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AMP Robotics
Recycling Reimagined

Featuring Carling Spelhaug,
Senior Communications Manager at AMP Robotics

Carling Spelhaug, Senior PR and Marketing Communications Manager at AMP Robotics, talks about how robotics can be used for recycling with moderator McKenna Avery from Climate Transformed.

Takeaways

- AMP Robotics applies AI-powered automation to economically and sustainably improve our global recycling system.
- They use artificial intelligence (AI) to identify and recover recyclables with rates of speed and precision previously unknown to the industry.
- AI enables economic improvements via retrofits within today's waste management infrastructure. The industry is adopting AMP's technology at a rapid pace.
- They are applying its technology to expand new infrastructure to turn once-considered contamination into new material markets.
- The company has just raised \$91 million in its Series C round.



Background

- Billions of dollars a year are lost to landfill due to the inability to recover materials.
- AMP's mission is to enable a world without waste, and they believe the evolving technology has the potential to do that.
- AMP is driving down the cost of recycling and significantly increasing the volume of recycled feedstock.
- They do this by deploying their technology into existing recycling facilities and by operating their technology and infrastructure in their own facilities.
- They ensure the safety of employees while deploying their systems in the existing facilities.

About AMP

- Founded in 2014, AMP is headquartered in Colorado. Currently, they have approximately three hundred employees with four facilities.
- They have deployed nearly three hundred systems across continents and in over twenty-five states of the US.
- AMP has attracted top global investment firms and raised \$170 million to scale their operations and retrofit existing facilities.
- AMP deploys its systems to sort and recycle paper, plastic, metals, construction & demolition waste, electronic scrap, and organic waste.

AMP Impact Statistics

- AMP operates in eighty material recovery facilities, including Materials Recovery Facilities (MRF) and Plastic Recovery Facilities (PRF).
- Their AI system recognizes 50B objects on an annual basis.

Material Recovery Industry Challenges

- Materials produced by billions of people have a high sortation cost, with enormous capacity limitations.
- Materials get contaminated.
- There is a chronic labor shortage with significant staff turnover
- Personal injury risk is high

What Does AI Do for Recycling?

- The AMP Neuron is an AI platform that uses deep learning to train continuously by processing millions of material images into data.
- AMP has the world's largest recycling data set.
- AMP Neuron identifies close to 6.6B items and recycles nearly 215M items monthly.
- This software uses pattern recognition of colors, textures, shapes, sizes, and logos to infer in real-time the recyclable materials and contaminants in sortation environments.
- AMP Neuron identifies and sorts materials based on form factor, color, grade, polymer type, food contact, and non-contact.
- It sorts items into hundreds of categories and sub-categories of paper, plastic, metals, and other materials.
- It is capable of tracing down to the Consumer Packaged Goods (CPG) brand owner.

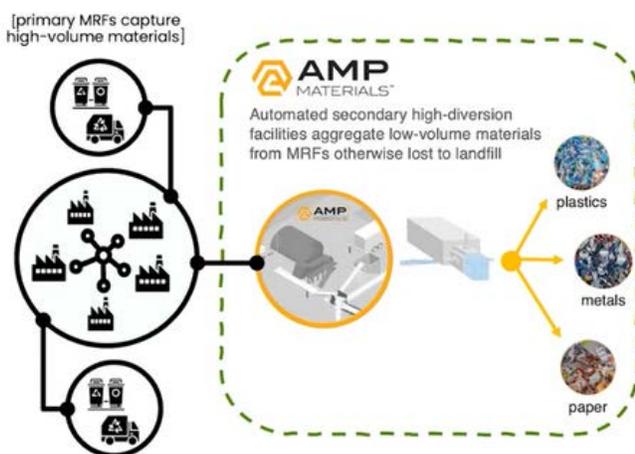
Applying AI and Data to Increase High-Quality Material Feedstock

- AMP's flagship product is AMP Cortex, a high-speed robotic sorting system guided by AMP's groundbreaking AI technology.
- Their robots intelligently perform physical tasks of sorting, picking, and placing material to achieve up to 99% accuracy and up to 80 picks per minute.
- The system has three components: the eyes, the brain, and the arms.
- The eye component is a camera that records the material to be picked and sorted.
- The brain component is AI. AMP digitizes the material stream via AI and computer vision-enabled robotics to identify and sort materials at superhuman speed with pinpoint accuracy.
- This software guides the robotic arms to pick and place the material for recycling.
- AMP retains real-time data on what is and isn't recovered, validating compliance with material value and quality for reclaimers and mills.
- As AMP deploys its system, the industry leverages hundreds of units' network intelligence. This network effect increases sorting intelligence. If a challenging object or a new material is identified, we train the AI to detect the identified objects in the future.



