or discourages outside capital from entering the industry. Clarity in policy will help to mitigate this risk and increase capital infusions.

3. Please highlight innovation, technological or otherwise, you have seen in the field of e-waste recycling in recent years, and explain how those changes improve the overall recycling rates of electronic products?

Over the past five years, there has been tremendous investment in automation and automated process control. This includes the implementation of robotically controlled testing, product movement, and product grading. It also includes the implementation of advanced ERP (Enterprise Resource Planning) systems that have significantly increased the efficiency, reporting, repair throughput, and controls (both data security and environmental) of companies operating in the electronics recycling space. Some of the latest technology includes identification of battery containing materials, making it easier to identify batteries before shredding, significantly reducing the risk of thermal events.

4. How can we harness these developments and encourage more companies to come up with plans for reusing or recycling their products? What is the role of the federal government in spurring such market transformations?

These innovations require significant capital investment from companies to acquire and implement. As stated above, clear policy plans that mitigate business risk in these types of transformational investments can assist in the access to capital and the cost of that capital. The United States also needs educational initiatives focused on recycling. Many consumers are still unaware that electronics can and should be recycled properly. Devices that end up in landfills pose risks to the environment and municipal recycling facilities.

5. Does the mishandling of electronic waste create concerns for the mishandling of personal data and/or national security concerns? Please explain this connection in detail and include any suggestions you have to improve the proper management and disposal of data often embedded in household and commercial electronic waste.

As stated in my testimony, the industry has made tremendous investments and significant strides in the efficacy and throughput of data-cleansing software. As also stated, the misperception is that data is safer on a device stored in a home rather than at an electronics recycling facility that could quickly and efficiently completely eradicate the data. Studies have shown that an often-cited reason for not recycling electronics is the fear of data escape. Dispelling this myth through public education could decrease the volume of electronics warehoused in home and office environments.

6. Do you think electronic waste should be categorized as hazardous waste? How does your view differ from the international agreement on this subject outlined in the Swiss-Ghana amendment to the Basel Convention?

Electronic waste should not be categorized as hazardous waste. In fact, the term “waste” should be avoided, as these are valuable products that can be put back into second or third lives and valuable resources that can be recovered, including critical minerals that will help close the loop on the circular economy. Unfortunately, under the terms of the Basel Convention, controls can only be put in place if materials are moved to the hazardous category. In an attempt to better regulate the illegal transboundary movement perpetuated by a small number of bad actors, these products and resources are now moved into the Annex II classification.

7. Give that the United States is currently not party to the Basel Convention, how can the federal government ensure that there are continued, reliable international markets for American companies to participate in? What additional actions must be taken at the federal level in the next 18 months to ensure this continued trade?

It is critical that the United States work toward Article 11 agreements with key trading partners crucial to the electronics recycling industry over the next 18 months. This would include closing negotiations within the OECD and adding a bilateral agreement with Malaysia. The need for other key bilateral agreements could arise as the electronics recycling industry in the United States evaluates the pending impacts of the implementation of the Swiss Ghana proposal.

8. How does the Environmental Protection Agency currently regulate the electronic waste processing and handling sector, and are there additional authorities Congress should consider

vesting within the agency that would improve the capacity for electronic waste recycling domestically and internationally?

The existing federal statutes for processing and control of universal and hazardous waste provide the proper framework for controlling the recycling of electronic products. Consistent enforcement of these regulations on the small number of “bad actors” that are in violation would help improve the competitive framework for electronics recycling companies in the United States.

9. How would standardized design standards for electronic products help improve the collection and recycling of electronic waste?

As stated in my testimony, the ability of electronics recycling companies to cost-effectively recycle and recover critical material from electronics products is largely determined in the design phase of the product. The more cost-effective the material recovery process is, the more demand there is within the electronics recycling industry to acquire those products and to create convenient/efficient systems to capture the products at the end of life. The one significant development in this area is the modern desktop computer that requires little to no tools to process. Aside from PCs, few items have followed suit. To further exacerbate the issue, items are getting smaller, and many products contain embedded batteries, making them incredibly difficult and expensive to recycle.

Senator CAPITO. Thank you, Mr. Boswell.

We will now turn to Kitty McIlroy, who serves as the President and Director of the Maryland Recycling Network, and is the project manager for the Northeast Maryland Waste Disposal Authority.

Ms. McIlroy, thank you for coming.

**STATEMENT OF KITTY McILROY, PROJECT MANAGER,
NORTHEAST MARYLAND WASTE DISPOSAL AUTHORITY**

Ms. McILROY. Good morning, and thank you, EPW Committee. My name is Kitty McIlroy, and I am here to speak from my experience as a project manager for electronics recycling contracts at a State agency, the Northeast Maryland Waste Disposal Authority. I am also here as President of the Maryland Recycling Network to highlight where our network has identified room for policy improvement.

I hope to provide some context for what exactly the public sector has been facing over the past 10 years regarding electronics.

Why is electronics recycling needed? Waste rates are increasing, and many local governments in Maryland, for example, are already shipping waste out of State due to limited landfill capacity. Recovery of electronics is also a safety priority, since electronics, specifically lithium-ion rechargeable batteries, are more likely to cause facility fires if not separately collected and safely stored, due to impacts from compaction vehicles and equipment when moving waste.

There are benefits to recovering our reliance on foreign supply, and mining operations, and instead, recovering these precious metals domestically since global demand continues to grow due to the jewelry, electronics, and auto industries.

Keeping heavy metals from electronics out of landfill leachate is also beneficial, as there are costs to treating it at water treatment plants. Electronics recycling also contributes to local job growth, and when funded properly can eliminate disposal fees to local jurisdictions.

How programs are currently managed. In Maryland and many States, most municipal electronics recycling is managed by local jurisdictions. Their existing infrastructure, drop off sites, staff, historical knowledge, public education, and procurement procedures allow them to run these programs efficiently. Some have even implemented curbside collection for electronics.

However, electronics recycling is generally not cost free, especially for bulky TVs and computer monitors, which dominate the municipal stream. Managing hazardous components, such as lead and mercury, and providing on site capacity, storage, infrastructure, transportation, equipment, labor, and recycling certifications contribute to a net cost.

Local jurisdictions in Maryland generally fund these programs through local taxes, general funds, enterprise funds, special revenue funds, and tipping fees. Twenty-five States plus the District of Columbia have a variety of electronics laws, some requiring funding and/or collection to be provided by manufacturers. The remaining States have no electronics laws.

As it has been well documented in industry news over the past decade, many State laws fall short. Thus, the bulk of electronics end up at municipal drop offs, with the burden, operational obliga-

tion, and cost left to local government. This is especially true in Maryland. Over the past decade, many of these programs have closed in the State, or at least partially, due to a lack of funding, meaning that many governments are forced to landfill electronics, notably TVs and monitors, as the only alternative.

Beginning calendar year 2014, after the electronics recycling market crashed, only four of eight Authority Members were able to continue their full programs, amounting to over 5 million pounds a year of TVs and monitors landfilled, rather than recycled.

For Authority Members, in fiscal year 2023 and 2022, it has cost over \$900,000 a year to run these programs. Currently, only 7 of 23 counties in Maryland are able to provide permanent recycling for all electronics at no cost upon drop off for residents.

Proven solutions that can function as a national model. No matter how well this market recovers, it will always be subject to unpredictable commodity markets, recession, and inflation. The public sector needs a sustainable source of funding, especially for rural communities that are far away from processors, and for jurisdictions with limited resources to manage full time programs. Many stakeholders believe we need a national solution.

At a minimum, I believe we need a national, Congress chaired work group with reps from local and State government, non-profit EPR experts, recyclers, producers, retailers, and certification bodies to review existing best practices. The workgroup could look at replicating what works and provide a streamlined, cohesive set of policy recommendations.

A few laws in States like Connecticut and California could provide this framework. They function exceptionally well in terms of funding and administration, including manufacturer, retailer, and recycler requirements. Some non-profits already administer programs on behalf of State departments and are experts in doing so, which could be explored nationally. There are certainly many in this field who would be willing to work on this.

Thank you for your interest in taking this first step at improving our electronics recovery on a national level.

[Due to size constraints Ms. McIlroy's prepared statement is not included in this hearing record but is available on this govinfo.gov Web site. The live, online link is <https://www.govinfo.gov/content/pkg/CHRG-118hhrg54562/pdf/CHRG-118hhrg54562-add1.pdf>]

Senator CARPER [presiding]. Ms. McIlroy, thanks so much.

