AWARDS

Winner Takes All

ARE TECH PRIZES THE BEST WAY TO THE CUTTING EDGE? BY PATRICK DI JUSTO

Economists call them *ex ante* rewards. They are the technology prizes designed to spur innovation, challenging entrepreneurs to do something that outstrips the state-of-the-art in return for a sizable payoff. They have yielded a wealth of advances, including precision timepieces, unpickable locks and private suborbital joyrides. Awards up for grabs today include those from J. Craig Venter's science foundation, which may offer as much as $10 million for anyone who can develop automated technology that can sequence a human genome for $1,000, and NASA, which is offering $250,000 for a machine that can extract oxygen from lunar soil. Is basic research being prized out of the market?

"Anytime you do research and development, there's a cost associated with it," says Ian Murphy, director of media relations for the X Prize Foundation, which rewarded the first private manned suborbital flight. "What a prize does is to create a sense of competition that allows you to leverage your money. The Ansari X Prize was a $10-million prize, but a little over $60 million of research was spent by everybody. And when you're done, you only have to pay the winner."

But there's no such thing as a free lunch, according to Douglas Holtz-Eakin, director of the Congressional Budget Office. "Prize competitions do not change the underlying factors that determine risks and rewards," he warned in a 2004 appearance before the House Subcommittee on Space and Aeronautics. "Innovators and researchers must be paid for what they do. Inducement prizes have to be very large if the objectives sought are risky and expensive."

From an entrepreneur's point of view, how the prize is paid out matters as much as the size. One drawback to many technology prizes, such as the Defense Advanced Research Projects Agency's Grand Challenge to develop a robotic ground vehicle, is that they often lack a tiered award structure, opting instead for a single large pot for the winner. In an early example, the $25,000 New York–to-Paris Orteig Prize, won by Charles Lindbergh in 1927, had nine entrants, seven of whom spent more than the amount of the prize money in their attempt. When those teams lost, they lost big.

Even the people at the X Prize Foundation realize the drawbacks of a winner-take-all approach. "Toward the end we were thinking, 'Boy, we wish we had a second- and third-place prize,'" Murphy concedes. In a subsequent study for NASA's Centennial Challenges, the foundation determined that a multitiered prize structure—with purses of $150 million, $75 million and $50 million—would provide the right incentive to develop a human orbital vehicle. "This allows the companies that are really, really close to continue to work, to continue to find investors," Murphy explains. "You're also encouraging multiple firms to stay in the market, hence driving down that competitive price. That's what it's all about."

Patrick Di Justo is based in New York City.

PRIZE of $10 million went to SpaceShipOne.

SCALED COMPOSITES, LLC

RAISING STANDARDS

All the prize money in the world will not advance an industry if the challenge does not push the envelope. For all its new design and materials, SpaceShipOne, the winner of the Ansari X Prize, essentially replicated the flight of the X-15, an experimental plane developed nearly 50 years ago, says Randa Milliron, co-founder of Interorbital Systems, an unsuccessful Ansari X Prize competitor. She contends that the prize did not set the bar high enough. "We should be going into Earth orbit or even lunar orbit," she insists. "That's what the industry needs." Her company is focusing on raising the money to create a privately developed five-person orbital spacecraft by 2008. "You want to give us a challenge?" she asks. "Give us a challenge that actually takes us somewhere."

ENERGY

Pinching Out Sulfur

REFINING WAYS TO TURN HEAVY OIL INTO SWEET CRUDE BY JR MINKEL

Removing sulfur is a stinky proposition for oil refineries. The U.S. and Europe are tightening limits on the sulfur content of gasoline at the same time the crude oil coming out of the ground is becoming increasingly "sour," or sulfurous. Desulfurization technology "has pretty much been wrung out," says Thomas Wellborn, principal consultant of Denver-based Hydrocarbon Exploration and Development. "We need

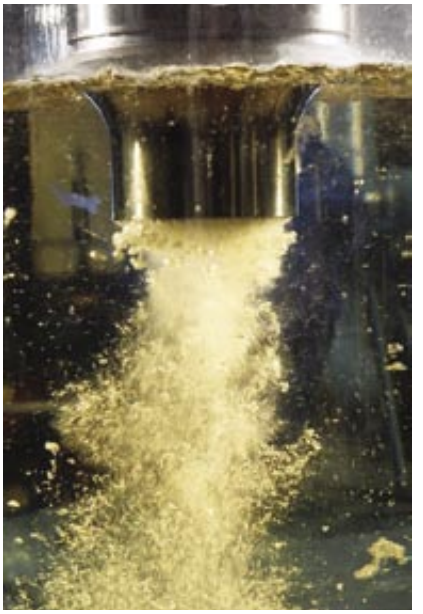
new, innovative technologies." A few young companies with unconventional methods may soon answer that call.

