

## CASE STUDY: CODY FRIESEN

### Introduction

Cody Friesen, the founder of SOURCE Global (formerly Zero Mass Water) and, before that, Fluidic Energy, develops renewable technologies to directly improve the lives of people and communities around the world. He invented a rechargeable metal-air battery, as well as solar-driven hydropanels that generate water from air. Friesen received the Lemelson-MIT Prize in 2019 for his dedication to invention and mentorship, with a focus on mitigating climate change and delivering increased access to clean, safe drinking water and reliable energy to underserved communities across the globe.



Cody Friesen (Photo/Lemelson-MIT Program)

### Background and Early Life

Cody Friesen grew up in Gilbert, then a small town in Arizona. He came from modest means, and his father and grandfather, a former Mennonite, instilled in him a deep work ethic. Friesen's upbringing in a diverse landscape — ranging from deserts to cotton fields and citrus orchards — would later inform his appreciation of the history of the land, cared for by indigenous populations long before the arrival of people of European descent.

Friesen always maintained a meticulous curiosity about how the world works, from traversing expansive landscapes to taking apart and reconfiguring Christmas toys. Particularly interested in science and engineering, he found himself drawn to books on electricity and magnetism, and television programs like *Mr. Wizard* and *Beyond 2000*, which illustrated exciting experiments to kids on-screen and off.

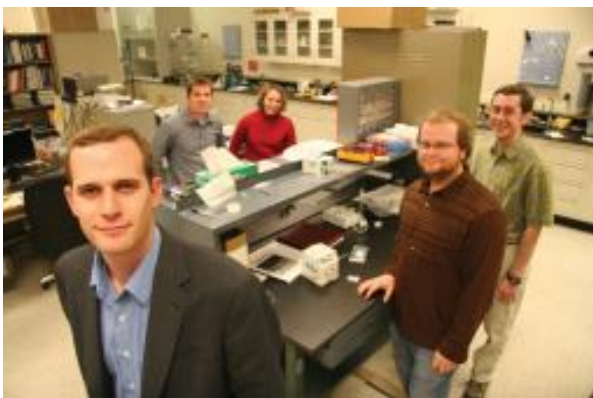
Friesen credits his high school physics teacher with providing a crucial foundation in advanced physics, which he applied to his higher education and career. He earned a bachelor's degree in materials science & engineering from Arizona State University in 2000, where he worked in the lab of materials science and engineering professor Karl Sieradzki, conducting electrochemical and scanning tunneling microscopy experiments. The lab afforded him the financial assistance he needed to stay in school, and gave him a group of peers and mentors equally enthused about scientific invention who were also oriented toward rigorous work.

Building on this foundation, Friesen pursued a Ph.D. in materials science at the Massachusetts Institute of Technology. Early on in his tenure at MIT, Friesen struggled with insecurity about whether or not he belonged among his wealthier, top-school-pedigreed peers. He set out to prove himself by taking an accelerated course load, earning his doctorate degree in 2004 after only four years. He received support and guidance from Professors Carl Thompson, an experimentalist, and Nicola Mazari, a computational scientist. Incorporating both approaches to materials science and engineering into his thesis, Friesen developed new methods for making quantum mechanical calculations. Recruited as a professor in materials science by ASU, Friesen returned to Arizona after receiving his Ph.D.

## Process: From Intent to Impact

Back in Arizona, Friesen combined the inventor proclivities of his youth with the pure science approach of his higher education. At ASU, Friesen organized his lab around improving zinc-air batteries. Used in a variety of contexts over the past century, these batteries had many good qualities — they were nontoxic, long-lasting and inexpensive. But zinc-air batteries were not rechargeable, unlike many of their more toxic or expensive contemporary counterparts. Zinc contains energy that can be released upon exposure to air, generating zinc oxide, but early attempts to recharge zinc-air batteries yielded elemental buildup that made them impossible to recharge more than a few times. Friesen employed a line of thinking he learned at MIT and would use for many years and inventions to come: he focused intently on the problem itself, its inherent challenges, and ways to use existing materials to generate a new solution. In this particular case, he created holes in the structure in which he implanted layers of nickel to prevent buildup, thus allowing the batteries to be charged repeatedly for many years.

Friesen turned this invention, the first and only of its kind, into a business in 2007. A few years after he founded Fluidic Energy to commercially manufacture metal-air rechargeable batteries, the firm began deploying zinc-air battery systems to remote communities. The installation of zinc-air batteries markedly improved lives, allowing communities to move away from using lead-acid batteries and diesel generators, which often provoke environmental toxicity on the ground and in the air. It also mitigated power grid unreliability, which has serious and immediate implications in developing and rural areas. Lack of sustainable energy can destroy water infrastructure and food production, creating major health and safety hazards. Employing an alternative to lead-acid batteries and diesel generators affected several fundamental needs: access to water, food and breathable air.