I apologize for having to be out of the room. We just nominated a judge for the Federal District Court in Delaware, and I needed to be there to introduce her to the Judiciary Committee. But I am glad I got to hear the end of your statement. I have read it, and look forward to doing the same with the statements from our other witnesses.

I always like to make sure I pronounce people's names right. So I would pronounce your first name "Charles." Your second name, however, is it Pellicane?

Mr. PELLICANE. Correct.

Senator CARPER. Very good.

Executive Vice President of Business Development and Operations at Human-I-T. Mr. Pellicane has joined us today to share perspectives on reuse, on refurbishment, and equitable access.

Please proceed, and we look forward to what you have to say, then we will ask some questions of all of you.

Thank you.

STATEMENT OF CHARLES PELLICANE, EXECUTIVE VICE PRESIDENT, BUSINESS DEVELOPMENT AND OPERATIONS, HUMAN-I-T

Mr. PELLICANE. Thank you, Chairman Carper, Ranking Member Capito, and distinguished members of the Committee, for this opportunity to testify before you today.

My name is Charles Pellicane, and I am the Executive Vice President of Business Development and Operations at Human-I-T. Human-I-T is the country's largest digital equity organization, with 175 employees and interns in 10 States, primarily in California and Michigan. We are also an active member of the National Digital Inclusion Alliance, a AAA certified vendor with the National Association for Information Destruction, and a member of AFTRR, the Alliance for Technology Refurbishing and Reuse.

While promoting digital equity is our primary focus, we sustain ourselves by providing IT Asset Disposition services, or ITAD services, to businesses and organizations. Thus, we solve two problems with one solution. We solve the problem of e-waste by partnering with corporations, government agencies, community groups, and other organizations to collect and process unwanted technology. We use refurbished technology and the revenues from that service to supply free and low cost computers and monthly Internet plans for students, seniors, and families.

Because our model promotes reuse over recycling, we not only keep e-waste out of landfills, but we also create positive social impact in underserved communities. We hire from within the communities that we serve and in doing so we create unique, future proofed job opportunities.

Our entry level employees receive hands on training in technology repair, IT, tech support, and e-commerce, and their roles come complete with full benefits, health insurance, paid time off, and a 403(b) retirement savings plan.

Half of our team are in their early career, meaning they are 30 years old or younger; 80 percent are people of color; and more than a third are women working in a typically male dominated field. In many ways, Human I-T is a working example of how conscious capitalism can create equitable opportunities, develop work force skills, and reduce environmental impact, all at the same time. Every day, we work to empower people and protect the planet.

Today, I am asking you to address the market's failures in recovering aging consumer electronics, advocate for reuse and circular economy policies, and support the Secure E-Waste Export and Recycling Act, and implement the Computers for Veterans and Students Act of 2022, also called the COVS Act.

Currently in the United States of America, no single e-waste refurbisher or recycler can achieve significant market share due to a patchwork of State and local policies and the high costs associated with recovering, transporting, and processing electronics products. There is little to no extended producer responsibility, which puts

the responsibility for recycling onto individual consumers instead of manufacturers.

Nearly every city and State has a different approach. Many do not even consider electronics within their recycling goals and simply point consumers to hazardous waste facilities instead of a safe and easy collection site.

At this time, it is not viable for Human I-T to scale our public facing collection services because the value of household consumer technology depreciates quickly and because of other factors like planned obsolescence, restrictive design features such as “glues and screws,” and the absence of a right to repair. As a result, as much as 65 percent of consumer electronics are not even recycled, let alone reused.

Unfortunately, lack of recycling and reuse puts the United States in a troubling position. We are heavily reliant on imports of many materials, such as cobalt and lithium, which are essential for manufacturing advanced technologies. Supply chains for many of these minerals are vulnerable to various risks, such as foreign government actions. We can reduce our dependence on foreign supply chains by reusing and then recycling our electronics domestically.

E-waste contains a significant amount of valuable metals, and also hazardous substances. Therefore, it is considered both as an economically sound secondary resource and an environmentally problematic one.

When we think of electronics within a circular economy it is imperative to think of the inner loops of the circle, and not just the outermost loop of recycling. Those inner loops include maintaining devices and prolonging the life of technology, reusing and redistributing working devices, and refurbishing and remanufacturing non-working devices.

According to the EPA Environmental Benefits Calculator, it is 25 times more beneficial environmentally to extend the life of electronic devices than to recycle them at 3 to 5 years of age. While at the same time, reusing first and then recycling relieves the pressure and reliance on the primary supply of critical minerals.

Therefore, the proper recycling and processing of electronic waste presents an opportunity to stabilize the critical materials market and provide proper disposal and treatment of a hazardous waste stream. In doing so, we will ensure sufficient resources to meet today’s needs and those of the future.

You can help non-profit refurbishers like Human-I-T by funding public education to raise awareness on the importance of reducing e-waste. You can also pass policies to create a more circular economy such as Extended Producer Responsibility and the Right to Repair. Additionally, supporting the domestic markets by keeping resources local through implementing legislation like the Secure E-Waste and Recycling Act and the COVS Act.

Additional information is included in my written testimony, and I am available to answer questions during this hearing or afterward.

Thank you for your leadership in moving this important conversation forward. Together we can create a circular economy that strengthens our country and communities.

[The prepared statement of Mr. Pellicane follows:]



Testimony of Charles Pellicane, Executive Vice President of Human-I-T

U.S. Senate Environment and Public Works Committee Hearing: *Improving Capacity for Critical Mineral Recovery through Electronic Waste Recycling and Reuse*

July 26, 2023

Thank you Chairman Carper, Ranking Member Capito, and the distinguished members of this committee for this opportunity to testify before you today. As well, thank you for addressing this critical topic before us today: *Improving Capacity for Critical Mineral Recovery through Electronic Waste Recycling and Reuse*.

My name is Charles Pellicane and I'm the Executive Vice President of Business Development at Human-I-T. Human-I-T is the country's largest digital equity organization, with 175 employees and interns in 10 states, primarily in California and Michigan. We are also an active member of the National Digital Inclusion Alliance, a AAA-certified vendor with the National Association for Information Destruction, and a member of AFTRR, the Alliance for Technology Refurbishing and Reuse.

While promoting digital equity is our *primary* focus, we sustain ourselves by providing IT Asset Disposition (ITAD) services to businesses and organizations. Thus, we solve two problems with one solution:

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- We use refurbished technology and the revenues from that service supply free and low-cost computers and monthly internet plans for students, seniors, and families

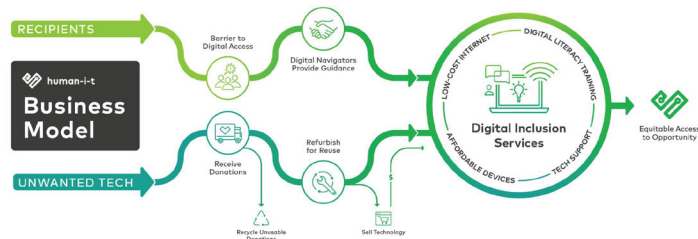


Figure 1.

Because our model promotes reuse over recycling, we not only keep e-waste out of landfills but we also create positive social impact in underserved communities.

We hire from within the communities that we serve and in doing so we create unique, future-proofed job opportunities. Our entry-level employees receive hands-on training in technology repair, IT, tech support, and e-commerce, complete with full benefits, health insurance, paid time off, and a 403(b) retirement savings plan. Half of our team are in their early career, meaning they're 30 years old or younger; 80% are people of color; and, more than a third are women working in a typically male-dominated field.

So in many ways, Human-I-T is a working example of how conscious capitalism can create equitable opportunities, develop workforce skills, and reduce environmental impact, all at the same time. Every day, we work to empower people and protect the planet.

Today, I am asking you to:

- Address market's failures in recovering aging consumer electronics;
- Advocate for reuse and circular economy policies; and,
- Support the Secure E-Waste Export and Recycling Act, known as SEERA, and implement the Computers for Veterans and Students Act of 2022, also called the COVS Act.

Currently in the United States of America, no single e-waste refurbisher or recycler can achieve significant market share due to a patchwork of state and local policies and the high costs associated with recovering, transporting, and processing electronics products.¹ There is little-to-no extended producer responsibility, which puts the responsibility for recycling onto individual consumers instead of manufacturers. Nearly every city and state has a different approach. Many do not even consider electronics within their recycling goals and simply point consumers to hazardous waste facilities instead of a safe and easy collection site.

