



**UPDATE from University Tech Park | Fall 2017**

**Spotlight on: Cavendish Energy**

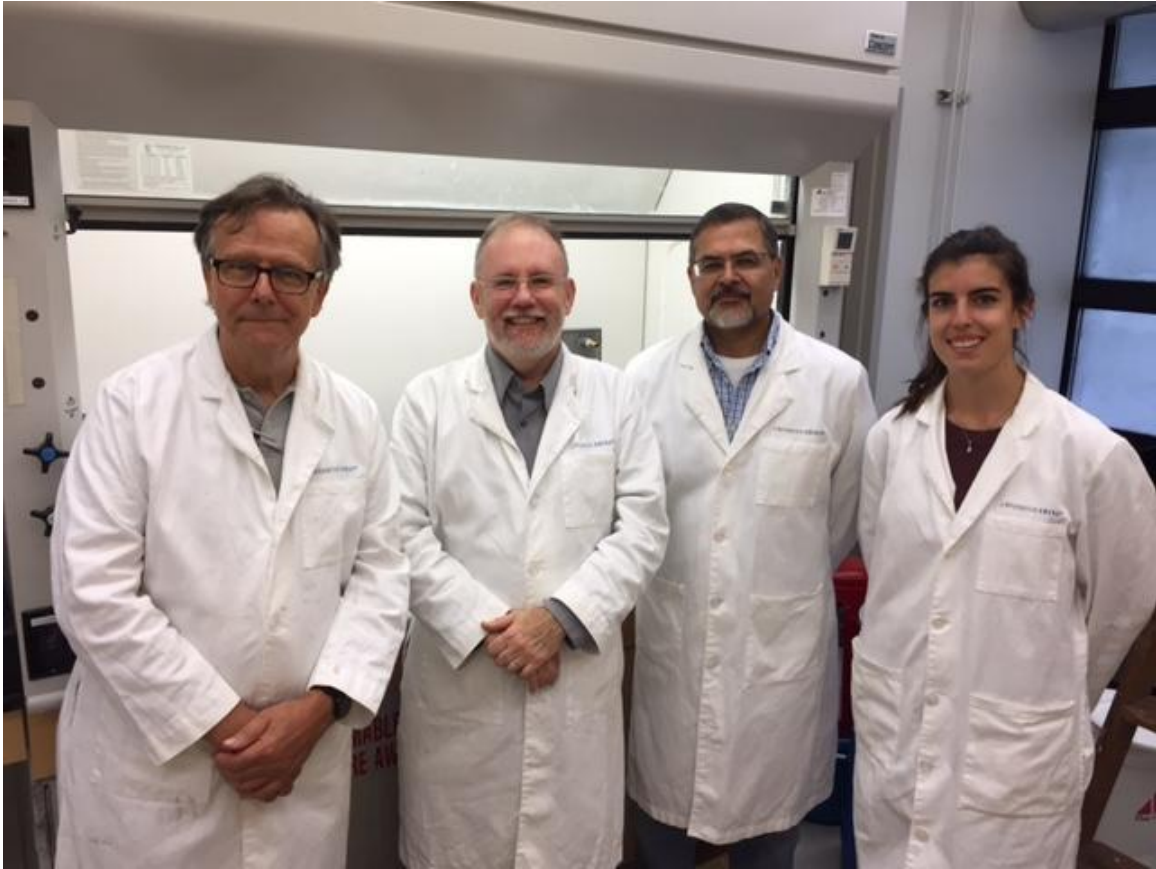
## Hydrogen power generated on-site and on demand

Hydrogen has long held the promise of providing abundant clean energy. Yet our ability to build the technology to produce pure hydrogen at low costs and high volumes has proven to be intractably elusive.

Most current technology requires a much higher energy input than the energy actually produced. That's even before we consider the huge obstacles that any new energy technology faces, considering the entrenched nature of the way we produce, transport, store and use fuels.

But **Cavendish Energy**, a 2-year resident of University Technology Park, is challenging the status quo with a patented process that promises to shift the conversation about hydrogen.

The Cavendish Process™ uses an innovative control process to generate hydrogen without using hydrocarbon feedstock or electrolysis. "With this process we can generate hydrogen on demand from aluminum in a first-of-its-kind, cost-effective, efficient, scalable, controllable, and environmentally benign manner," says Cavendish co-founder **Dr. Ujval Vyas**.



*Cavendish's team at the Tech Park, from left: device designer/fabricator John Kriegshauser, chemical engineer Alan Bath, co-founder Ujval Vyas and Illinois Tech intern Marta Guerrero. Not pictured: co-founder Roger Bezdek.*

Vyas says the process creates significant amounts of hydrogen at 99.99+% purity without requiring high pressures or temperatures. "The cost is lower than virtually all competing technologies," he adds.

Because it can produce hydrogen on-site as needed, it also avoids many of the technical, safety, and cost challenges of transporting hydrogen as a compressed gas or cryogenic fluid, Vyas says.