AMP's Products

- AMP Cortex™: This is a high-speed robotic sorting system guided by AMP's groundbreaking AI technology. Their robots intelligently perform physical tasks of sorting, picking, and placing material to achieve up to 99% accuracy and up to 80 picks per minute.
- AMP Vision: This is a modular computer vision system that captures material recovery data in real-time. It identifies material composition at different process stages. This system helps validate outgoing bale quality for MRFs and incoming bale quality for plastic processors.
- AMP Clarity: This is a web portal for near real-time recycling data and insights driven by a modular computer vision system. This solution is designed to help customers better understand the facility at any point in time, track variation of materials, helps in the validation of the material quality and pre-bale specs, and provides the basis for real-time audits and recovery metrics.



AMP Materials

- AMP is building and operating next-generation automated high-diversion facilities.
- Their portfolio includes paper, plastic, and metals, with a high focus on plastics.
- They resell these commodities, including bespoke chemicals and polymers, to processors, end-market buyers, and manufacturers.
- With their technology, AMP recovers low-volume, and hard-to-recycle materials.
- The application of AI for material identification and advanced automation has now matured to the point that it has become feasible to develop secondary sortation facilities that are economical to deploy as well as sustained naturally.
- From primary MRFs that capture high-volume materials, automated secondary high-diversion facilities aggregate low-volume materials from MRFs that would have otherwise been lost to landfills.
- AMP recovers up to 90% of recyclable materials from this aggregate and upgrades low-quality materials to high-quality feedstock.
- AMP's AI identifies and sorts plastics with high levels of specificity.
- They produce economically sustainable volumes of recycled material types and form factors that were previously not possible.
- They create new value streams and develop new material markets.
- They ensure chemical-compliant bales, custom blends for plastics reclaimers, and advanced recycling processes like chemical recycling, gasification, or pyrolysis.

"Our application of AI for material identification and advanced automation has now matured to the point that it has become feasible to develop the secondary facilities that are economical to deploy as well as sustained naturally." – Carling Spelhaug

Questions & Answers

Can you talk about the domestic outlets in the market?

We don't help our customers find their market. We buy materials, sort them, and upgrade the quality of our materials business. We are exposed to commodity prices. Right now, material prices are down, and we have to figure out how to fetch the highest prices. We can't control the commodity markets, but we can produce the highest possible quality.

How much does a robot cost, and how much can a facility save by using a robot instead of hundreds of employees?

We usually don't quote costs directly. Our technology can help facilities save up to 70% of labor costs within two to three years.

Do you work with government-owned or privately-owned facilities?

We work with customers across the spectrum, from giant national players to regional independently-owned facilities. We also have municipal customers. We try to be as flexible as possible to make the technology accessible to recycling facilities.

Do you need human labor along with the robot?

It depends on where our customers use it. In some areas, we still need humans to eliminate obvious contaminants.

What percent of items in the stream can be considered contaminants?

Recycling programs vary across the US. Generally, 25% to 30% of items can be considered contaminants.

Discuss the funding environment for recycling technology.

The market potential is enormous. We see our latest investment as a solid validation of the role of advanced technology. The private investors understand the importance of increasing the recovery rate of materials, scaling landfill diversion, and overall more sustainable materials management. Due to high market potential, it is easier to get investments.

Do you see AMP as a comprehensive solution to landfills, or could there be more extraction in places with no recycling infrastructure built in?

Right now, it is cheaper to landfill things than to recycle. Recycling can become a really attractive business if we reduce the cost of sorting materials. There are no limitations to using AMP technology for sorting materials in any waste stream.

How would you compare your solution to TOMRA (alternative recycling process)?

TOMRA offers a broad range of recycling technology solutions, with robots being one of them. Our focus is specifically on robotics.

Questions & Answers

Can you give an overview of AMP's recycling facilities in different regions?

Most of our deployments are in the US; some are in Canada, Europe, and Japan. European countries tend to have higher recycling rates, less landfill space, and different collection schemes. Member states in Europe have agreed to a 90% of collection target for plastic bottles by 2029. Plastic bottles must contain at least 25% recycled content by 2025 and 30% by 2030.