At this time, it is not viable for Human-I-T to scale our public-facing collection services because the value of household consumer technology depreciates quickly and because of other factors like planned obsolescence, restrictive design features such as 'glues and screws,' and the absence of a right to repair.²

As a result, as much as 65% of consumer electronics are not even recycled, let alone reused.³

Unfortunately, this lack of recycling and reuse puts the United States of America in a troubling position. We are heavily reliant on imports of many minerals, such as cobalt and lithium, which are essential for manufacturing advanced technologies. Supply chains for many of these minerals are also vulnerable to



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various risks, such as foreign government actions.⁴ According to the International Energy Agency:

For lithium, cobalt and rare earth elements, the world's top three producing nations control well over three-quarters of global output. In some cases, a single country is responsible for around half of worldwide production. The Democratic Republic of the Congo (DRC) and People's Republic of China (China) were responsible for some 70% and 60% of global production of cobalt and rare earth elements respectively in 2019. The level of concentration is even higher for processing operations, where China has a strong presence across the board. China's share of refining is around 35% for nickel, 50-70% for lithium and cobalt, and nearly 90% for rare earth elements. Chinese companies have also made substantial investment in overseas assets in Australia, Chile, the DRC and Indonesia. High levels of concentration, compounded by complex supply chains, increase the risks that could arise from physical disruption, trade restrictions or other developments in major producing countries.⁵

We can reduce our dependence on foreign supply chains by first reusing and then recycling our electronics domestically. E-waste contains a significant amount of valuable metals, and also hazardous substances. Therefore, it is considered both as an economically sound secondary resource and an environmentally problematic one.⁶

When we think of electronics within a circular economy (see Figure 2), it is imperative to think of the inner loops of the circle (maintain/prolong; reuse/redistribute; refurbish/remanufacture), not just the outermost loop of recycling. It is twenty five (25) times more beneficial environmentally to extend the life of electronic devices than to recycle them at three to five years of age.⁷ While at the same time, reusing first and then recycling relieves the pressure and our reliance on the primary supply. Therefore, the proper recycling and processing of electronic waste presents an opportunity to stabilize the market of critical materials and provide proper disposal and treatment of a hazardous waste stream.⁸ In doing so, we will assure sufficient resources to meet today's needs and those of the future.⁹

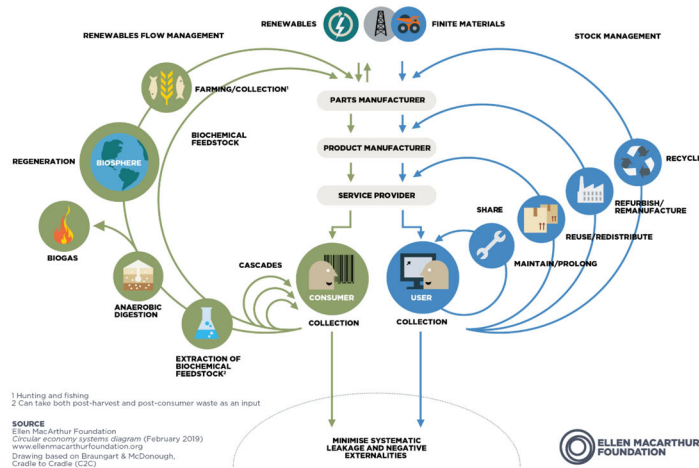


Figure 2.

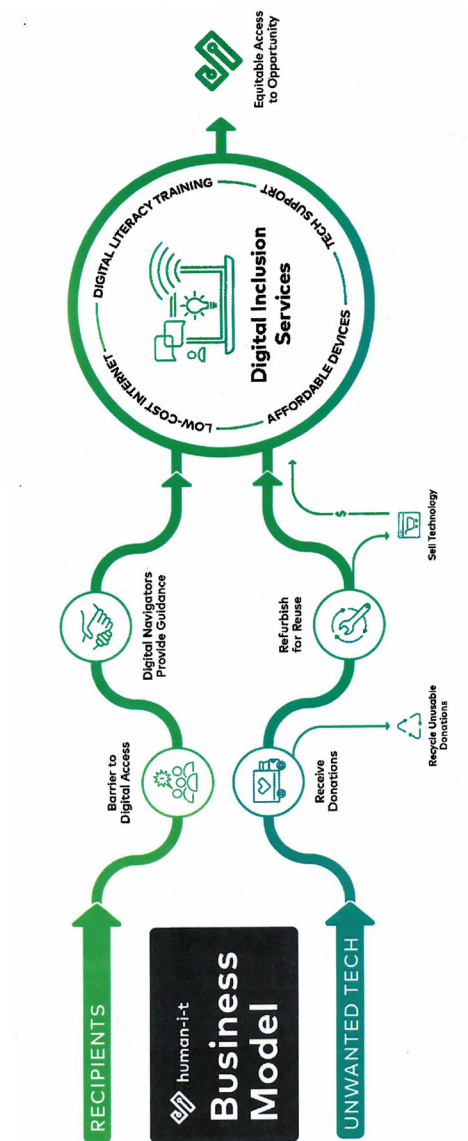
You can help nonprofit refurbishers like Human-I-T by funding public education to raise awareness on the importance of reducing e-waste, passing policies to create a more circular economy such as Extended Producer Responsibility (EPR) and the Right to Repair, supporting the creation of producer responsibility organizations, and supporting domestic markets by keeping resources local by implementing legislation like SEERA and the COVS Act.

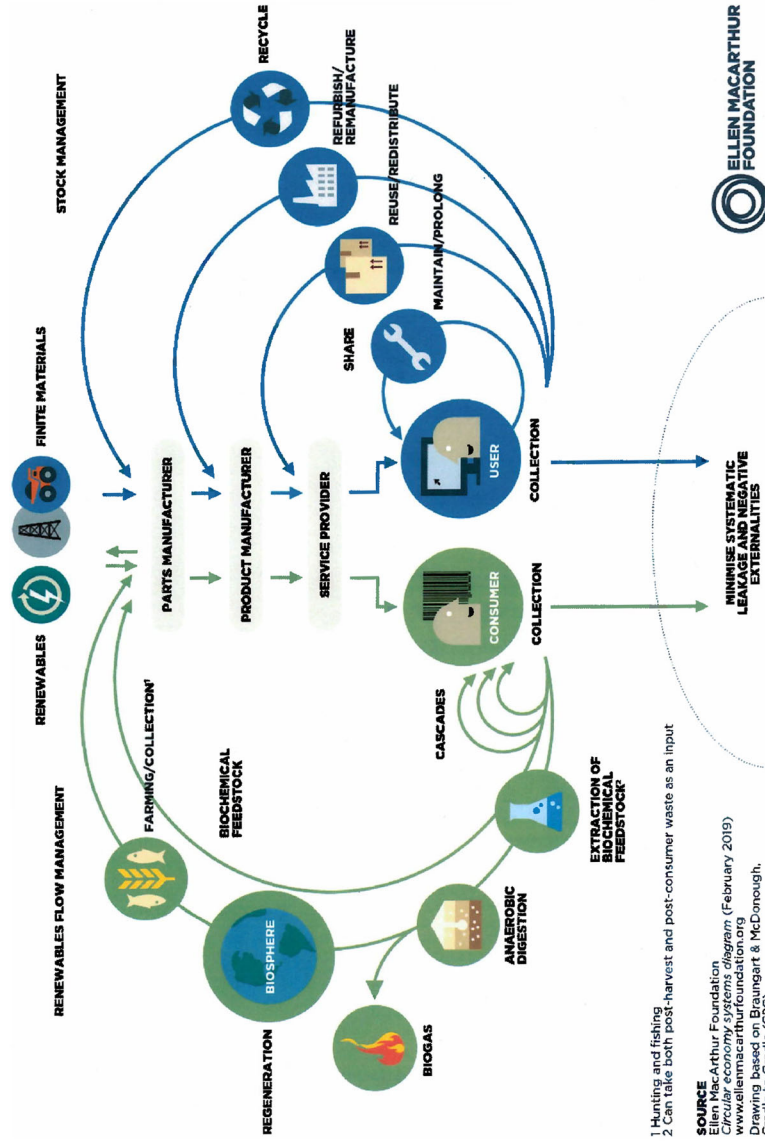
Additional information is included in my written testimony and I'm available to answer questions during this hearing or afterward. Thank you for your leadership in moving this important conversation forward. Together we can create a circular economy that strengthens our country and communities.

