SMALL BUSINESS INNOVATION RESEARCH CASE STUDIES - SMALL BUSINESSES TAKE ON THE CHALLENGES OF WATER REUSE

DESCRIPTION: Profiles of 5 small businesses with innovative water reuse projects. These case examples showcase the challenges and opportunities surrounding the commercialization of new products.

CREATORS: The Environmental Protection Agency, Office of Research and Development

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Small Businesses Take On the Challenges of Water Reuse

EPA's mission is to protect human health and the environment and to that end EPA works to ensure that Americans have access to clean water. To serve this effort, the National Water Reuse Action Plan (WRAP) was developed to build technical, financial, and institutional capacity for communities to pursue water reuse practices.

EPA is one of 11 agencies across the federal government that participates in the Small Business Innovation Research (SBIR) Program to support the development and commercialization of innovative technologies that support its mission. Through its SBIR Program, EPA has supported several small businesses with particularly innovative water reuse projects. A number of these businesses are profiled below, showcasing the simultaneous challenges and opportunities surrounding the commercialization of new products in this critical area.

Aspen Products Group, Inc.

Aspen Products Group, Inc., is a small business in Marlborough, Massachusetts, with six employees. When the company was established, it focused on technologies for fuel cells; however, it shifted its focus to membranes that control emerging and organic contaminants in water. It has developed nanofiltration membranes that produce water at up to 10 times the throughput of conventional nanofiltration membranes, leading to reductions in energy consumption and capital cost. The High-Flux Nanofiltration Membrane for Emerging Contaminant Control removes organics, pesticides and emerging contaminants from water. With SBIR support, Aspen Products developed and demonstrated the value of novel membrane technologies for the nanofiltration industry; however, the membranes addressed contaminants that are not widely regulated, which hindered their marketability to original equipment manufacturers and ultimately prevented the successful commercialization of the technology for this application.

Cambrian Innovation

Cambrian Innovation is a Boston-based business of 28 employees focused on the development of simple, sustainable and cost-effective water reuse methods. SBIR supported the company's Bio-Electrochemical Systems for Ethanol Wastewater Treatment project, in which it developed a treatment for ethanol stillage (liquid waste resulting from ethanol distillation) that is based on microbial fuel cell processes and can produce small amounts of electricity. Cambrian Innovation also has developed multiple processes for wastewater treatment and resource recovery that create fewer waste byproducts, use less energy and result in lower operating costs. The business successfully maintains 22 facilities hosting different technologies, and its processes are used by some of the top names in food and beverage processing. Despite its broad success, Cambrian Innovation originally found commercializing its products to be challenging. The company had multiple approaches funded through different SBIR agencies, but could champion only one for commercialization. While the EPA project was one of the ones that did not move forward, EPA's support facilitated Cambrian's development of multiple water reuse technologies and enabled it to determine which project had the highest commercial potential, with the largest customer base and the highest likelihood of addressing relevant industry needs.

dTEC Systems, LLC

Seattle-based dTEC Systems, LLC, is a four-employee business centered on phosphorus removal and recovery that received SBIR support for its Phosphorus Recovery and High-Efficiency Biological Nutrient Removal from Wastewater with an Innovative Aerobic Granular Sludge Sequencing Batch Reactor Process project. By the end of this project, dTEC Systems had effectively demonstrated that its system removes large amounts of biological phosphorus and nitrogen at multiple regional municipal plants in Washington state. Because municipal water regulations dictate that water may contain only a low level of phosphorus, the need for dTEC's technology was apparent, which drove the implementation of its phosphorus-recovery process. Building relationships with and understanding the unique needs of the local municipalities was also key to gaining support for the demonstration of a new technology.

Microvi Biotech

Microvi Biotech, a business with 15 employees in the San Francisco Bay area, uses materials science and innovative microbiology technology to improve water purification and wastewater treatment methods to enhance renewable chemicals and fuels. Developed via the SBIR-supported project High-Efficiency Nutrient Removal and Recovery for Achieving Low Regulatory Limits, Provi™ is a treatment system that consolidates the treatment of phosphorus and ammonia in wastewater using novel biocatalysts composed of specialized high-efficiency microorganisms. This process removes ammonia and recovers phosphorus without producing secondary waste streams, and it lowers operating costs. Microvi Biotech installs this system for its customers—which span the municipal, agricultural, and manufacturing sectors—who then pay for only the water, not the technology. In doing so, Microvi Biotech minimizes risk and costs for its customers, leading to successful commercialization and adoption of its system. Microvi Biotech found entry for its technology in the United Kingdom where the market is more visible than the decentralized U.S. market. The company also won the Institute of Water Scottish Region Innovation Award after successful completion of a series of large-scale demonstrations.

