GAIA Recap on EV Battery Repair Teach-In

GAIA's February 2024 Electric Vehicle (EV) Battery Repair, Reuse and Repurpose Teach-In helped GAIA members and partnering organizations learn more about the EV battery supply chain, how they are recycled, and why design for repair, reuse, and repurpose is so important. Here are the key takeaways for each panel:[1]

Sheila Davis presents on GAIA's environmental justice EV agenda

Panel 1 - A Zero Waste Environmental Justice Agenda For Maximum Usable Battery Life

Ethan Elkind, Meg Slattery and Sheila Davis laid the foundation for the day's discussion, reviewing the battery's social and environmental impact on mineral extraction, how the battery's life can be extended through repair and repurposing and the adverse impacts of poor product design on people in the global South. A recording of the panel discussion can be found here.

Ethan from the Center for Law, Energy & the Environment at University of California, Berkeley Law School provided an overview of the EV battery's life cycle impacts, walking us through the stages of battery manufacturing. Raw materials like cobalt, lithium, and other minerals go from mineral extraction to cathode production, to cell production, to pack production, which then go to vehicle manufacturing. Overall, Ethan called for the prioritization of upstream design solutions before a spent EV battery ends up in recycling. Ethan's presentation can be found here.

Meg, a PhD candidate at University of California, Davis, gave an overview of EV battery reuse and recycling, highlighting structural design challenges that make it hard to reuse and repurpose spent EV batteries, and that a battery's warranty influences its end-of-life pathway. Vehicle manufacturers use fewer modules to make the battery lighter and place the cells directly into packs to avoid additional material use. This cell-to-pack design makes it harder to dismantle and take apart the battery from the vehicle. Meg's presentation can be found here.

Sheila, GAIA's US & Canada EV Waste Researcher & Strategist, presented on the lessons learned from the recycling of e-waste and lead-acid batteries, grounding them in environmental justice and right-to-repair principles. While lead-acid batteries are one of the most recycled batteries on the planet, their recycling is also one of the most polluting activities. Sheila then talked about the need for diagnostic tools, standardized components, labeling, and other changes necessary for better design. Sheila's presentation can be found here.

Panel 2 - Obstacles To Repair, Reuse & Repurpose

Jeff Chua, Peter Mui and Dr. Leslie Adogame continued the conversation by talking about barriers to repair, reuse, and repurposing, including infrastructural challenges in countries like the Philippines and Nigeria where many spent

[1] GAIA is committed to making complex information about battery reuse, repurposing and recycling processes and designs more accessible to our members, civil society organizations and the public. Please refer to the Glossary for key terms here.

batteries are imported and issues of waste colonialism stemming from global North countries like the US. A recording of the panel discussion can be found here.

Lien De Brouckere moderates the second panel on obstacles to repair, reuse, and repurpose

Jeff, GAIA's EV Battery Waste Strategist and Advocate in the Asia Pacific, spoke about the occupational hazards in an informal sector repair shop in the Philippines. Informal battery buyers are stepping in to deal with EV batteries amid waste picker reluctance to dismantle EV batteries. However, the occupational hazards from dealing with waste lead-acid batteries include electrical and chemical burns and respiratory illnesses and deaths due to exposure to lead and other chemicals. Jeff's presentation can be found here.

Peter, founder of FixIt Clinic, spoke passionately about the many barriers - especially proprietary software and technology like Apple's Pentalobe screw - that corporations put up to prevent consumers from repairing their own electronics. It was inspiring to hear him speak about the value of curiosity and tinkering, and his vision for the democratization of advanced manufacturing. He stressed the need for legislative changes to enable consumers to repair their own electronic devices. Peter's presentation can be found here.

Dr. Leslie, Executive Director of Sustainable Research and Action for Environmental Development in Nigeria, pointed out the lack of regulatory infrastructure and resources for the environmentally sound management of e-waste in developing countries. As a result, crude treatment processes that pose a high risk to the environment and human health are employed. Currently, there are no standards to assess the quality of EVs or EV batteries in Nigeria. Dr. Leslie's presentation can be found here.

Panel 3 - Solution Pathways To Effective Repair, Reuse & Repurposing

Omar Osvaldo Reyes, Daniella Lumkong, Zora Chung, and Lien De Brouckere dove more deeply into the technical aspects of EV battery design, showcasing how they can be altered to allow for better repair, reuse, and repurposing. A recording of the panel discussion can be found here.

Omar Osvaldo Reyes talks about challenges to EV battery disassembly

Omar, a third year student studying Computer Engineering and Electrical Engineering at Stanford University, talked about the disassembly aspect of EV batteries, explaining barriers to repair ranging from instruction manuals deemed proprietary information, proprietary sockets, complete removal of a vehicle's interior to access the battery pack, and sheer weight of 1,000 lbs preventing removal of a battery pack for

repair. Lack of open access to Original Equipment Manufacturers (OEM) parts and manuals, and highly variable processes to access a battery's cell level further complicate repair. Omar's presentation can be found here.