*Friesen, left, with his team at ASU, who received a grant for their work on metal-air batteries. (Photo/U.S. Department of Energy)*

Fluidic Energy embarked on a “500 Island Project” with Caterpillar Inc. and Indonesia’s state-owned electric company to bring renewable, reliable electricity to 500 villages throughout Indonesia in 2015. This partnership provided safe and sustainable electricity to an estimated 325,000 households and 1.7 million Indonesians, and created new local manufacturing jobs. The following year, Fluidic Energy and Caterpillar partnered with Madagascar’s government to install its battery systems in 100 remote villages, providing 400,000 people with clean, reliable energy for the very first time. These are just two instances of how inventive thinking worked to improve local economies and standards of living, while also reducing CO<sub>2</sub> emissions and mitigating global climate change.

Friesen moved on from the company in 2014, and it was sold in 2018; the company’s new owners renamed it NantEnergy. Since his team invented them in the 2000s, Friesen’s zinc-air batteries have been installed in nine countries across Asia, Africa, Latin America and the United States, with output poised to expand in the 2020s.

Friesen’s work follows the same trajectory as his mindset, which he recalls shifting in the last decade. He always wanted to succeed in his field, but he began to analyze his purpose: what exactly he hoped to achieve and why. He observed that his greatest sense of fulfillment came from working on a team — whether with grad students, postdocs or within his company — to positively impact people on tangible, individual levels. This shift in priorities compelled him to scrutinize one of the world’s greatest inequities: the lack of clean, drinkable water in populations around the globe.

Differences in geography at home and abroad inspired Friesen’s innovation. While installing renewable battery systems with Fluidic Energy in Indonesia, which experiences approximately 10 feet of rainfall per year, Friesen pondered whether it would be possible to harness water similarly to how solar panels harness energy from the sun. Renewable energy would go beyond electricity in this case, loosening constraints on drinking water, the scarcest of fundamental resources. Friesen set out to efficiently, sustainably generate clean water for businesses, communities and people who need clean, safe, high-quality drinking water across the world and where it’s needed most, including his



*SOURCE hydropanels installed in Puerto Rico.  
(Photo/SOURCE Global/Cody Friesen)*

arid home state of Arizona.

By 2014, Friesen had devoted his lab at ASU to passively extracting, distilling, and delivering moisture from the troposphere, the lowest layer of earth's atmosphere. The troposphere maintains approximately six times the water volume of all rivers on the planet. The sun regularly evaporates water over the ocean, pulling it into the air. This inspired Friesen's innovation: the SOURCE hydropanel. The panel pulls in air through solar-powered fans and draws its water vapor onto a hygroscopic material, which attracts only water molecules. Solar thermal panels then increase the water's vapor pressure, releasing it from the hygroscopic material and creating a rain-like condition within the device. The water falls into a reservoir at the base of the device, which mineralizes and stores it for later use. Each hydropanel can distill up to five liters of clean, safe drinking water per day. The hydropanels protect themselves by going into hibernation when the temperatures drop below freezing, require no piped water or electricity to operate, and can therefore effect change in some of the most remote but populous areas of the planet.

Near the end of 2014, Friesen founded Zero Mass Water, now SOURCE Global, a company that builds his hydropanel invention and installs it across the globe. The company's original name derives from the firm's culture and Friesen's approach to innovation, which revolves around becoming emotionally invested in problem statements, rather than in any one solution. Friesen and his team focus on the problem at hand — disparities in access to clean drinking water, for instance. Instead of tying themselves to any one solution to the problem, the team lets the data guide them. They are always prepared to pivot and shift their solution statement. In other words, they are "zero mass," or inertia-free, able to change their approach without any loss of momentum.