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Senator CARPER. Mr. Pellicane, thanks so much for that testimony.

And to everyone else, thank you, too.

My colleague, Senator Capito, has heard me quote Albert Einstein probably too much. A lot of people may remember the Einstein quote, what is the definition of insanity, do the same thing over and over again and expect a different result. That is a good quote. But my favorite is, in adversity lies opportunity. In adversity lies opportunity.

How might that be relevant to this hearing today, Mr. Kochhar?

Mr. KOCHHAR. Very relevant. Back when we started Li-Cycle in 2016, we were told we were way too early, running a science project, why are you recycling batteries when we are just talking about EVs on the road. So as you said, within a problem lies an opportunity. And to give you an idea of today's EVs, there is probably about \$4,000 worth of value in that battery on average to be recovered. This year alone, that would be over \$3 billion of value to be recovered, just from today's sales, this year.

Thinking forward to 2030 and beyond, you are talking about tens of billions, hundreds of billions in our market. What is needed is technology to bridge that gap. So we recover lithium, which is a lot of the value in the batteries, and you have to tackle that, and it takes a long time.

So I truly believe that, and that is the spirit of entrepreneurship.

Senator CARPER. Dr. Einstein would approve of your testimony, I am sure. Looking down and smiling.

Mr. Boswell, same question. In adversity lies opportunity. Is that true in this sense?

Mr. BOSWELL. I think it is very true. I want to thank you for your leadership on the Recycling Caucus.

Senator CARPER. Actually, we have a colleague from Arkansas, Senator Boozman, we are all in cahoots on this together.

Mr. BOSWELL. Well, it is very meaningful to the industry. It really is very meaningful to the industry.

And as you look at our industry, one of the things that is also changing in the electronics space is the generational differences as products come out, it is getting smaller and smaller. I am sure Apple wouldn't love for me to say that an iPhone 14 isn't that much different from an iPhone 13.

What that is doing is increasing the opportunity for us to reuse products and to use those products to bridge the digital divide. So our industry has really shifted its focus on how we can reuse these products and extend their life. We have been very effective in doing that, because we can eradicate the data. And we are even developing operating systems that can build multi-generations back to allow these products to be deployed both domestically and internationally to help bridge that digital divide.

So there is quite a bit of new opportunity evolving in the industry.

Senator CARPER. Great, thank you.

Ms. McIlroy, same question. In this adversity we are talking about, is there opportunity? In the midst of all this adversity that we are talking about, is there opportunity? What might that be?

Ms. McILROY. It is a little bit different answer from the public sector. But yes, certainly I think there is opportunity. There are some of our member jurisdictions, or at least one specifically, that has already started a curbside collection program for electronics. I think if government starts looking at that option for maximum convenience for residents to recycle, I think it would be utilized in full.

Right now, they have a great network of physical drop off centers. But not everybody wants to spend a Saturday dropping off an old TV. So I think a curbside collection option would be great.

Senator CARPER. OK, thanks.

Mr. Pellicane, same question, please.

Mr. PELLICANE. Thank you.

When we think about the opportunities from recycling electronics, the panel really spoke to job creation as well, but our organization represents that unique aspect of providing opportunity to some historically disadvantaged communities. Refurbishing electronics not only provides opportunity to those disadvantaged communities, because it is really an example of circular economy at work.

When Human-I-T takes in technology with that focus on refurbishment, we are creating jobs for collecting, inventorying, processing, and shipping those electronics. And as I mentioned previously, for many of our employees, this is their first opportunity to work in the technology space. And a number will actually make this their career. We are very proud to have former employees to go on to work for a number of IT organizations, including at Google.

Once that piece of technology is refurbished and we are able to give it to a person in need, this thing creates other opportunities. So this takes someone who was previously lacking in opportunity and gives them the ability to go to school, to take vocational courses, apply for jobs, and even start a business. So those persons now contribute to their local economies, which leads to of course the need and use of more technology.

So in refurbishing electronics, this not only provides an initial person with a job, but that refurbished device then goes on to provide a multitude of opportunities to the recipient in addition to them being able to fully participate in our society through things like tele-health and online banking.

Senator CARPER. All right, thanks for that response.

Senator Capito.

Senator CAPITO. Thank you.

Thank you all very much.

Mr. Boswell, Ms. McIlroy actually kind of hit on this a little bit. I represent a rural State. We can't even sustain recycling much for paper or tin cans, things we have been doing for years, because the economic model is not there. How would you envision improving the accessibility of e-waste recycling to rural America? Do you have any suggestions there?

Mr. BOSWELL. Yes, I think one thing that is unique about the electronics recycling space that is somewhat different than other recycling spaces is the barriers to entry are very low. My company, my sister and I started our company with a few thousand out of

savings, and we used a borrowed desk in the back of somebody else's warehouse.

So it is scalable. The vast majority of companies in the industry are very small, mom and pop operations. I think the key to making that work is allowing those entrepreneurs that are in these rural areas, I live in a rural area as well, probably not as pretty as West Virginia, but I live in a rural area.

Senator CARPER. Where do you live?

Mr. BOSWELL. I live in Texas, beautiful State, by the way. I live in Tioga, Texas, a town of 500. We actually have a small, entrepreneurial business within 5 miles of my home that collects electronics in the local community.

What we are doing through ISRI and SERI, the R2 certification body, is we are creating training mechanisms to allow those smaller entrepreneurial businesses to learn how to properly eradicate data and also learn how to handle these materials safely. Because that really represents some of the barrier to entry, is making sure you know how to do it right. What we don't want is people doing it wrong for their local community. And these resources are available free of charge.

Senator CAPITO. So would you say there is enough of an economic model at the very end to sustain these, obviously sustain these businesses?

Mr. BOSWELL. Yes, where they develop that economic model is reuse. In rural communities, often you have a gap with people affording reasonable electronic products. They kind of bridge that gap between, let's say, the school and some of the community members to do that. It is always going to be small. When we started, we only worked a few miles around where we were. But it can be done at a very small scale. But it has to be done right. Because otherwise people won't trust to use that service.

Senator CAPITO. Right.

Let me ask you another question. In your testimony you mentioned, just for clarification for me, you mentioned that it would be helpful that when these products are being created that the consideration for the reuse and recycling should be on the front end rather than at the back end. Is that occurring now or not?

Mr. BOSWELL. There have been some tremendous strides in that. ISRI has a Design for Recycling Award, and many of the winners, like Dell and Samsung, had been electronics companies. But the market is constantly changing, so we need that dialogue to be ongoing. The EPA has been instrumental in the past in bringing some of that dialogue to the floor, getting recyclers and manufacturers in the same room to feed that information back.

So it is being done. But there is still a long way to go.

Senator CAPITO. Yes, that makes sense, too.

Mr. Kochhar, on your company, are you strictly dealing with EV batteries? Are you doing phones, too, and other things?

Mr. KOCHHAR. We do all types of lithium batteries, phones, mobile appliances, vacuum cleaners, et cetera. So yes.

Senator CAPITO. So you are constructing your first major recycling—

Mr. KOCHHAR. So we are in a commercial operating phase, so we have a two phase model, so we basically break down the batteries, we shred them——

Senator CAPITO. You are doing that now.

Mr. KOCHHAR. Yes, and the key there is you don't have fire. So that is what the IPs are around, is how do you prevent that.

Senator CAPITO. When you shred a battery, though, and try to recover the lithium, how do you do that?

Mr. KOCHHAR. The first step is really physical separation. The issue in this industry is when you go into an e-waste process, like a traditional one, and Mr. Boswell spoke about that, you have an embedded battery in like a phone, right? You put it in a shredder, it is going to catch on fire.

So what we do is we take that battery which would come from an e-waste group, and the way we shred is under a liquid, so basically you are preventing access to oxygen, it doesn't catch on fire. So we have four of those operating facilities today, generating intermediate material. Then the facility you are referring to is where we will extract the lithium from that intermediate material.

Senator CAPITO. What about, Mr. Pellicane, I think it is interesting, your perspective with the reuse portions of it, and the statistic that you used on how much that would eliminate a lot of waste if we just simply reused or elongated the life of certain things. I went to the electronics show in Las Vegas last year, and the types of products that are, you have e-bikes, you have chips in your dishwasher, in your refrigerator, you are talking about massive appliances.

