

Profiling Energy Industry Entrepreneurs:

What Can be Done to Foster Clean Energy Entrepreneurship in a Time of Fiscal Restraint?



A REPORT FROM THE NATIONAL SMALL BUSINESS ASSOCIATION

Foreword

American small businesses are known for their innovation, drive and significant contribution to the U.S. economy. More and more, they also are becoming known for their commitment to environmental sustainability. Long gone are the days when small-business owners dismissed energy efficiency and environmental stewardship. Instead, today's small-business owners embrace energy efficiency and sustainable practices as conscientious community members, as well as a means to improve their bottom line.

While energy efficiency is becoming a greater part of the American small-business lexicon, there is a strong and growing group of entrepreneurs who are creating and developing new technologies and business models that help move the industry – as well as the country – forward. These small businesses operate in an industry dominated by corporate giants and well-funded universities, yet they continue to achieve new, clean energy breakthroughs, underscoring the fact that small business truly drives U.S. innovation.

The National Small Business Association (NSBA) has been a long-time advocate for small-business energy efficiency and has compiled the following report, "Profiling Energy Industry Entrepreneurs: What Can be Done to Foster Clean Energy Entrepreneurship in a Time of Fiscal Restraint?" This report was completed with support from the Bipartisan Policy Center (BPC) and will provide new and compelling information on this emerging industry of small, clean energy businesses.

These so-called "clean energy companies" or "green small businesses" hold great potential for job creation as the industry grows, as well as offer new ways consumers and businesses can reduce their energy usage. However, very little is actually known about these companies, their technologies and how their unique start-up experiences require a different way of looking at them. We are pleased to offer this report as a critical way to better understand these companies.

Given the strained economic times we all face, garnering financial support for a small-business startup is extremely difficult, and it is all the more difficult for emerging technology startups. However, the promise and potential these firms hold make it critical that we understand their distinctiveness and support growth in this industry. This report provides detailed profiles of several clean energy businesses, identifies the various challenges they face, and offers policy recommendations to help spur continued industry growth during challenging economic times.

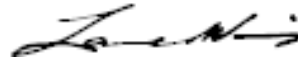
Today, there are 70 million people in the U.S. who operate or are employed by a small business. Harnessing these individuals' commitment to reducing U.S. energy use can, and should be, a top priority for policymakers looking to bring down unemployment, reduce American energy dependence, improve public health, and more.

NSBA is pleased to provide you with this report. We hope you find it useful.

Sincerely,



Todd McCracken
NSBA President



Larry Nannis
NSBA Board of Trustees Chair

Clean tech entrepreneurs, clean energy startups, green businesses – the names for these companies are almost as numerous as the views about their economic potential. They have been described as everything from saviors of the American economy to examples of what is wrong with federal government spending. Despite the sweeping generalizations that typically accompany this emerging industry, there has been relatively little investigation into the businesses themselves. This report examines several of these emerging “clean energy” businesses on an individual level, and identifies the challenges they have overcome and the obstacles they still face. The report concludes with recommendations that encourage continued growth in this industry while recognizing that generous subsidies are no longer an option.

The profiled entrepreneurs had to overcome economic, policy and technological uncertainty to grow their idea into a viable business. While many small businesses faced economic uncertainty over the past few years, these companies also had to confront the technical challenge of developing a new product in a country without a national energy policy. Despite these challenges, these companies have added new jobs to the economy while other industries have been stagnant.

The growth for most of the clean energy industry has been steady but slow. The “green job” boom that was promised has yet to materialize. Yet to pull the plug on a nascent industry based on results during the “Great Recession” seems shortsighted. The country’s economy needs to add new jobs, but this endeavor must be balanced with cautious fiscal spending. How, then, do policymakers balance the need for risky start-up capital, with Congress’ reluctance to increase government spending?

