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EPIC 4 Potential Focus Ensuring Repurposing batteries is economically viable

CEC Public Comment: Docket #: 20-EPIC-01 Project Title: Development of the California Energy Commission Electric Program Investment Charge Investment Plans 2021-2025

These comments concern CECâ€™s EPIC 4 Funding - Concept 4: EV Battery Reuse and Recycling.
We are RePurpose Energy, a previous recipient of EPIC 3 funding. We have used this funding to advance R&D around the battery, testing, rapidly assessing battery State of Health (SoH), and adhering to the UL 1973 and 1974 standards, which are prerequisites to UL 9540 and 9540a.

We are currently in the process of obtaining UL 1973 and 1974 and expect to receive both by the end of 2023. These certifications are necessary for the disassembly, testing, reassembly, and sales of second-life EV Batteries.

Even though we will be a UL 1973 and 1974 certified facility, the testing and battery cycling processes required to be able to add UL 1973 and 1974 certification to every battery we sell or deploy would be unachievable, which puts the industry at risk. Beyond the capital costs of going through the certification process - ~$1.2 million for the 4 standards listed per cell type. The time-consuming element required for each repurposed battery (cell) is unattainable. It is clear that ULâ€™s standards for repurposing batteries were developed from an academic perspective, lacking an assessment of the practical realities of implementing these standards at an industrial scale.

For example: Once weâ€™re a certified 1974 facility later this year, to put a UL Certification on the batteries we repurpose each battery has to go through physical inspections, BMS checks, open circuit voltage testing, internal resistance testing, and self-discharge testing (which is about 24 hours per battery cell). Rejoule, another EPIC recipient estimated that â€œit would take 40+ hours to complete UL 1974 testing per used battery [cell]â€□. In our case, we are disassembling battery packs, which would require testing down to the cell and module levels.

Applying the 40-hour metric per battery, we calculated it would in principle take approximately 15 years and $2 million in labor costs at minimum wage to produce a single 1 MWh container of repurposed batteries (that are disassembled further than the pack level). In other words, after pursuing 1974 for several years, we will obtain it for our facility, but it will be impossible to sell a battery product with the 1974 certification, which is a requirement for most storage developers to purchase and install.

These certifications are valid for only 1 model number of battery cells, meaning the whole process must be completed again to repurpose batteries from different EVs, even different EVs of the same model but different years. Effectively then, it will only be possible to repurpose batteries from the best selling 3 EVs of any given year, significantly limiting the ability and usefulness of battery repurposing.

Further, despite the fact that UL 1973 is a cell certification that is nominally the responsibility of the cellâ€™s manufacturer, this burden is pushed to battery repurposers for EV batteries since many EV batteries do not have UL 1973 certifications. On a side note, why is it suddenly required once the battery is removed from an EV? Aside from matters of cost, this adds the obstacle of requiring cooperation with the manufacturer of the cell and EV, since UL requires OEM datasheets for the battery cell and pack in order to issue 1973 certification. This means, for example, that repurposing Tesla batteries is effectively illegal because Tesla will not share datasheets, and these are the most numerous EV batteries currently available. Or, consider the case where the company that manufactured a vehicle is no longer in business, so cannot provide datasheets. This requirement then makes it impossible to repurpose any batteries from any of their vehicles.

An additional concern we have is with the testing labs that UL uses to implement the testing specified in these standards. Unfortunately, they short-circuited the batteries we sent for testing by testing the batteries in the manner we explicitly stated not to in the manual we sent. This added time and cost to all parties and it brought up the concerns for future certifications.

We see the cycling tests are redundant for multiple reasons. EV batteries get cycled 100s to 1000s of times by the time they reach the end of their usable EV life. An additional discharge cycle that requires 3-4 hours is redundant, especially when there are tools like the ones weâ€™ve developed that determine battery State of Health accurately in minutes. Unfortunately, the way UL has written their standards does not allow for any improved and more efficient testing technologies since the standard specifies exactly the methodology that must be followed, rather than specifying the required data/results.

Another concern is the lack of nationally recognized testing laboratories (NRTL) capable of certifying for UL 1974 and UL 1973 causes long lead times and delayed responses from UL. Only CSA, UL and SGS are able to certify UL 1974, although every lab we talked to has little to no experience in dealing with the UL 1974 standard in general. The lack of NRTLs that are able to certify UL 1974 and UL 1973 results in longer lead times to be assigned a certifier and longer project times due to certifiers being unfamiliar with the standard.

