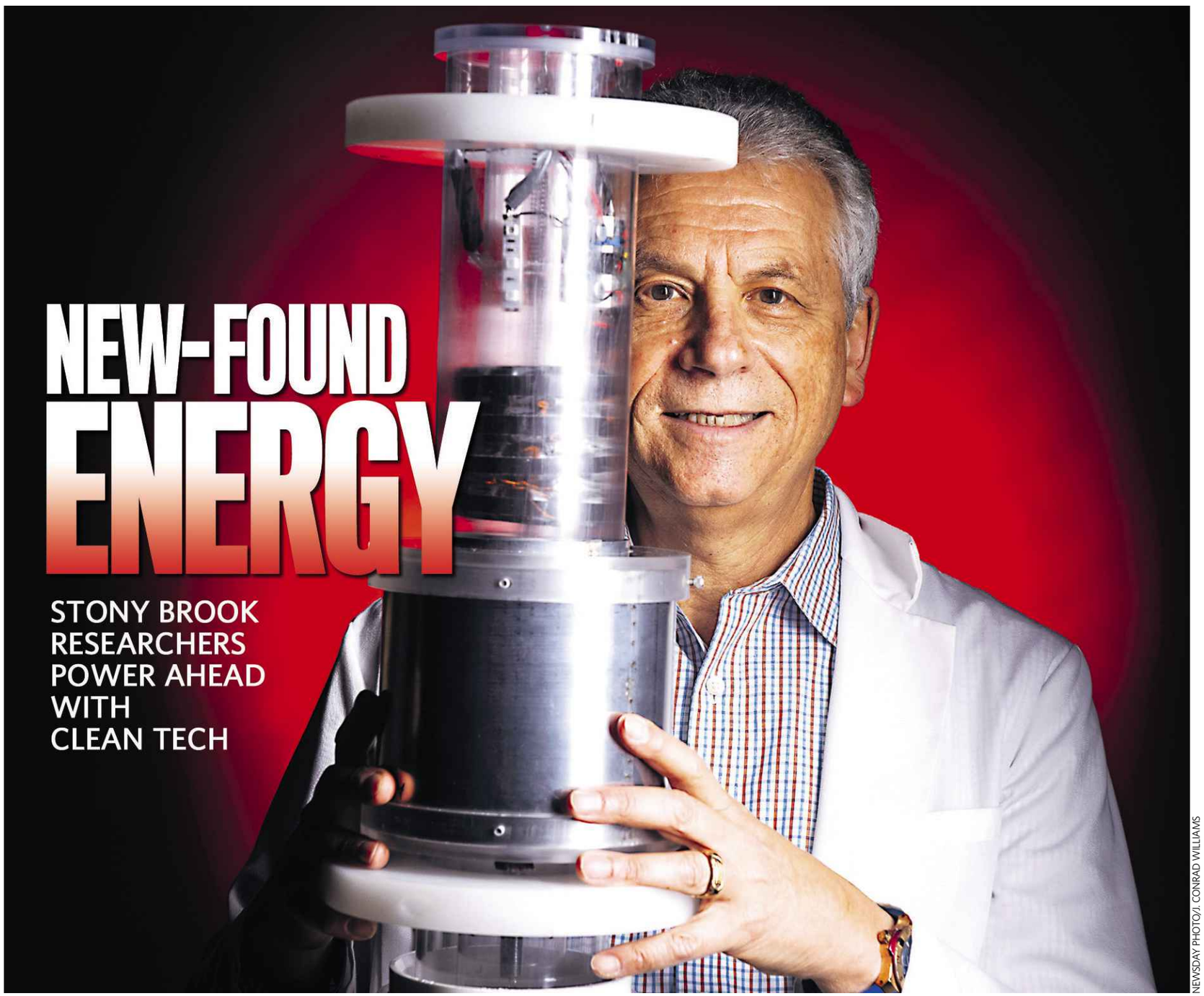
NEW-FOUND ENERGY

STONY BROOK RESEARCHERS POWER AHEAD WITH CLEAN TECH



NEWSDAY PHOTO/J. CONRAD WILLIAMS

BY KEN SCHACHTER
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Researchers and energy entrepreneurs at Stony Brook University are tackling a $1 trillion challenge: How to curb energy use and nudge users toward sustainable power sources.

