

# LEMELSON-MIT

**Winner of the 2019 \$500,000 Lemelson-MIT Prize – Cody Friesen, PhD**

*Founder and CEO of Zero Mass Water, Founder of Fluidic Energy, Associate Professor of Materials Science at Arizona State University, and Henry Crown Fellow of The Aspen Institute, Cody Friesen is a pioneer in infrastructure-free water solutions, and renewable, environmental energy technologies.*

## SOURCE Hydropanels

If you have ever purchased a new handbag or backpack, among other things, you probably noticed a small packet marked “Do Not Eat” on the inside. These pouches are filled with silica gel which is a type of desiccant—a substance used to absorb moisture. The silica inside the porous sachet might seem insignificant, but it actually keeps your purchased items dry and safe from moisture damage during the shipping process.

Desiccants are an important part of inventor Cody Friesen’s work. An Associate Professor of Materials Science and Engineering at Arizona State University (ASU) and founder of Zero Mass Water and Fluidic Energy, Friesen figured out a way to use a powerful desiccant to generate drinking water using nothing but the sun and air. His invention is called the SOURCE Hydropanel, and it is novel in its ability to optimize liquid water production from air without electricity, even in very low humidity.

Friesen and his group developed nanostructured composite materials that have the kinetics of traditional solid desiccants while also having the water loading capacity of liquid salt-based desiccants. By attracting moisture present in air, the desiccant material Friesen uses inside the SOURCE Hydropanel quickly traps water molecules from the air and binds them together, even under very dry conditions.



The ultra-efficient solar technology inside SOURCE Hydropanels causes the respiration of the desiccant-captured water molecules into a high humidity gas. The gas then goes through a psychrometric cycle in which it extracts heat from the sun. In this way, liquid water is generated from the vapor. The water becomes drinkable after minerals like calcium and magnesium are added and an optimal pH level is reached. The worldwide fleet of Hydropanels is controlled by machine learning algorithms that enhance water production in real-time.

# LEMELSON-MIT

## Rechargeable Metal-Air Batteries

Friesen's interest in renewable technologies isn't limited to water. Metal-air batteries have been around for about 100 years, but until Friesen, no one had been able to invent a rechargeable metal-air battery that would last through a substantial number of cycles. That's because in traditional zinc-air batteries, dendrites grow on the zinc anode and create an electrical short when they come in contact with the cathode. Friesen's invention takes a unique approach by *using* the dendrites and incorporating their structure for an increased current. Essentially, the batteries use a method of resetting the electrochemical cell by applying the dendrite charge to the cell to drive oxidation of the metal, removing uneven, dendritic distributions of metal that may cause premature shorting of the electrode bodies. This approach improves the battery's capacity, energy stored, and cell efficiency.

In addition, Friesen's team developed a proprietary non-precious-metal-catalyzed air cathode structure. They also created a process to create a material that is porous enough to allow enough oxygen to diffuse into the cell, while preventing the liquid electrolyte from leaking out of the cell so that it can enter and reach the catalyst. After years of experimenting, Friesen was able to create an air cathode that can withstand thousands of hours of discharge life.

## Applications and Commercialization

Friesen has over 100 active patents and 42 granted patents. Many of these patents are directly related to the technology behind the SOURCE Hydropanels and the rechargeable metal-air batteries. Friesen formed two companies to bring these technologies to the world, particularly to emerging markets where the potential to positively impact people's lives is greatest.

Friesen's first company, Fluidic Energy, was formed to commercialize and deploy his battery systems at critical load sites across the globe. Friesen helped raise over \$150MM in equity financing to build the company, which has provided power during over a million long duration grid outages worldwide. The batteries allow for the replacement of polluting diesel generators that often serve as the backup solution for power outages. The result is a dramatic reduction in operating expenses associated with diesel fuel and generator maintenance. Fluidic was majority-sold to Patrick Soon-Shiong and renamed NantEnergy. The company is now dramatically expanding its global reach and its penetration in the marketplace.

Friesen started Zero Mass Water (ZMW) to drive advancement and deployment of his water generation solutions, while promoting economic and social benefits to the communities that implement them. ZMW takes measures to ensure that its Hydropanels are installed using local labor, fostering the economic growth of the area. Installed in arrays starting at 2 Hydropanels and expanding to fields of several thousands of panels, SOURCE makes high-quality drinking water a renewable, accessible resource for households, businesses, and communities.

# LEMELSON-MIT

SOURCE is completely changing the paradigm of water. It eliminates the current measures we take to produce safe drinking water, which include: pipe infrastructure, digging, transporting, and cleaning. As a worldwide water crisis continues to expand, renewable, infrastructure-free delivery of clean drinking water is paramount. The SOURCE Hydropanels are already being used by schools in Mexico, Syrian refugee communities in Lebanon and Jordan, and fire stations in Puerto Rico that have been hit by hurricanes. SOURCE has also been deployed across the United States in homes, schools, and offices. ZMW plans to continue its mission to lead with love by expanding its reach to even more people in need. In fact, Friesen is donating the Lemelson-MIT prize to a project that ZMW has in the works with Conservation International to provide clean drinking water via SOURCE Hydropanels to a Bahia Hondita community in Colombia.