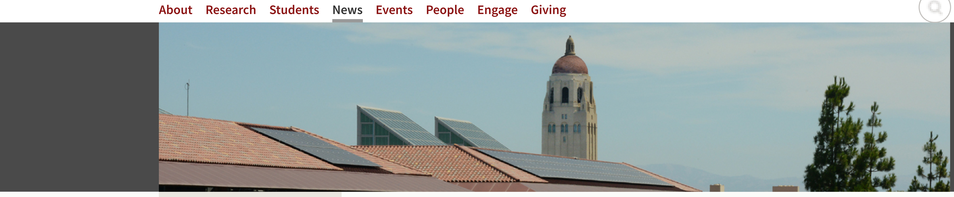

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Stanford team wins 2022 EnergyTech University prize with battery recycling business plan

MAY 12, 2022 | PRECOURT INSTITUTE

By Claudia I. Moses

In late February, Stanford University juniors Lyna Kim and Evan Baldonado, and sophomore Patrick Kim zoomed into the California regional competition for the U.S. Department of Energy's inaugural EnergyTech University Prize to present their commercialization idea before a panel of judges. They were up against mostly graduate students with more industry experience than they had, so the team's expectation of winning was low. They didn't even come up with a snappy name.

Snappiness may be overrated. The team won their regional and its $2,500 prize. And, a month later at the national competition, they took home first place and $50,000.

The **EnergyTech University Prize** challenges teams of college students to develop and present business plans for commercializing sustainable energy technologies to a panel of judges. The teams must identify a high-potential energy technology, conduct a market analysis to determine commercialization opportunities, and create a business plan.

Recalled Baldonado, "Lyna reached out and said 'Hey, do you want to form a team?' I'd done a lot of sustainability-related things, but I thought it would be cool to learn more about energy."

The format of the competition gave the team, "Mechanochemical Recycling of LCO Batteries," confidence that they could be serious competitors despite having less experience than most of their competitors.

"One of the cool things about the contest was that it was based on the strength of the pitch, not necessarily the experience of the team," said Baldonado in an interview after the competition.

First-place Stanford team presents at EnergyTech University Prize nationals.

The technology

The Stanford team developed a plan to commercialize the recycling of lithium cobalt oxide batteries, which is the most common type of rechargeable lithium-ion battery. LCO batteries are used in most small portable electronics such as mobile phones, tablets, laptops, and cameras. According to the team, while lithium-ion batteries are revolutionizing energy storage, demand for them will soon outstrip the materials available to build them. With expanding battery use in electric vehicles, consumer electronics, and energy infrastructure, the team saw an opportunity to market the gap between needed and available materials.

"The cool part about this was that you were able to find existing research, and figure out how to turn it into a business plan," said Baldonado. "This is not a concept that we came up with, but we made a pitch to commercialize that research."

According to the group, cobalt is the primary resource in rechargeable batteries that will cause a strain on supply, but an opportunity lies with recycling spent batteries and reusing their materials. Citing the diminishing market share of LCO batteries due to high cobalt costs and relatively short battery lifespans, Baldonado argued in front of judges that the batteries should be recycled to recover their valuable contents.

"Currently, only 5 percent of batteries are being recycled, so there's a ton of room for growth to parallel the lithium-ion battery market," said Baldonando.

The technical recycling process involves three simple steps, a streamlined process developed by the Department of Energy's **Ames Laboratory** to reduce the number of steps needed for the current recycling process.

"A steel mill ball grinds up the batteries to gather material such as aluminum," said Baldonado. "Later, magnets are used to remove the cobalt, and the separation and purification process yields lithium carbonate."

Celebratory team dinner for, (from left), Patrick Kim, Evan Baldonado and Lyna Kim, who took first place in the 2022 EnergyTech University Prize competition.

Business plan

Today's methods of recycling involve burning and melting, or using acids, which are expensive, according to the team's presentation. Current methods also fail to recover some material, are environmentally suspect due to the abrasiveness of the chemicals, and "are just plain inefficient," according to Baldonado. The team's plan aims to reduce all of these negative variables.

"Phase one is partner acquisition, where we aim to gain end-of-life battery feedstock to recycle," said Baldonado.

Next, the group proposed acquiring pre-existing recycling plants rather than constructing new ones. And lastly, the group would sell their collected materials to raw metals customers. Using the **EverBatt** model from Argonne National Lab, the team estimated that their plan would bring in over $28 million in annual profit. Additionally, due to consumer pressure to create sustainable supply chains, the group thinks rising costs of cobalt will bump up their profit.

"Major lithium-ion battery consumers are willing to pay a green premium for recycled cobalt," said Lyna Kim.

The business would reduce the need for mining, slash chemical leakage as a result of improperly disposed batteries, and support the EV transition.

"I think participating in this competition has taught me more about the business side of things," said Baldonado, who in 2021 researched public opinion about climate change with Stanford's **Political Psychology Research Group** through the **Summer Undergraduate Program on Energy Research** at Stanford's Precourt Institute for Energy. "Learning how to make a pitch, how to really sell it, and some basic economics behind running a business was very eye-opening for me."

The team is not sure where they will go with their idea. At the end of the day, however, Kim said they met their goal.

"We wanted to work together to bring new tech to light and make waves in climate," she said.