XploSafe, LLC

XploSafe, LLC, is a business with 12 employees based in Stillwater, Oklahoma. XploSafe's Economic Recovery and Reuse of Nutrients from Wastewater project was supported by SBIR and led to the development and commercialization of low-cost biodegradable sorbents to passively adsorb target nutrient ions in wastewater. Once recovered, these concentrated nutrients can be used as fertilizer. The business' original goal was to sell the product to large water treatment plants, but XploSafe quickly found that these larger plants had no incentive to take on the necessary risk or spend sufficient capital to adopt the new technology. Thus, XploSafe shifted gears to target smaller markets, advertising its technology as a solution instead to the small, but substantial, sphere of aquarium treatment, which requires the removal of the same nutrients in its water treatment processes. Thus, PhosRox™, an inorganic sorbent media for phosphate and nitrate removal, was born. By targeting the smaller aquarium market, XploSafe successfully distributed its product and created value and revenue for the business. XploSafe was awarded the 2021 EPA Green Chemistry Challenge Award in the Small Business Category, recognizing a groundbreaking scientific contribution in the green chemistry field for their development of PhosRox™.

Challenges

These small businesses developed valuable water reuse technologies that addressed important areas including energy efficiency, recovery of valuable nutrients and removal of target contaminants, as well as improved operating costs but still faced challenges when attempting to commercialize their work. Although the need for improved water reuse technology is increasing, incentives to adopt innovative technology are sometimes lacking.

Many potential clients are in municipalities with water reuse regulations; because they are already compliant with existing regulations, few are compelled to adopt new, improved technology. This resistance to change makes it particularly challenging for small businesses with innovative technology to break into big industries or regulated utility entities. The differing restrictions and regulations around water reuse in different states and industries also proved cumbersome for project designers, who had to adjust their methods for potential customers based on industry location.

The deployment time for new water reuse technology—when accounting for development, demonstration, and implementation of the technology—is long, which dissuades potential customers or investors who are seeking quick results and returns. Even when customers are interested in new technology, new processes often require that customers use many of their own resources to implement them. Thus, risk-averse adopters, industries and municipalities are unlikely to invest the time, capital, and energy necessary for the successful adoption and implementation of innovative water reuse products and methods.

Lessons Learned

These small businesses have had to be resilient and adaptable to find the best ways to advance commercialization of their reuse technologies. Some of the lessons they have learned are summarized below.

Market Entry

Some small businesses have found success going to industrial facilities before breaking into the municipal market.

Some companies found success by pivoting their technologies to smaller, more niche markets like aquariums or breweries who want to move towards sustainable approaches (with less by-products and energy use) and are less risk averse than a larger municipality. Other market entry points include golf courses and turf farms. Regulatory drivers, including low phosphorus standards, make decentralized treatment, possibly powered by renewable energy, another target market for some of these entrepreneurs.

In addition, smaller businesses often look to establish relationships with larger engineering consulting companies to help break into the municipal market. But these firms may have a disincentive to recommend anything that would increase risk.

Business Model

Small businesses must evolve their business plan or technology to meet the needs of the customer. In some cases, companies have found that it is more appealing to sell the end product, clean water, rather

than the technology itself. Other companies found that by eliminating secondary wastes, they not only addressed an important environmental issue, but also made the solution more economically appealing.

Market Drivers

In the future, other market drivers will increase the need for new technology solutions. Concerns and new regulations surrounding perfluorinated chemicals such as per- and polyfluoroalkyl substances (PFAS) and other chemicals of emerging concern (CECs), along with the need to minimize residual streams, will create a need for innovative and cost-effective solutions.

EPA Support

In an effort to advance novel technologies in the water reuse space, EPA's SBIR Program has provided support and opportunities to facilitate the commercialization of new water reuse technology. For multiple years, EPA has highlighted reuse as a topic in its annual SBIR solicitation. Initially, topics focused on broad reuse areas such as monitoring and treatment and have since evolved to target more specific needs like those for urban settings and agriculture applications. Through its SBIR Program, EPA has supported small businesses attempting to break into the large and competitive sphere of water reuse by providing them commercialization support aimed at facilitating connections in the industry and providing access to experts in the field that could potentially lead to valuable partnerships. EPA's SBIR Program also supplied critical financial support; having EPA funding behind a technology helped validate the supported businesses and projects, which enabled many of their potential clients and partners to invest in the businesses with confidence. While there are significant barriers to entry especially in municipal markets, developing, supporting, and commercializing methods by which water can be reused is worth the effort and risk. Recovering water and nutrients from waste is critical, and EPA's SBIR Program will continue to support the businesses that are working to create technology solutions in the water reuse space.

To help navigate the varying water reuse regulations across states, EPA recently released the Regulations and End-Use Specifications Explorer (REUSExplorer). This is a web-based tool for exploring water reuse regulations and guidelines that is searchable by state, source of water, and end-use application.

To learn more about EPA's SBIR Program, please visit: https://www.epa.gov/sbir

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To learn more about EPA's National Water Reuse Action Plan: https://www.epa.gov/waterreuse