That number — what Americans spent on energy in 2016, according to a federal agency — offers a powerful incentive to develop more efficient and cleaner technologies. So do government targets such as New York State's goal to generate half of the state's electricity through renewables by 2030.

Scientists at Stony Brook's 49,000-square-foot Advanced Energy Research and Technology Center — which was built with $35 million from New York State — are taking on about 35 projects, including self-cleaning solar panels, a natural gas-fired heat pump and water heater, fast-charging electric car batteries and others.

"Our focus [is] on big societal problems — it's why we selected energy as a major thrust," said Fotis Sotiropoulos, dean of the College of Engineering and Applied Sciences. The goal is not simply research, but concepts that can become businesses: "We really focus on research that has a translatable component."

Customers are expressing interest in some of the products. One company at the center, Unique Technical Services, is working with UPS on converting diesel delivery vehicles to electric and fuel-cell power.

David C. Hamilton, director of operations at the center, is a former executive at fuel cell, utility and satellite radio companies. He mentors researchers in creating a brand, writing grant

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ENERGY from A37

Plugged In

Entrepreneurs tackle cutting-edge energy tech

SBU COMMUNICATIONS / JOHN GRIFFIN

Professor Alexander Orlov

applications and launching products in the marketplace. "I live vicariously through these guys," he said.

Efficient and renewable energy is big business. In 2017, energy startups attracted $1.1 billion in venture capital, according to a National Venture Capital Association report. Global investment in clean energy, including solar, wind and battery projects, was $138.2 billion from January through June, according to Bloomberg data.

Burning fossil fuels — oil, coal and natural gas — warms the planet, scientists have found. A NASA website says that burning fossil fuels increases the carbon dioxide in the atmosphere, contributing to global warming by trapping more heat that would otherwise escape — the "greenhouse" effect.

Fossil fuels accounted for 81.4 percent of global energy use in 2015, only 5.3 percent less than in 1973, according to the International Energy Agency.

The Stony Brook center's building itself is a model of environmental engineering, with solar cells, rainwater-flushed toilets, no-irrigation landscaping and electric-car charging stations. Inside, workers scrawl math formulas on white boards, fine-tune product prototypes and polish slideshow presentations for prospective investors.

Seven years after it opened, the center's labs and offices are full. Other researchers are waiting for completion of a $25 million expansion to add 25,000 square feet.

Researchers and startups are drawn to the center by competitive rents, mentoring services, commercial connections and access to the students of Stony Brook's engineering school, which produces roughly 1,000 graduates with bachelor's degrees annually.

Stony Brook president Dr. Samuel L. Stanley Jr., who chairs the governing body overseeing Brookhaven National Laboratory, in Upton, said access to that research institution allows tenants of the center to tap its sophisticated tools.

"Productive collisions" between students, scientists and entrepreneurs who bump into each other in hallways and lunchrooms at the university's research park, provide yet another benefit, Stanley said. "It's a very intentional strategy."

The center sprang from a fundraising collaboration between Yacov Shamash, Stony Brook's vice president for economic development, and Robert B. Catell, the center's chairman and a former utility executive who retired as chairman of National Grid in 2009.

"I try to bring my practical experience in the energy business to the research world," said Catell, who also works to connect fledgling companies with investors.

These are some of the center's projects.

Fast-charging electric cars

Plug-in electric and plug-in hybrid cars such as Teslas, Nissan Leafs, Chevy Volts and Bolts no longer are novelties on Long Island roads.

Though manufacturers are making steady progress in increasing the range of cars running on batteries, the time required to recharge remains a hurdle.

Filling a car's tank with gasoline takes about five minutes, including entering the ZIP code of your credit card and deciding whether you want a receipt.

Time spent charging a battery-powered car varies, depending on the car model and the type of charger, but can easily last several hours.

Esther Sans Takeuchi, a professor of chemistry and materials science and chemical engineering, is leading a project funded in June by a $1 million U.S. Department of Energy grant to cut that time to 10 minutes.

"It's a very audacious goal," said Takeuchi, who is chief scientist of the energy sciences directorate at Brookhaven National Laboratory. "The vision is if you can charge in 10 minutes, you can grab a cup of coffee and you're good to go."

BARRY SLOAN

Paul Schwartz's company is designing a compact heat pump that works on natural gas.

Electric-car lithium-ion batteries are kept in the charging slow lane by limitations on how fast ions and electrons can be moved, she said.