What we need the CECâ€™s help on is communicating and addressing how time-consuming, and ineffective in terms of additional safety some of these processes are. If we are able to fix some of these standards, it will open up competition and more companies will be willing to pursue second-life battery repurposing. We see the need to reevaluate and fix some of the processes, as currently, they are likely the largest barrier to more companies innovating in the area of second-life battery repurposing.

We were told at the public comment webinar that the CEC â€œ.. doesnâ€™t work directly with ULs, but if this is something that a recipient would like to pursue in their future project, we can look into how to collaborate.â€ We would love the opportunity to work with other industry leaders and the CEC on this important objective.

A few avenues we brainstormed on how to do this include collaborating with CALSSA, the CEC, and industry leaders to create a new type of certification or optimize the existing ones. We wanted to note that in the past, a similar process was used to address how inverter manufacturers measure efficiency.

Not addressing these needs can very likely stop the industry before it starts are companies will not want to enter the space given the rigorousness and untenable time constraints, or they will move to counties that are more open to innovation and actually support the reuse of EV batteries with policy.

The CEC has identified several possible project focuses, we agree the following focus areas are critical to pursue to ensure battery reuse and repurposing is scalable as well as technically and economically viable.

From CEC

CEC Rescue Possible Project Focus Areas:
1. â€œDevelop flexible battery management systems and power electronics to enable safe EV battery reuse with different form factors, state of health, manufacturers, and chemistry.â€
We have developed methods to accurately asses battery state of health in minutes instead of hours. The developed algorithms can learn new battery types and chemistry within about a month of data introduction. We see this as critical to ensure ease of second-life battery repurposing as over 200 new EV models from over 15 manufacturers will come to market in the next few years. The types of innovations we and others in our industry have created to rapidly assess the state of health could be significant in addressing the barriers of making UL certification testing, disassembly, and reassembly while adhering to safety standards significantly more efficient.
2. â€œDevelop and support open access testing resources and standardization to address
deployment barriers including fire safety.â€
We see this as the most critical area to address as it has been our biggest deployment

barrier in repurposing and commercializing second-life batteries. We view the reevaluation and optimization of these UL 1973 and 1974 certifications as absolutely critical to ensuring battery reuse is an economically viable and scalable industry. Additionally, UL 1974 and 1974 are prerequisites to UL 9540 and 9540A which are required by the fire code.
3. â€œReduce reconditioning costs and time-related to sorting, grading, safety and reliability testing, and logistics.â€□

The biggest factor in reducing costs and time related to sorting, grading, safety, and reliability testing is the processes required for UL 1974 evaluation. UL 1974 is the standard for evaluation for repurposing batteries, its scope covers the sorting and grading of battery packs, modules, and cells, as is a way to determine if used batteries such as EV batteries are suitable for different use such as commercial stationary storage. To reiterate, the most time-consuming element of this is the requirement to cycle/discharge each battery/module and the poorly formulated method required for the self-discharge test. Working with UL, or adjusting the fire code to require a new, non-UL standard, that allows for new methods to determine the battery state of health and other safety-related parameters would significantly reduce the costs and time related to sorting grading, safety, and reliability testing.

CEC Questions:
Due to limited funding, what focus area should we prioritize?â€□

What are the challenges associated with battery reuse for residential storage and grid-scale storage solutions?

UL 1973, 1974, and likely 9540 and 9540A are required to connect second-life batteries to the utility grid. If installers are unsure if theyâ€™ll be able to obtain permission to operate (PTO), they will not purchase second-life batteries. The manual and inefficient battery cycling/testing methods required by UL are untenable for companies pursuing battery repurposing beyond the pack level. Repurposing batteries beyond the pack level is important because itâ€™s necessary to achieve better performance and energy density.

The same analysis referenced above done by Rejoule, estimated that the UL Testing requirements for RePurposing EV batteries at the pack level would add 30% cost, which adds additional barriers to competing with new batteries. As mentioned previously, for RePurpose Energy and future companies aiming to repurpose batteries beyond the pack level, module, or cell level, to produce a 1 MWh second-life battery with an individual certification would cost ~$2 million and take ~130,000 hours or 15 years. We hope to address these barriers to ensure reusing batteries is a viable option for California and the country to meet itâ€™s climate goals.

We are very appreciative of the support weâ€™ve received from the CEC and look forward to continuing the dialogue and collaborating on these important initiatives.

Best Regards,
RePurpose Energy