Is the industry looking at this too? We have said a lot about phones and e-batteries. But there is a whole host of other products that really fall into this category.

Mr. PELLICANE. Yes, absolutely. Anything with a cord, a battery, can be recycled. You spoke to the growing kind of electrification of things. We also know the Internet of things as well, where you spoke to chips going into dishwashers and your refrigerators, so that these devices can talk to each other.

But then that of course opens up issues, right? Those devices contain data and they also contain hazardous materials, as we have spoken to. So the industry is looking at those things. We as a refurbisher collect those things and then pass those on to those certified downstream recyclers that Craig spoke about.

Senator CAPITO. Thank you.

Senator CARPER. Senator Ricketts, welcome back. You are on.

We have a couple of recovering Governors on this panel, and the mother of maybe a future Governor on this panel.

Senator RICKETTS. One of the things I wanted to talk about was actually, when it comes to U.S. citizens, and we are talking about recycling their electronics, the privacy. There are literally hundreds of thousands of devices that get recycled every year. And there is little accountability or tracking with regard to where they go and what is happening to them.

So Mr. Pellicane, I am going to ask you to maybe start on this first, and just talk a little bit about, what do you think is the threat, what is the risk for the 120,000 laptops, 350,000 cell phones

that get recycled every year? Are U.S. citizens' private information being put at risk with these devices being discarded in e-waste?

Mr. PELLICANE. There is definitely a risk there with that data being recycled, if it is not being handled properly, if it is not being handled by certified organizations. We are certified to the National Association of Information Destruction's AAA certification, which means that we handle that information properly.

But if it is not being handled by the right collectors, by the right recyclers, that does create a risk, not only with that data being accessible, but also with the potential for counterfeits and other issues there as well. That is why we support the Secure E-Waste Export and Recycling Act to ensure that those products are handled domestically.

Senator RICKETTS. Also, it has been confirmed that counterfeit parts from China are ending up in critical defense systems here in the United States. Obviously, this is an issue that the Defense Department has long identified as presenting a legitimate threat to our Nation's readiness.

Much of the material used in counterfeit electronic parts is e-waste shipped from the United States to the rest of the world, from around the rest of the world to China. This e-waste goes through a process known as blacktopping, where parts are made to look brand new to the naked eye. Then these products are resold on the marketplace.

How do counterfeit parts make it into advanced U.S. missile systems and other military equipment undetected?

Mr. PELLICANE. You definitely speak to something that is particularly concerning and definitely was one of the impetuses for that Secure Electronics Export and Recycling Act that has recently been introduced. I am not an expert in that area of how those items are ending up in our systems, and would have to defer to those experts. But I would definitely look to provide you with that information after the hearing.

Senator RICKETTS. Do you have any ideas on what things we could further be doing to make sure that this doesn't happen, that we don't end up with these counterfeit parts from Communist China?

Mr. PELLICANE. Yes, that is where, again, I will point to that Secure E-Waste Export and Recycling Act that was introduced in the House, and obviously continuing to follow that legislation as it moves forward.

Senator RICKETTS. OK.

Do any of our other witnesses have any thoughts on what we can do to prevent this?

Yes, please go ahead.

Mr. BOSWELL. Yes. So counterfeit parts are an issue. I actually come from the defense electronics background, used to be on the Harpoon Missile Program. So obviously we were very sensitive to the high quality of our parts.

I will say that with the growing complexity of integrated circuits, in my company we try to recover parts for repair and recycling. And it is very, very difficult, re-balling a ball grid array takes extremely difficult procedures. We have actually found it is better to just go buy new parts than to try to recover the parts.

I think what you will see in China is a lot of those counterfeit parts are really commercial grade parts made at poor facilities that are remarked because it is just too expensive to take these parts and actually get them to new condition. It is a significant challenge to do that.

Hopefully in the future, we will get better at recovering ICs, because it would actually be much more sustainable. To combat that, at least, when I was in the defense business, 100 percent testing on parts was something that we required.

Senator RICKETTS. Yes, because if you are trying to refurbish these things and it is not in a super clean room, it is just a small particle of dust can—

Mr. BOSWELL. Even worse is on a ball grid array, the connections are so close together, and you have to get those each re-balled. And it is a very, very difficult and expensive process.

Senator RICKETTS. So I take it when you say that you are asking for all these parts to 100 percent testing of the parts, that is now happening for some of these parts that are going into some of these advanced systems in the Defense Department?

Mr. BOSWELL. One hundred percent testing would, and again, I am no expert, and I can provide you more information at a later time, but 100 percent testing, at least in our situation, and this is a few years back, would reveal the difference between a commercial and a defense grade part.

Senator RICKETTS. But is it accurate to say that if the Defense Department was having a problem with this thing, they were not doing 100 percent testing?

Mr. BOSWELL. I can't answer that question.

Senator RICKETTS. Thank you, Mr. Chairman.

Senator CARPER. You bet.

We have been joined by one of the two retired Navy captains who serve on this Committee. We have a Marine colonel over here.

Mark, we have just been talking about, Mr. Boswell has been talking about the Harpoon Missile Program, which apparently you were a part of. When I was in P3 aircraft mission command, we used to carry Harpoons. So that brought a smile to my face.

All right, Mark, welcome. Thanks.

Senator KELLY. We could carry them on the A-6 Intruder that I used to fly. Actually carried one, I never had an opportunity to shoot it.

Thank you, Mr. Chairman.

I want to address our domestic source of critical minerals. Securing them is incredibly important. It is not just to support growing domestic industries like battery manufacturing, but also for our national and economic security, and our foreign adversaries, China and Russia, control the vast majority of certain critical mineral supply chains. And we have seen in recent months that they are willing to utilize that control to apply pressure on us.

For example, earlier this month, China announced that it would restrict the export of gallium and germanium products to the United States. This is a critical mineral used in microchips, in defense systems, and renewable energy systems. This is just one example of a critical mineral that is controlled by our adversaries.

So I am glad we have an opportunity to dive into this hearing today to discuss one strategy that we have to reduce our reliance on supply chains which need to cross an ocean. And that is reusing critical minerals from existing devices.

In fact, about a month or so ago, a couple months ago, I had the opportunity to visit with the Secretary of Energy, Secretary Granholm, one of Li-Cycle's recycling spokes. This factory, I would call it, or facility, is located in Gilbert, Arizona.

I am glad that Mr. Kochhar is able to join us today and share more about his work and what the company is doing in Arizona and across the country to recapture and reuse critical minerals in batteries and other devices. It is pretty fascinating, what you are able to do.

And if scaled up, this process can be a win-win for our country. These companies will create great paying manufacturing jobs here at home, and they will reduce our dependence on critical minerals from abroad, and help us scale up our renewable energy economy.

Mr. Kochhar, it is good to see you again. Can you start off by discussing how much e-waste will be disposed of in the coming years? Do we have the capacity in the United States right now to recapture and reuse all these materials?

Mr. KOCHHAR. Thanks, Senator. The short answer is no, we don't have enough capacity to deal with these materials domestically. In fact, I often get asked, who is your biggest competition? Well, our biggest competition is actually shipment to Asia. People ask about company names; it is really that.

We have a lot of groups that are brokering, trading these materials, leaking it from the United States. I think an objective should be that if we make it here, we should use it here and recycle it here. I think that would be a way to keep these critical materials in the supply chain.

Now, what is the gap? The gap is around domestic solutions, to actually do that economically. So that is what we are doing. But also recovering things like lithium, which is what we focus on, a lot of the value.

So just some stats quickly. This year, probably 100,000 tons of batteries alone, lithium-ion batteries alone in the United States need recycled. Our capacity today as a country is probably 30,000 tons. So it is far from the mark, and it is growing very fast every year.

Senator KELLY. It was a fascinating visit. They chop up these batteries, and they have processes that pull out not only the lithium, but the cobalt sulfite, the nickel sulfite, magnesium carbonate, and other materials, and then just sell them to manufacturers of batteries. It is really a win for everybody.

Have companies like yours benefited from the Bipartisan Infrastructure Law and the Inflation Reduction Act?

Mr. KOCHHAR. Tremendously benefited. I thank Congress for the work that has been done, and the Senate. We have seen a big acceleration in terms of the demand for these materials, and actual domestic activity. One of our challenges has been, how do we get it back into the supply chain here, our downstream? If it is not there, they are going to be shipping it overseas. So that has been great.