Refineries separate crude oil by boiling point, which is related to density. Most desirable are the lighter (less dense) fractions, which include gasoline and diesel. Heavier fractions contain more sulfur, and too much renders the petroleum useless. Decades ago oil refineries adopted a process called hydrodesulfurization (HDS) to strip sulfur atoms from oil molecules. Sulfurous fractions are mixed with hydrogen and a cobalt-molybdenum catalyst, yielding hydrogen sulfide. Providing hydrogen for the process is expensive, and as oils get more sour, higher pressures and more stable catalysts are needed to break the sulfur bonds. Sourer oils also tend to be heavier, which requires further refining and brings along nitrogen and heavy metals, which foul the catalyst.

Alternative technologies floated in recent years include sulfur-eating bacteria and sulfur-oxidizing reagents, and some experts see room for better-designed catalysts, too. These methods tend to operate on the distilled fractions, but pretreatment of the crude oil itself may be an attractive option. "The better the selectivity upstream, the less need for energy- and capital-intensive separation processing downstream," says Charles Russomanno, a technology transfer manager at the U.S. Department of Energy.

One pretreatment option may be ultrasound. When blasted with ultrasonic waves, liquids can undergo a process called acoustic cavitation, in which bubbles form and violently implode. SulphCo is developing small, modular ultrasound desulfurization units based on this effect. The company, located in Sparks, Nev., claims its process can both snap loose sulfur atoms and lighten the crude, resulting in 30 to 50 percent less sulfur and about one third more diesel and kerosene. "If SulphCo's process works, it's an elegant solution to part of our problem," Wellborn says.

Refineries would have to integrate



OIL SANDS contain sulfur that must be removed. Sweetening such crude oil could be achieved more economically with a sulfur-stripping technique from SulphCo, in which an ultrasonic probe generates bubbles that implode in a billionth of a second (*right*). The process, called acoustic cavitation, creates transient temperatures of about 5,000 degrees Celsius and pressures of about 1,000 atmospheres.

such units into their process, combining pretreatment and post-treatment. "It gets into pretty complex equations to balance the two together," says Abe Albert, a refining specialist for Hart Downstream Energy Consulting in St. Louis. On the plus side, SulphCo president Peter Gunnerman says, the treatment would make downstream desulfurization more efficient, and the capital investment would be only 5 percent that of HDS. SulphCo completed a small demonstration unit in South Korea last September.

Another technique is designed to remove all the sulfur from very heavy oils in one shot. Trans Ionics, based in the Woodlands, Tex., is focusing on so-called tar sand, or bitumen, an especially heavy and sour oil of which the Western Hemisphere holds 65 percent of the world's reserves, primarily in Canada and Venezuela. To deal with such heavy oils, refineries would typically thermally "crack" the oil (that is, cook it) and then treat the liquid products. Trans Ionics intends to extract sulfur with elemental sodium, which would then be recycled in a novel sodium sulfide battery. Funded by DOE grants, Trans Ionics has filed for patents on various components, including a novel thin-film electrolyte, says company president Robert Schucker, who expects commercialization by 2012.

The world's refineries were originally tailored to a much less stringently regulated world, notes Douglas Rundell, a BP refining technology project leader in Naperville, Ill. The challenge to the myriad proposals for new methods is to prove they can reliably augment that infrastructure. Refiners are open to a well-argued case, Rundell says: "If somebody comes along and shows that process 'x' works and the economics are compelling, people will go with it."

JR Minkel is a frequent contributor.

SUNCOR ENERGY, INC. (*top*); SULPHCO, INC. (*bottom*)