How to spur energy storage innovations

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Imagine flying all the way from coast to coast, completely guilt-free, in an airplane that doesn't emit a single particle of greenhouse gas or air pollutants. That could happen someday, perhaps brought to reality thanks to the incentive of a $10 million prize that has been proposed by a team of MIT students.

Ever since the first privately financed piloted rocket was launched into space in 2004, spurred by the $10-million Ansari X-Prize, the foundation that established that prize has been creating similar awards to encourage other technological leaps. Follow-up prizes have been offered for the creation of a practical 100-mile-per-gallon car, and for a privately funded robotic lunar mission, among others.

The foundation is always looking for new ideas to promote advances in areas that need an extra boost because they are not attracting enough commercial research and development effort. The X-Prize Lab@MIT, a collaboration between the Institute and the X-Prize Foundation aimed at creating concepts for new prizes, led by instructor Erika Wagner of the Deshpande Center for Technological Innovation, just completed its third semester-long class devoted to developing new prize ideas. This time, the subject was energy storage, and the final presentations by the four teams of students in the class were held on Friday, Dec. 11.

Graduate students Daniel Codd (mechanical engineering), Wendelin Michel (AeroAstro), and Paul Tu (MIT Sloan School of Management) proposed the "Clean Aviation" X-Prize. The concept, they explained, would be to hold a race from California to New York, in which all the competing planes would have to be powered entirely by electricity and produce no emissions. The planes would be allowed two stops during the journey, which would have to be completed within 24 hours. The first to cross the finish line would get a $7.5 million prize, while the plane that covered the longest distance on a single leg of the flight would win $2.5 million.

"World aviation burns 200 million gallons of fuel per day," explained Tu in his team's presentation. "That's equivalent to one Olympic-size pool every minute." That situation is unlikely to change without an outside impetus, he said, because of the expense of developing alternatives and "the entrenched interests of major aviation companies and petroleum companies."

Michel explained that while this is not the first proposal for a green-aviation challenge, it's the only one requiring an all-electric, emissions-free system. The plan calls for holding the race three years after the contest is announced, and then if no team is able to complete the challenge, holding a second contest two years later for a reduced prize.

“It would be open to all possible entrants, from people working in a garage to Boeing.”

That plan, with its coast-to-coast race, would likely produce the most visually interesting, media-appealing contest, but the other three teams also came up with concepts for interesting challenges that could lead to technological advances with potentially widespread applications. One team, for example, proposed a prize for the creation of a small (miniature refrigerator-sized), mass-producible power storage module suitable for use in individual homes, as a way of offsetting the peak loads that dominate electric utilities’ needs for new power plants. The goal would be to have the units priced at $100 each, to spur widespread adoption, and the prize would include an initial order for 50,000 units to be installed in a single area of a city.

Widespread adoption of such a technology, the team said, could eliminate the need for half of all power plants, since half of the nation’s generating capacity is in place just to meet peak loads. Once developed, said team member Tim Grejtak, a junior in mechanical engineering, “we anticipate this would be an entirely market-driven approach,” with units being sold in typical big-box consumer outlets.

The other proposals were for similar kinds of self-contained storage systems, but at different scales and aimed at different applications. One team proposed a prize for units capable of storing enough electricity to be usable by the electric utilities themselves as load-leveling systems. They propose a prize for a 25-megawatt unit, able to deliver its power over a six-hour period. The other team suggested a device suitable for use in villages in the developing world, where they could power computers in a school, for example. The devices, which would deliver 5 kilowatts of electricity for up to 10 hours, would be a way to help bring power to the 1.6 billion people around the world who currently lack access to reliable electric power.

Ultimately, the decision about which, if any, of these proposals will be launched as X-Prize competitions rests with the X-Prize Foundation itself. The foundation was created and is run by Peter Diamandis ’83, SM ’88, who initially set it up to administer the first X-Prize, which led to back-to-back flights into space by the one-person rocket called SpaceShipOne, in 2004. The successor to that craft, the eight-person SpaceShipTwo, was unveiled last week and is expected to begin carrying ordinary citizens (and quite a few celebrities) into space in about two years, ushering in a new era in space transportation.

At least one of the expert judges, who rated the different plans that were presented last week, thinks these proposals deserve to move forward. Robert Metcalfe ‘69, co-inventor of Ethernet and founder of 3Com, mentioned that at the foundation’s headquarters in Playa Vista, Calif., there is a large whiteboard on the wall that lists all the ideas currently under consideration as future X-Prizes. “You have never seen anything so exciting” as that listing of potential prizes, he said. The four new ideas presented by the MIT students, he said, are “not yet up on that board, but will surely get there.”

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