As I mentioned in my remarks, we have a \$375 million loan commitment from the DOE, which we are very appreciative of. We are already doing it, but this just helps to accelerate what we are doing.

Senator KELLY. And that loan guarantee is helping you scale the company?

Mr. KOCHHAR. Yes, that is our facility in Rochester, which is where we will extract that lithium, nickel, cobalt, which is the key part of what we are doing.

Senator KELLY. Any additional steps that you think Congress should be focused on to ensure that e-waste which can be recycled does not end up in a landfill?

Mr. KOCHHAR. Yes. I think what I said regarding leakage of material to Asia is something that needs to be looked at. It is kind of a hidden thing happening. It needs companies to step forward and actually build, like we are doing. But there are policy initiatives that could help around that. And there is a range of things we are going to have to support there in terms of being a resource.

Senator KELLY. Thank you for being here today, and thank you, Mr. Chairman.

Senator CARPER. Senator Kelly, thank you for being here today and for adding to this hearing.

Senator Sullivan, welcome. We are glad you are here.

Senator SULLIVAN. Thank you, Mr. Chairman. I appreciate the witnesses here.

I want to begin with a basic question. I think it is one that increasingly everybody is coming to an agreement on, which is if we have critical minerals in the United States that we should try to mine them and process them here as opposed to relying on China. Is that generally agreement? I see everybody nodding their heads.

Then part of that is because we have the highest standards on the environment in the world, certainly in Alaska we do. It is a never ending source of frustration despite that kind of broad based policy consensus, Biden administration in so many areas in my State at least, when they see critical minerals or mining opportunities, they shut them down. You guys don't have to comment on that.

I am meeting with the BLM director in my office tomorrow. She and Secretary Haaland have just been targeting Alaska incessantly. It is unbelievable. We have a place called the Ambler Mining District, copper, cobalt, zinc, silver, gold, other metals, probably the biggest, one of the biggest mining deposits on the planet Earth. We did an EIS during the Obama administration, into the Trump administration, got a record of decision, 6 years, \$10 million, I think it was.

Same day the President of the United States holds a critical mineral summit at the White House on the importance of critical minerals, the Department of Interior reverses the record of decision and tells Alaskans to start over. So I am going to have a little discussion with Tracy Stone-Manning in my office tomorrow saying, this is nuts, nuts. This is just a pro-China, anti-environment, anti-American policy. That is what they are doing. Anti-environment, because China trashes our environment. Alaska has the highest standards in the world.

Anyway, I just had to rant about that, because it is just crazy, crushing jobs in my State. And it is driven by the radical left. So Tracy Stone-Manning and I are going to have a nice chat about that tomorrow.

But let me go back to this other issue, friend shoring not only the production of critical minerals, but the electronic waste recycling and reuse, especially given some of the security concerns.

I will just open this up to all the witnesses. How do we do that better? In the electronic waste recycling, if we can't do it all here, and I agree with that previous comment, that we are doing that within the collection of our strong allies, and yes, making sure China is not in that loop, because then we become vulnerable.

What is the best way to do that? And I am assuming everybody on the panel of witnesses agrees with the importance of doing that.

Mr. Kochhar, we will start with you and then just go down the line.

Mr. KOCHHAR. Yes, I think there are two sides to it. I think on the corporate side, company side, we need innovation. We started our company 7 years ago, because we didn't see a path for recycling lithium. And as Senator Kelly mentioned, we also get nickel and cobalt kinds of things, too.

So it is a long journey. It is not easy.

Senator SULLIVAN. Are you taking those supplies all over the world?

Mr. KOCHHAR. It is interesting. The batteries are everywhere, so we basically get them locally, from where we are. We are in New York, Alabama, Arizona, so we get them locally from around that area. Also, the making of battery kicks off scrap. So I think a big part of it is what do companies need to do to step forward.

On the policy side, I think some of the steps that have been taken are very helpful to incentivize. But there are aspects, as I mentioned, around leakage of material that need to be looked at. It is not just in batteries, it is in e-waste, it is in other industries. We have to be practical about it, you can't stifle companies at the same time, that is difficult. But that is a big threat. We have seen it in our industry, 90 percent plus of lithium, nickel, cobalt, all heading through China.

So we need to build it here. That is a corporate responsibility. But there needs to be the right policy environment to help support that.

Senator SULLIVAN. OK, good.

Mr. Boswell.

Mr. BOSWELL. I agree that there is a tremendous—well, let me step back 1 minute for Senator Ricketts. I misspoke. It is required to be 100 percent test, according to the 2012 NDAA. That was one of the reasons to do that, to protect against that problem.

But yes, this is a global industry, and there are global supply chains involved. But we are developing a tremendous infrastructure here in the United States to recycle and reuse these products. Companies like mine are constantly looking for new ways to make that path easier for consumers.

One of the things I think there is a lack of understanding of is that this is done at a very high level and very technically. I think

the historic impression of our industry was that they are a junk guy. And we are not junk guys.

In fact, in some ways what we do is far more technical than the manufacturers, because we have to handle everything from an Apple iPhone to a Cisco router. We have done that by tremendous investment in technologies to not only erase these products, but also to refurb them.

We do come up against issues sometimes with the manufacturers where they don't support the reuse market. A lot of the economics of electronics recycling is based on reuse. An item like an iPhone is worth 15, 20, 30 times more, 100 times more in some cases as a reusable product than it is a recycled product for the material recovery.

So the economics of reusing it support much of what we do.

Senator SULLIVAN. OK, thank you.

Mr. Chairman, I just have two other witnesses, if they can just quickly respond to that question. I am over my time.

Senator CARPER. Go ahead.

Ms. McILROY. I will go quickly.

Senator CARPER. Take your time.

Ms. McILROY. Really, there is a vast network of underutilized collection sites in the country right now. Local governments are collecting the majority of municipal electronic waste. And a lot of that, if they don't have the local budget to support it, it is going to end up in their landfill.

So if we were able to get a sustainable source of funding to them, you would see an exponential increase in what we would be capturing nationally. I think that is really important to focus on.

Senator SULLIVAN. Good, thank you.

Mr. Pellicane.

Mr. PELLICANE. I agree with my peers on continuing to drive private and public partnership, to drive awareness of the issue and to also create the collection and processing infrastructure. Ultimately really deferring to the EPA's sustainable materials management approach, use materials in the most productive way with an emphasis on using less, reducing toxic chemicals and environmental impacts throughout the material life cycle, and assuring that we also have sufficient resources to meet today's needs and those of the future.

Senator SULLIVAN. Great.

Thank you, Mr. Chairman.

Senator CARPER. You bet. Thanks so much for being here.

I understand that you and Senator Whitehouse are partnering on some of the aspects of what we are talking about here today. That is good.

Senator SULLIVAN. Yes, sir, I am continuing to do that with him.

Senator CARPER. Great. Thanks.

Mr. Kochhar, your name has been pronounced several ways today, what do your parents call themselves?

Mr. KOCHHAR. You got it, sir.

Senator CARPER. All right, thank you. Are your parents still alive?

Mr. KOCHHAR. Yes, they are.

Senator CARPER. When you are asked, does your mom ever say, what do you really do? When she says that, what do you tell her?
[Laughter.]

Mr. KOCHHAR. Yes, I think they are still trying to figure it out, from what I can tell.

[Laughter.]

Senator CARPER. I will tell her you are doing something good for the country.

Mr. KOCHHAR. We hope.

Senator CARPER. And for the planet, I think.

In your testimony, you mentioned industry's need for clear and consistent regulations that govern the movement of batteries and recovered materials to and from battery recycling facilities. That interstate movement of materials is predominantly regulated by provisions in the Resource Conservation and Recovery Act, affectionately known as RCRA around here, which governs the disposal of solid and hazardous waste.

Given the technological advancements that have occurred in I think about a half-century since RCRA was enacted into law, as well as the development of new industries such as lithium-ion battery recycling, do you feel that existing Federal laws currently provide the direction that Li-Cycle needs to operate domestically?

Mr. KOCHHAR. Yes, I think with any growing industry, you are going to have a whole host of emerging issues. I think that is what we are experiencing in not only e-waste and the substantive e-waste being lithium-ion batteries, and also of course in EVs. There are some very practical things, how do you move these materials, what are they classified as. We take in battery input of all types, everything from small batteries in your phone to battery manufacturing scrap. And then we make these intermediate products that Senator Kelly was talking about that he has seen, which contains the cathode, the anode from the material, the copper, the aluminum.