Takeuchi has been granted more than 150 U.S. patents. Her battery advances are credited with quintupling the life span of implantable cardiac defibrillators. Takeuchi said she came up with the electric-car application when she was rethinking the solution to the defibrillator problem.

Takeuchi, who drives a hybrid car, said her fast-charging batteries would require a fundamental change in battery chemistry, but would not require the factories that produce electric-car batteries to do a major retrofit.

"We live in a fossil fuel economy," she said. "We're going to live in an electron economy."

Internal combustion: Not dead yet

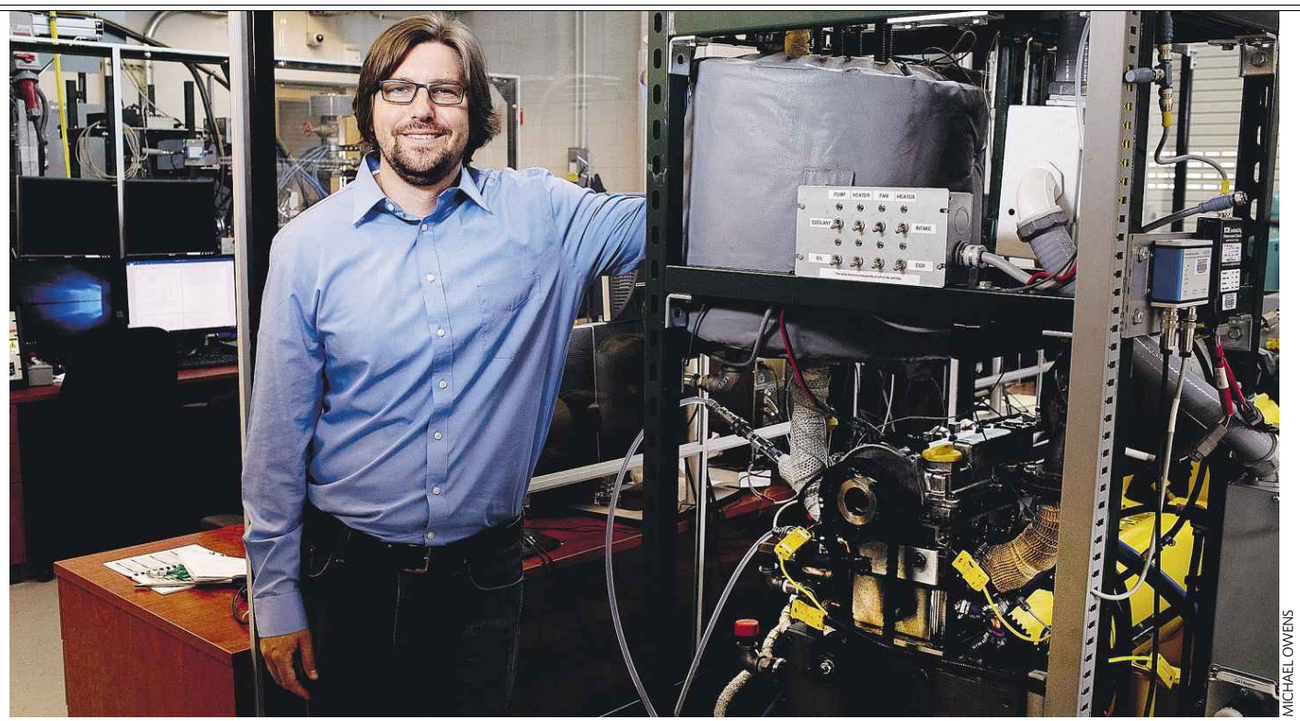
Contrary to conventional wisdom, the internal combustion engine is alive and well, says Benjamin Lawler, a mechanical engineering professor at Stony Brook.

Lawler oversees the Advanced Combustion Laboratory at the center. In the laboratory, about a dozen researchers tweak special research engines' timing, compression and air-fuel mix to increase efficiency.

Lawler bristles at the notion that electric cars are clean while internal combustion engines are "dirty, old and antiquated." That narrative, he said, ignores the energy required to make electric-car batteries and emissions from power plants.

"There are people who do 'well-to-wheel' analysis. Some show conventionally powered vehicles are more efficient than electric vehicles if they get all their power from coal," he said.