*A SOURCE hydropanel installed in Dubai. (Photo/SOURCE Global/Cody Friesen)*

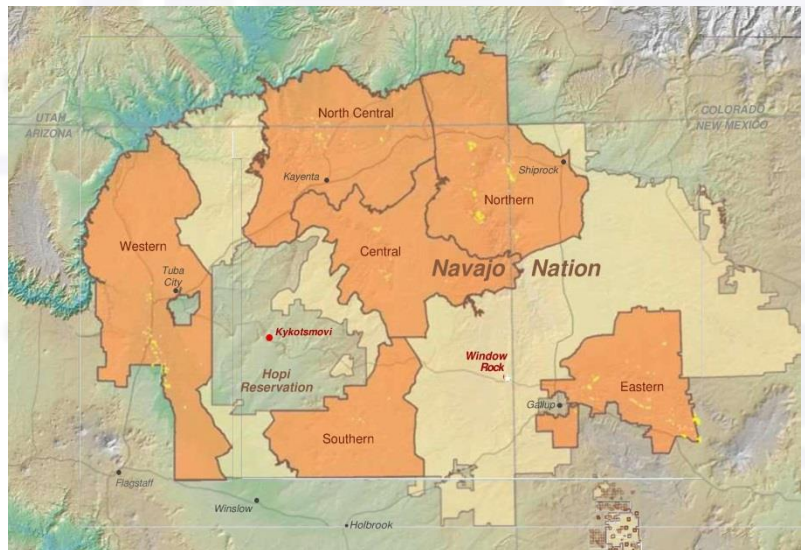
Increasing access to clean drinking water has a massive impact on both global and individual levels. Every 10 seconds, one person dies from a waterborne illness. Waterborne illnesses drive half of all inpatient hospital stays globally. Water shortages directly affect nearly 25 percent of people around the globe, with climate change threatening to rapidly increase that number to a startling 50 percent by 2050. Friesen's inventive work addresses these problems head-on.

SOURCE Global has now installed its hydropanels in 45 countries, embedded in a wide array of geographic and

social climates. They have provided clean water to schools, hospitals, hotels, government offices and refugee camps, to name a few. The panels operate in tropical forests, deserts and many climates in between.

In December 2019, for instance, Friesen’s team installed 149 hydropanels in Bahia Hondita — a remote area on the coast of Colombia where only 4 percent of residents had access to safe drinking water. Climate change compounded this problem, with heightened sea levels and tropical storms poised to pollute what natural water sources did exist. The hydropanels have made a significant and measurable difference in this community, supplying them with clean water in a renewable, reliable way, thereby also mitigating disease and decreasing mortality. This invention frees the people of Bahia Hondita to focus on other aspects of life. The community’s women, for example, used to walk six hours per day to fetch drinking water, only to return with water that was often salty and brown. Now, supplied with an indefinite source of clean water, they can put that time and energy into education or other pursuits that may better their lives.

More recently, in an entirely different environment much closer to Friesen’s home, SOURCE Global addressed another urgent, yet longstanding, water crisis. The American Southwest’s Navajo Nation lost 98 percent of its surface water in the last century alone. During the Cold War, Navajo lands were mined for uranium to produce nuclear material, a practice that contaminated the Navajo water supply long after mining ceased. This history, its consequences, and the precarious health of Navajo Nation are personal for Friesen. He views the Navajo as stewards of the Southwest, and questions the sophistication of an American society that does not take care of all its people.



*A map of Navajo Nation with areas that contain abandoned uranium mines marked in orange, and the mines within marked in yellow. (Image/U.S. Environmental Protection Agency)*

As the COVID-19 pandemic exacerbated this crisis, Navajo Nation leaders partnered with Friesen and his team to find solutions to the region’s water challenges. Navajo Nation’s virus infection rates climbed precipitously in April 2020, spurred by poor water access that made sanitation processes exceedingly

difficult. Lockdowns also complicated access, as those who relied on water from stores or wells faced shortages and closures. SOURCE Global worked with Navajo Nation to install hydropanels.

Beyond his company-made contributions, as a professor Friesen has mentored a new generation of scientists and inventors. He founded the ASU Innovation Open, a competition that provides mentorship and funding to students creating hardware ventures. The program awards approximately \$300,000 each year. Friesen has also allocated money earned through his companies to support the competition, as well as offering full scholarships to ASU students of modest means.

Inventors must communicate clearly and creatively across disciplines in order to encourage students to innovate, motivate customers to take chances on new products, and address the many problems that plague the world. Friesen uses metaphors to convey and deliver complex information and imaginative ideas. When applied to



*Friesen with SOURCE hydropanels. (Photo/SOURCE Global/Cody Friesen)*

grounded observation and problem-focused thinking, they break up the monotony of everyday thought and encourage creativity and accessibility, counteracting the notion that the work of innovation belongs only to a select and gifted few. After all, Albert Einstein imagined pursuing a beam of light to conjure and communicate his Theory of Special Relativity, and the Wright Brothers let bird wings guide their aircraft design. Indeed, as Friesen's work shows, innovation does not exist in new and faraway spaces, but between concepts with which people are already familiar. Metaphor helps to connect those concepts and illustrate that, with the right perspective in place, innovation is everywhere.