So we make our way through. But as you can imagine, and I just alluded to, these regulations were written for a very different world. This innovation had not happened at the time.

So I think there are some known areas that need clarification. We support regulatory clarification around this. It will help the industry to scale and address this issue of e-waste. We are happy to be a resource as you folks look at that.

Senator CARPER. A follow up question, and I think I may have answers already. What clarifications or updates to existing statutes would help create a reliable environment for private investments and job creation in the recycling sector? I think you may have responded; you have already spoken to that. Anything else you want to add?

Mr. KOCHHAR. Yes, I think it is really around the classification of what is a waste, what is a product, what does it derive from. Within waste, there are different classifications. These are very valuable materials. I quoted there very quickly before, \$4,000 an EV battery that can be recovered through the materials. These are valuable, critical material resources. They are richer than any mine, and they are available above ground.

So that is the area that needs a lot of clarification. We support getting some added regulatory certainty around that.

Senator CARPER. Good. Thank you.

Mr. KOCHHAR. Thank you.

Senator CARPER. Ms. Kitty, I was surfing on television last night, getting ready to go to bed. Before I went to bed, I thought I would look for some news on television. As I went along, I came across a rerun of a show called Gunsmoke, which Senator Capito is too young to remember. But as recently as last night, I heard your name. And how ironic is that, now I hear Harpoon Missiles, going back in time.

Senator Capito, would you like to jump in? You are welcome, and I have some more questions. Feel free.

Senator CAPITO. Yes, I just have one issue. I talked about it in my opening statement, that is the potential for fire with the lithium-ion batteries.

Ms. McIlroy, how are you all handling that in Maryland? Then I will ask everybody else if they have some suggestions here.

Ms. MCILROY. I think there are a couple of ways to answer that. Right now, I think local governments are in sort of a reactive position. I know they have taken measures to do, for example, site checks of their electronics that are stored on their collection sites at the end of each day, just to ensure that something hasn't short circuited to cause that fire.

What I have heard is sometimes maybe more often at some sites than others. Others, they will leave for the day and the fire will start slowly, then they will see video footage of overnight fire that has spread from electronics.

That is more of an incident when it is sitting in a stored container. But I think the biggest issue is when these electronics are being put in the waste stream by residents, and they are being compacted on the tipping floor, when the trash truck unloads.

Right now, they are mainly just having to react to that. They are told to have fire departments basically on call. Some sites are training their employees to use the fire extinguishers that are on site. Some are told to wait because of the potential chemical concerns, to wait for the actual fire department. So I think it is kind of all over the place with how people are reacting to this.

I had another point, but it slipped my mind. So I will end with that.

Senator CAPITO. Mr. Kochhar, you said in either your testimony or your response that you have a different method for preventing the fire. I guess water is not what you put on a lithium battery fire. How would you respond to that, and how do we eliminate that risk?

Mr. KOCHHAR. I think there are a couple of areas. Particularly in e-waste, it is really hard, because the batteries are embedded in the devices. I think of old Nokia phones, you could take the battery out. You can't do that anymore, it is waterproof almost in some ways, usually.

So that is the first step, and companies like Mr. Boswell's have to deal with that. Then we get the lithium-ion battery feed.

Now, the way we shred is under immersion of a liquid. This part of it we have patented, but it basically prevents fire. But we know

what we are getting, we are set up to handle this material. But in other cases, they are not. That is where the issue arises, if is you don't know, then you have the potential for fire.

Senator CAPITO. Mr. Boswell, do you have a response to the fire potential?

Mr. BOSWELL. Yes, I think the point he makes is valid. Companies in this industry that have had to deal with this problem, we are making a lot of strides in doing this safely, investing in training. ISRI provides training on how to handle batteries safely. Our companies themselves, we make a focus on how our employees should handle them safely.

The biggest issue is when they get into a stream other than to an e-waste processor. I think is some of the education funds that were out there, and infrastructure for recycling, it would be well served to help educate the public on the difference between the electronics recycling stream and the municipal recycling stream.

Senator CAPITO. Right.

Mr. Pellicane, do you have a comment?

Mr. PELLICANE. Yes, to just echo the sentiments of my colleague, Craig. As a non-profit refurbisher, we follow all local ordinances as well as industry best practices. But as Craig speaks to the issues, of course, when our employees that are trained, or employees like HOBI's organization that are trained are handling those. So really investing in that public awareness that Craig spoke to.

Also the infrastructure that Kitty spoke to, to be able to handle those things within municipalities.

Senator CAPITO. I would like to thank all of you. I am going to admit, when we had the topic of our hearing, I thought, is this going to be very interesting? And you know, it is very interesting. Because it really impacts everybody at every level, here in government, obviously, but in our garages and our closets and other places.

It is only going to get worse. I think the economic model has got to be there. I like the idea of a lot more reuse rather than just removing it and disposing of it. Because that is never going to get any better, either. And it is just going to accumulate.

Any way we can be supportive, I will take your suggestions.

Mr. Kochhar, you lined out some really interesting ones, and Mr. Boswell got into the trade issue, which sounds like an enormous issue and could be quite painful to fix as well.

I want to thank you all very much. I appreciate it. Thanks for coming in.

Senator CARPER. I think this is a wonderful hearing. We have a lot going on in the Senate, the committees and so forth. So members are pulled in a lot of different directions today. I love this hearing. I am delighted that you are all here participating.

Senator Capito and I work on a bunch of stuff together. And this is going to be a great one. So thank you.

If I could, a question for Ms. McIlroy, please. It deals with municipal programs, which you talked a little bit about already. You mentioned in your testimony that consumers predominantly dispose of electronics at municipal drop off sites. My question is, what is the benefit of having municipal programs collect electronics for

recycling, and how do municipal programs compare to manufacturers' take back programs?

Ms. McILROY. The benefits of it are that local government is already doing the majority of this collection and contracting for recyclers. So they already have the expertise, it is pretty streamlined at this point. It is just whether or not they have the funding to do it.

Another benefit is because the general public is already, I would say, well trained. They know to look up their jurisdiction's program if they have an end of life electronic that they need to get rid of. Trying to retrain the public to look on a manufacturer's website to find the specific information for that one device that they need to get rid of, I don't think that is realistic. That again would put a burden on local government employees, because they would still have to be training the public on that.

Either way, they would still have to be heavily involved, and it would take a lot of their time to still continue the management of electronics, whether or not it is actually ending up at their site. There would still be a big component that they would have to do public education wise.

From my perspective, I would feel uncomfortable not having the ability to do due diligence when I am contracting, doing a procurement for a recycler. If that is left to just manufacturers and the public isn't really involved in the procurement process, reviewing the financials, the certifications, going on site to these recyclers and seeing it in person and having the ability to audit and look at their downstream recycler's information, I don't think that would be a good trend to move toward. Because I don't know how much control public entities would have at that point if the programs are just manufacturer run.

Senator CARPER. Should we require manufacturers to pay into municipal collection programs?

Ms. McILROY. My personal opinion is yes. Within the Maryland Recycling Network, we are looking at, with some local elected officials, updating the current Maryland law to potentially do some sort of hybrid manufacturer funded model with potentially a consumer fee. Those are existing laws in other States that run on both of those models. We are looking at maybe updating what is in Maryland to see if we could do a blend of that, to basically take the financial pressure off of local government and put that burden on manufacturers and consumers.

Senator CARPER. I am going to go back to the first question I asked, Ms. McIlroy. I am going to repeat it and ask other witnesses if they would like to make a comment as well.

What is the benefit of having municipal programs collect electronics for recycling? And the second half is, how do municipal programs compare to manufacturers' take back programs? Do you have any thoughts on that? If you do, fine, if you don't, that's OK.

Mr. BOSWELL. I can say that creating avenues for consumers to do this conveniently is very important. You can look at the parallels, for instance, for the rechargeable batteries. Rechargeable batteries have multiple collection points, every Home Depot store, every Lowe's store is a place you can bring back a rechargeable battery, as well as a lot of municipal recycling alternatives.

So those multiple pronged approaches give consumers the most options possible. I think the issue you run into when you look at manufacturer funding is, we have run into situations, especially in electronics, there is probably more EPR in electronics than anything else in this country. We have seen some disastrous effects of that as there was no producer responsibility organizations that involved recyclers, that looked at what is a reasonable fee, what should this reasonably cost, rather than driving to the lowest cost alternative, which ended up creating CRT stockpiles in almost every State. Because the lowest cost alternative was the guy who said, I will take them, I will take whatever you pay me per pound, I will stick them in a warehouse, and I will figure it out later. That created a bigger problem than we had in the first place.