Daniella, a Masters student in Mechanical Engineering with a concentration in Manufacturing and Product Realization at Stanford University, presented on how the battery's life once retired from a vehicle could be further extended through repurposing for use in microgrids, energy storage systems, and EV charging stations. Third-party users often cannot access the necessary battery state-of-health (SOH) information, and structural barriers such as Tesla's cell-to-pack design prevent effective repurposing. In order for a battery to be repurposed, certain information needs to be accessible, including distance driven, age of the battery, charging and discharging rates, and the state-of-health. Daniella's presentation can be found here.

Zora, CFO of ReJoule, spoke about the company's work in efficiently and accurately testing and assessing an EV battery's health for repurposing, given that a vehicle's onboard battery management system (BMS) can be unreliable and other methods such as cycling are time-consuming. While all batteries degrade, they do so at different rates and are not just a function of miles driven. More challenges to repurposing include the cell-to-pack structural design, lack of availability of spare parts, and that auto mechanics already in short supply need to be certified as high voltage technicians in order to work on EVs. Zora's presentation can be found here.

Lien, GAIA's Global EV Waste Strategist & Advocate, talked about how digital labeling for batteries can provide information crucial for their repair and repurposing. This labeling can take the form of a battery passport or digital identifier. While several policy initiatives are underway on battery passports, their mandatory scope is largely limited to manufacturing, hazardous materials, basic chemistry, and responsible sourcing information. But to facilitate repair and repurposing, battery passports should also provide public access to detailed composition, dismantling instructions, replacement parts, safety information, state of health, performance, history of use and negative events. Lien's presentation can be found here.

Jessica Dunn speaks on the influence of EU Battery Directive and waste trade laws on US policy development

Panel 4 - Policies For Repairability, Reuse & Repurposing

Nick Lapis, Blaine Miller-McFeeley, and Jessica Dunn ended the day by going over recent legislative victories in places like California and Europe, highlighting tangible policy solutions that help to promote the repair, reuse, and repurposing of electronic devices and batteries. A recording of the panel discussion can be found here.

Nick from Californians Against Waste (CAW) talked about California's passage of SB 244, which requires manufacturers to provide the necessary parts, tools, and diagnostic materials to a consumer or third-party repair shop at the same cost as for authorized repair providers. Key lessons from that long campaign led by CAW can be inspiring to others, such as setting up rallies between the legislator's building and the capitol building, using news media to hold state representatives

accountable, and strategically scheduling fix-it clinics in the legislatures they were struggling with and inviting those representatives to speak. Nick's presentation can be found here.

Blaine from EarthJustice presented on federal EV battery circular economy initiatives within the US. The Inflation Reduction Act (IRA) defines EV battery materials recycled in the US as American-made, regardless of their origin—so EVs made with US-recycled battery materials are eligible for the IRA's purchase incentives. Blaine's presentation can be found here.

Jessica from the Union of Concerned Scientists spoke about the influence of the new EU Battery Directive and waste trade laws on US policy development. The EU Battery Directive incentivizes reuse and repurposing through its promotion of a battery passport. However, the EU does not address exported electric vehicles and does not ensure that they are reused and/or recycled. Jessica's presentation can be found here.

Key teach-in take-aways of barriers and opportunities on EV battery design for repair and repurposing:

- **Informal sector repair workers** in the global South and countries receiving e-waste have invaluable lessons to share, face grave health and environmental harms from dumped batteries and e-waste, and must be consulted to realize an effective right-to-repair and prevent waste colonialism.
- **Structural battery design choices** such as Tesla's preferred *cell-to-pack* construction was repeatedly flagged as a major barrier preventing repair and repurposing, whereas *modular battery design* is more repair and repurposing friendly.
- **Proprietary software and technology** were frequently cited as major barriers to repair – from bespoke sockets and screws, to proprietary instruction manuals, diagnostic tools and spare parts, to unreliable onboard battery management systems and inaccessible battery state of health information – the list just kept growing! Expanding the mandatory scope of *battery passport initiatives* to include such topics is just one opportunity to help reduce this barrier.
- **Access to information**, especially reliable state of health measurements indicating the level of degradation and remaining capacity of the battery - is very challenging. Fair and equitable access by third-parties to reliable battery state of health is critical to repurposing. Entrepreneurs are devising low-cost and rapid ways to *reliably determine battery state of health information*, and more legislative and policy support is needed to mandate robust access to this information.
- **Coalition building** is key to raising the support necessary to pass Right-to-Repair laws and other legislation that combats waste injustice.

Stay tuned for GAIA's next teach-in focused on hazardous chemical inputs in battery manufacturing production and recycling operations and the potential harm to workers, communities and the environment.