In the US, California is leading the way; they require a post-consumer plastic recycle content standard of 15%, which will be increased to 25% by 2025. There is a lot of confusion on the consumer side regarding what and where they can recycle. Different regions have different policies regarding waste management.

There is a lot of variability regarding how recycling is handled. Consumer behavior and norms play a huge role in that. Hopefully, we will eradicate this element by using technology.

Do you think we should shift towards the European model of separating waste on the front end?

Mingling material should not be an issue if we broaden the use of technology. It can be hard to change consumer behavior, so we need to upgrade our tech.

Can your technology be downsized?

The AMP Cortex robot is a ten-by-ten steel frame robot. We are working on different robot configurations that might work in smaller facilities, as space can be a limiting factor in adopting this technology.

What are some obstacles to scaling, and what goals do you want to achieve?

I don't think we have obstacles other than time and money. Our recent funding is helpful. We are heading into a difficult macroeconomic environment, and we see AI having the potential to be a player anywhere in the recycling space.

What is your perspective on the recycling process and how it relates to emissions?

We ensure to locate our facilities in proximity to our customers, people we buy residue from or sell it to. We have a mission to scale that part of the business in a geographical location where we can balance the benefits of recycling while minimizing environmental risks. We feel confident that we have a positive impact regarding what we help the industry to recycle. This technology has saved nearly 5 M tonnes of greenhouse gas emissions, equivalent to removing 1 million cars from the road, and this number is increasing.



Our mission is to enable
a world without waste.

Questions & Answers

How does the robot deal with food contamination?

AI system is trained to identify food contamination visually, and it can also detect food items by form factor.

New markets have been created that buy and convert materials. Do they need your technology to function?

A good example would be PET thermoform packaging that includes items such as cups, lids, and boxes made from the number 1 plastic resin called PET. Some PET thermoforms can be mixed with bales of more valuable PET bottles; on top of that, low prices for virgin resin create a competitive challenge. Some buyers of PET bottles are willing to pay a premium, but this is not the case with other PET thermoforms. But with AMP technology, we can separate thermoforms from other PET materials from the residue for advanced recycling processes. We support the policy made in California that encourages the collection of thermoforms. These improvements and technology capabilities are creating markets that are improving circularity for the materials that were once considered challenging.

How do you see the change in consumer behavior regarding consumption and recycling?

According to a recent study (not named), plastic recycling has dropped to 5% (previously at 9%), but the stats tracking bodies do not provide real-time data. Saying recycling doesn't work just because it is not at a place where it should be, makes it look like we are giving up. In reality, a lot of work is being done to make recycling a better business.



Questions & Answers

Do you see other innovations arising in the recycling space?

Having a large data set of recyclable material from machine learning opens up tremendous potential. For instance, we are developing the industry's first AI-powered automation system to recover film and flexible packaging. This addresses the huge contamination challenge MRFs face that can cause downtime in the facilities. We are also developing a product so that MRFs would be able to bale and sell the materials like they sell other commodities. We are excited about this innovation and will bring industry partners to the market in the next year.

Is there any upcoming policy that would change the recycling and waste management space?

We are closely following a policy area in Canada and Europe related to extended producer responsibility. Over the past two years, four states in the US have passed laws related to the Extended Producer Responsibility (EPR) of packaging. Many other states are also considering doing this. As these programs ramp up around the country, the producer responsibility organizations that are the enforcement bodies of these programs will face a challenge regarding how they can collect and process a vast

area of packaging type. Packaging manufacturers will be responsible for their packaging moving in the state. Currently, the collecting bodies manually ways to count, categorize and account for the types of materials collected. The manual way can be costly, lack transparency, and can produce erroneous results by bringing automation to real-time monitor the material and provide accurate data about the number and types of recycled materials.

Do you work with brand owners to consult them regarding how their packaging can be improved to be more identifiable and separable?

We work with producers or brands, such as Sonoco, a global packaging producer, to create new packaging material so that those materials can be easily identified where our systems are deployed.

What are AMP's goals for the future?

We aim to expand globally wherever there is a recycling problem. We want to expand in the areas such as construction and demolition, e-scrap, and organics. We want to continue international expansion, especially in Europe. We aim to increase the use of data to improve operations and help policymakers reach these sustainability targets. There are a lot of reasons to be optimistic about recycling.





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