Lawler hopes to save the traditional auto engine by modify-



MICHAEL OWENS

Ben Lawler, a professor of mechanical enginering at Stony Brook, is leading an effort to make the internal combustion engine more efficient.

ing its combustion cycle.

Under a $1.1 million Department of Energy grant that concludes on Sept. 30, Lawler is testing an advanced combustion cycle that uses a multifuel mix and does not require spark plugs for ignition. The engine ignites the air-fuel mixture with intense compression as in a high-efficiency diesel engine, but does away with that engine's sooty emissions.

Engines with the new combustion cycle could be about 20 percent more efficient than current gasoline engines, putting them on par with diesel engines.

"Clearly there are ways we can get pretty good miles per gallon," he said.

Efficient climate control

ThermoLift Inc. is an early-stage company that is close to launching its product.

The company, founded in April 2012, is developing a compact heat pump that operates as an air conditioner, heater and hot-water heater.

Heat pumps transfer heat energy either inside or outside a building to heat or cool it, depending on the season. Unlike conventional electricity-powered heat pumps, Thermolift's Ultimate Heat Pump can be powered by natural gas and function as a heater even when outside temperatures dip as low as minus 17 degrees, chief executive Paul Schwartz said.

MICHAEL OWENS

Inventor Esther Sans Takeuchi leads a car-battery project.

The system also is far more efficient, saving $957 a year in a 2,000-square-foot home compared with the cost of new equipment, he said.

Schwartz said the system uses no refrigerants and could also be adapted to run on heating oil.

Prototypes are being tested in the company's Ann Arbor, Michigan, office and at Oak Ridge National Laboratory in Tennessee.

The company has raised $16 million from private investors. About half of another $25 million fundraising round has been completed.

Among the investors is the center's chairman and utility veteran Catell.

The company has enlisted a manufacturer, Linamar Corp., based in Guelph, Ontario, and plans to launch a commercial product in 2020.

Letting the sun shine in

Solar panels convert sunlight to electricity. When they get dirty, the sunlight is blocked, reducing their efficiency.

The panels can be cleaned with water or rain. But some solar installations are in arid regions where water is not readily available.

Alexander Orlov, a Stony Brook materials science and chemical engineering professor, is borrowing an idea that NASA considered for solar-powered Mars rovers and is working to refine it for use on Earth. The concept is to develop special electrodes that would create an electrical field to repel dirt.

Researchers are working to reduce the amount of electricity required to create the field and increase the transparency of the electrodes to admit more sunlight.

"This is still a work in progress," Orlov said. He said an analysis of return on investment suggested a payoff for solar panel users in three to six years. Solar panels themselves typically last for about 25 years.

The project has received $150,000 in funding from the state's PowerBridgeNY program. The incremental funding running through April 2019 requires that Orlov create prototypes and conduct interviews with utilities and solar panel companies to understand the marketplace.

Another step: Testing the system using different types of dust under different types of weather conditions as required to meet industry standards.

Orlov said a sample of Arizona dust is on order.

From cancer care to wave energy

When Reed Phillips, an inventor and entrepreneur, was 5 years old, he was hit by a wave, sucked out by the undertow and almost drowned.

That near miss triggered a lifelong interest in the untapped energy of the ocean's movements.

He majored in physics at Stony Brook, but veered into medicine as an oncologist and palliative care specialist. Though he still occasionally fills in at Glen Cove Hospital, Phillips, now 70, said he has "largely retired" from medicine to devote time to his new career of "harvesting energy from the ocean," he said.

In 2012, he started Energystics Ltd. and so far has funded the company himself with about $275,000.

Phillips hopes to roll out his first product at the New York Boat Show at the Javits Center in January. It would be a generator on the boat that would produce power from the rocking of the waves.

Vertically mounted magnets in the generator bounce on springs to the motion of waves. As their magnetic fields pass through surrounding coils of wire, a trickle of electricity is produced that could keep a marine battery fully charged. This "drip charge" would let boaters avert the common problem of a dead marine battery due to disuse. Phillips has 10 patents related to the generator.

Plans call for making prototypes of a follow-on generator buoy tethered to the boat that would harvest energy by bobbing in the water.

"It's very expensive to call the seaborne AAA," he said.

ON THE COVER

Reed Phillips, a medical doctor, inventor and entrepreneur, is developing a generator to enhance marine battery life.