Senator CARPER. OK.

Senator Capito, I have a couple more questions, but why don't you go ahead?

Senator CAPITO. I have completed my questions, thank you.

Senator CARPER. All right, thanks.

I have a question for Mr. Boswell on the Basel Convention. I know you are aware that the United States is I think the only developed country not a party to the Basel Convention, a national agreement that governs the transportation of hazardous waste between nations.

How has the United States' failure to ratify the Basel Convention impacted the electronics recycling industry over the last 20 or 30 years? Also, how will the United States be affected by the new Swiss-Ghana amendment to the Basel Convention, which establishes new definitions for hazardous and non-hazardous electronic waste?

Mr. BOSWELL. This is the looming problem, the guillotine that is over the industry's head right now. January 1st, 2025, when Swiss-Ghana comes into effect, us being a non-party to the convention, we will essentially have only one trade partner outside of the U.S., and that will be Canada, because we do have a bilateral in place with Canada right now.

Hopefully we will get an agreement in place with OECD before that date. But this is a global market. The example I always like to use is, we do a lot of phones. Apple phones are dominant in the U.S., so everybody wants an Apple phone here. Android phones are much more popular in the rest of the world. I can get 22 percent more for a Google Pixel in the Middle East and Europe than I can in the U.S.

Come 2025, if that Google Pixel maybe has a cracked screen or something else that they would lump it in now, under Basel, if you drop your phone, it is now a hazardous material, because you cracked the screen. We would not be able to participate in those markets.

So I think in the short term, because it is coming so quickly, we would support bilaterals with key partners, trade partners and the OECD change would make a big change. But in the long term, yes, it looms as a problem for the industry.

Senator CARPER. I think my last question will be a question for the entire panel, for all four of you. And again, I think I speak for Senator Capito and my other colleagues as well on our Committee.

We have really enjoyed this conversation, and welcomed this conversation about the good work that all of you are doing to address what is a really critical issue of electronic waste. But a promising issue as well.

I am encouraged to hear from the four of you who are as committed to this issue, frankly, as we are. We appreciate your work to make sure that we leave behind a planet that is not just as good as, but maybe even better than the one we inherited from our parents and grandparents.

I want to give each of you the opportunity to share with us maybe two or three key actions that you think Congress should consider to improve electronics circularity, shore up our domestic supply of critical minerals, and address the link between reuse and providing access to digital products that fuel modern life.

Let me say that again. I want to ask each of you to share with us two or three key actions that Congress should consider to improve electronics circularity, shore up our domestic supply of critical minerals, and address the link between reuse and providing access to digital products that fuel modern life.

Mr. Pellicane, would you like to go first?

Mr. PELLICANE. Thank you.

As I mentioned in my testimony and as Senator Capito spoke to as well, there is a lack of awareness, there is poor collection infrastructure, and there is national security concerns all tied into this issue of e-waste. So really, those three areas are the key actions we can take to address it. It is funding public education to raise awareness on the importance of reducing e-waste.

As we have spoken to here today, nearly everyone has that old drawer or box on the shelf in the garage with a stack of broken laptops or a bunch of old cell phones. That is an indicator of a broken system. So informing people of the methodology to do that, and ensuring that that is out there is important.

Additionally, recently the Broadband Equity Access and Deployment and Digital Equity Act were passed. And that implementation of broadband infrastructure is going to lead to a huge increase in demand for free and affordable devices. There has never been a more critical time to open up new pipelines of devices for low income people to obtain and benefit from.

We can do that by raising awareness and increasing our infrastructure around collecting and reusing those devices. We can't think that just because we put that broadband infrastructure out there that people will access it. We need to give them the capability to do that with devices, Internet assistance, technical support, and digital literacy.

Additionally, Congress can pass policies, as we spoke about, to create a more circular economy, such as extended producer responsibility and the right to repair, really recognizing that the establishment of effective e-waste collection mechanisms includes the collection and processing of e-waste is critical, and that that infrastructure is different than your typical recycling infrastructure.

As we spoke about here today, making devices more easily refurbishable in general, and ensuring that any right to repair legislation includes non-profit organizations as well.

Finally, we spoke today about supporting domestic markets by keeping resources local through implementing legislation like the Secure E-Waste Exports and Recycling Act, and also the COVS Act. Really, there is that national security importance that we need to recognize, and that there is an ability to create jobs through the proper collection of those items while at the same time reducing our dependence on imported minerals.

Senator CARPER. That is a pretty good to do list. One of the things I look for is repetition. Sometimes people say, well, I don't want to repeat something someone has already said. Repetition is good, especially in a setting like this. So feel free to repeat if you would like.

Ms. McIlroy.

Ms. MCILROY. I am going to second the exploring the EPR policies. Specifically, I really do think that we could be successful with a Senate or Congress led work group to look at our high performing State laws in this country. I would say there aren't that many of them, but there are some that stand out.

Senator CARPER. Like find out what works, do more of that? Learn from mistakes, laboratories of democracy.

Ms. MCILROY. Yes. And I think we want to make sure, as was mentioned earlier, we do not want to leave recyclers out of the conversation. I know that there are some States on the East Coast where I have talked to recyclers that were struggling when their programs were supposed to be funded by State laws, but didn't end up happening in reality, and they were left holding the bag, or local government was.

So I think there are some really good models out there, and I think as long as everybody is involved, we could probably come up with a good solution.

Senator CARPER. Thank you.

Mr. Boswell.

Mr. BOSWELL. I certainly want to echo education. I think there is a lot of room here, and it needs to go beyond just hey, these products are recyclable. I think one of the fallacies, we have mentioned it countless times here, is that people believe their data is safer in their drawer than with my company. I can tell you, in your drawer, somebody would say, wow, that is \$75 on eBay, your 14 year old takes it, sells it on eBay, and your data is gone.

You send it to us, and within days, maybe even hours, that data is really gone. Because when we erase it, it is gone from everywhere. It is non-recoverable.

I think a second thing, it is important that we understand that these products, and we say e-waste, but this is not waste. These are products that can be reused. These are valuable, critical materials that we can recover from the products. So we sometimes use that waste moniker and we put a burden on the industry around that moniker that makes it more cumbersome and costly for us to move these materials.

Finally, the trade is going to be a huge issue. Our solutions for companies here in the U.S. to still participate in the global market are very, very important for the industry.

Senator CARPER. Thank you for that.

Mr. KOCHHAR. In the spirit of keeping it to repetition, I will repeat the top three from my recommendations. First, I think there needs to be an assessment of this leakage issue that I talked about around, not only batteries but also e-waste, in the spirit of making it here, using it here and recycling it here, that is No. 1.

No. 2 is around regulatory clarity on the movement of batteries, materials, the intermediate products. Again, it is a new industry. So that will take some public-private conversation to figure that out.

The third would be considering steps that other jurisdictions have taken, such as minimum recycled content in new batteries. It needs to be adjudicated well that it is not overly ambitious, but you can get to a path where it creates an incentive to get there.

Thank you very much.

Senator CARPER. Before we close out, Senator Capito, any last thoughts?

Senator CAPITO. No, I just want to express again my gratitude for you all for being here today, to continue our work. Thank you.

Senator CARPER. In closing, let me thank each of you for joining us today, for appearing and for your testimony. I also want to thank you for what you do with your lives. We want to thank you for what you do with your lives. There are some people out in the audience sitting behind you that I would like to thank as well for what they are doing in this important effort.

I believe we have had an important and I think an inspiring discussion today about the impacts of electronic waste and the role that recycling is playing and can play in shoring up our domestic supply of critical materials and minerals.

Before we adjourn, a little bit of housekeeping. Senators will be allowed to submit questions for the record through the close of business on Wednesday, August 9th. We will compile those questions and send them to each of you and ask you to reply by Wednesday, August 23rd.

Additionally, the hearing record will remain open until August 23rd for anyone who wants to submit materials pertinent to this hearing topic.

I don't know if Dr. Einstein is tuned in today and is watching this hearing, but if he is, he must be thinking, in adversity lies opportunity. He was right then, and he is right today. There is lots of adversity amidst plenty of opportunity here. It is up to all of us to seize the day. Carpe diem.

Thank you so much. With that, we are adjourned.

[Whereupon, at 11:37 a.m., the hearing was adjourned.]