### ***A team of green tech veterans***

Cavendish Energy was founded in January 2014 by veterans from the green energy arena. **Roger Bezdek**, a PhD in energy economics and an internationally recognized expert in environmental and energy analysis and forecasting, directs the company's market analysis. Dr. Vyas, a long-term consultant focused on sustainability, construction, and emerging technology, guides the R&D behind Cavendish's core technology and possible applications.

Colleagues for many years, the founders have collaborated on many projects, and are committed to avoiding the confirmation bias so rampant in many technology start-ups in the energy sector.

"We're a pretty experienced and hard-nosed group with years as consultants, policy experts and technical professionals at high levels in the sustainability space," says Vyas. "We keep each other honest and focused on the empirical data to ensure our technology works better and provides more value than other solutions out there."

Other team members include **John Kriegshauser**, a master fabricator and head of the architecture labs at Illinois Tech, who handles design, fabrication, and testing of Cavendish devices. **Alan Bath**, a former chemical engineer and R&D specialist with Proctor and Gamble, manages testing and validation of the chemistry associated with the process.

"We have people with deep business experience teamed with innovators who've actually created and marketed new products," says Vyas.

### ***Public sees the potential at Gas Technology Institute demo***

In July 2016, the public caught its first glimpse of the Cavendish process at a demonstration held at the **Gas Technology Institute** (GTI) in Des Plaines, Illinois. GTI is a leading research, development, testing and training organization focused on energy and environmental challenges and has been performing technical and consulting support for Cavendish Energy for the past year.

Twenty-five invited guests from the private and public sectors were present. In that demo, hydrogen was produced at a rate of 2 to 3 liters per minute, powering a 100-watt fuel cell which produced electrical power to activate a dimmable LED array of more than 7,000 lumens.



*First demo at GTI: a hydrogen-powered light array*

Subsequent demonstrations at GTI and Cavendish's UTP lab have produced 10 times that amount of hydrogen and showed full control over the technology. Cavendish is now working to increase production up to 200 liters per minute (1 kg of hydrogen an hour) and anticipates these rates by the end of this year with the placement of an operating alpha device with their first customer.

"We believe we have a truly disruptive technology," Dr. Vyas says. "To us, this means providing vastly better value for the same or slightly higher price, equal performance for a significantly lower price, or better performance for a lower price. We feel all three are within reach."

### ***Eyeing the possibilities***

The latest version of the Cavendish process will enable large-scale manufacturing by a 3rd party, suitable for prototyping, modularization, and modification for many commercial and military applications. Since the device uses only simple processes, capital requirements are relatively low, Vyas says.

The team is focused on small and medium-sized applications, including:

- Tabletop hydrogen for analytical chemistry and other applications

- Hydrogen energy for horticultural and related applications
- Specialized portable applications for back-up power, construction and mining
- Industrial and non-industrial applications for direct burning of hydrogen
- Direct input to fuel cells up to the 1000W range for backup power applications
- Department of Defense tactical and remote applications



*Early prototype of hydrogen gas burner*

"We're very opportunistic," says Vyas. "We want to find the markets where we can immediately solve problems and drive revenues." For now, that means Cavendish will not be directly entering the crowded and entrenched vehicle market, he notes.

### ***The value of being at Illinois Tech***

Cavendish chose the Tech Park on the recommendation of **Jay Marhoefer**, the founder and inventor of **Intelligent Generation**, a graduate company of UTP and former law school classmate of Vyas at IIT's Chicago-Kent College of Law.

"The Tech Park has been a great home for us," says Vyas. "Entrepreneurship is the bridge between science and the marketplace, and the incubator is helping to create that bridge, which will improve lives in countless ways."

A part of Cavendish's funding came through connections at the Tech Park. "We were able to leverage a referral from Director **Catherine Vorwald** into a source of funding and a first customer. The fact that they think about funding and other support that in-house companies need is a tremendous value," Vyas says.

Cavendish has also hired Illinois Tech students as interns. "The student population here is one of UTP's greatest assets," Vyas notes. "When we hire students, we are confident they will have the right set of skills and attitude."

### ***Being "like Velcro"***

The Cavendish team believes that fast adoption of its new process will come through joint development and licensing agreements that will drive product

development and widespread use of the technology. It has already signed agreements with commercial partners.

"We want our story to be like the development of Velcro," says Vyas. "It's more efficient to allow people who are currently in the market to create the products that will use our underlying process."

Right now, Cavendish is focused on smaller, more nimble players in any market segment who may be able to prove the new process' viability and create change rapidly by quick adoption.

"We aren't necessarily interested in working with market-sector leaders," Vyas says. "We want to partner with the Number 3 or 5 or 7 companies in any market - the ones vying to become Number 1."

The Cavendish team is energized to be part of fresh innovations coming from the material sciences field. "We know that improvements in technology have been responsible for 50% of the growth in GDP over the last 100 years," Vyas says. "But good technology delivers the most important thing - an increased quality of life for all."



*Bath and Vyas in their UTP lab*

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