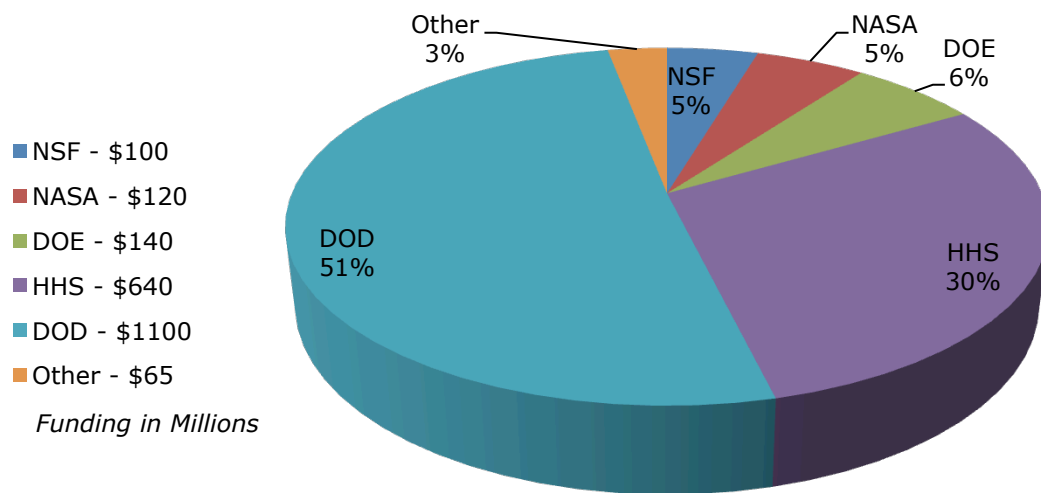
The companies highlighted below have utilized various federal, state and local economic growth programs to build their businesses. By examining the programs that have helped create this first wave of growing businesses, policymakers can hear from the companies directly about what kind of programs work, as well as what the U.S. can do better.

SBIR Overview

The Small Business Innovation Research (SBIR) program is a federally funded grant program that requires federal agencies with research budgets of more than \$100 million to set aside a portion of their research and development (R&D) funds for projects that will be undertaken by innovative small businesses. In 1982, the program was signed into law by then-President Ronald Reagan. Since its formation, the SBIR program has enjoyed strong bipartisan support, but in recent years has been subject to frequent short-term extensions, rather than long-term reauthorizations.

Eleven federal agencies currently contribute to the program. Each participating agency devotes 2.5 percent of their annual research budget to the SBIR program. Agencies develop research solicitations and accept proposals from qualified small businesses. Research awards are then made on a competitive basis. The Small Business Technology Transfer (STTR) is a similar program that connects small businesses and university research offices. The STTR program includes smaller dollar amounts (0.3 percent of the agency's research budget) and is frequently coupled with the SBIR program.

SBR Funding by Agency



An analysis of the 2009 budget showed that \$2.15 billion in research dollars made its way to small businesses through the SBIR program. Of this amount, almost half (\$1.1 billion) was allocated from the Department of Defense's military research budget. The Department of Health & Human Services' budget was \$640 million; the Department of Energy's budget was \$140 million; NASA's was \$120

million; and the National Science Foundation's was \$100 million. The remaining agencies consisted of the Departments of Homeland Security, Commerce, Agriculture, Education, Transportation and the Environmental Protection Agency for a total of \$65 million dollars in funding for SBIR projects.

SBIR Phases

The SBIR program is divided into distinct research phases with different funding levels apportioned to each phase. Phase I SBIR contracts allot small businesses up to \$150,000 to conduct a nine-month study on the feasibility of solving an agency problem through new research or technology development. Solicitations during Phase I describe the agency's research needs and invite small businesses to submit R&D proposals outlining their plans for meeting the agency's goal. After winners are selected and the research begins, the agency continues to assess the company with a focus on evaluating the scientific, technical and commercial merit – as well as ultimate feasibility – of the proposed research concept.

After Phase I projects have been completed, the agency reviews the first phase of work and determines which projects hold the most potential. These projects are then given Phase II contracts, which provide the company with up to \$1 million to build a prototype of the proposed technology over the course of two years. At the close of Phase II research, SBIR companies are expected to have private sector funding or a contract to provide the product to the government. In light of the constrained capital market, some agencies have developed a Phase III step in which the agency funds additional research or provides follow-on grants or contracts using non-SBIR agency funds.

Venture Capital Overview

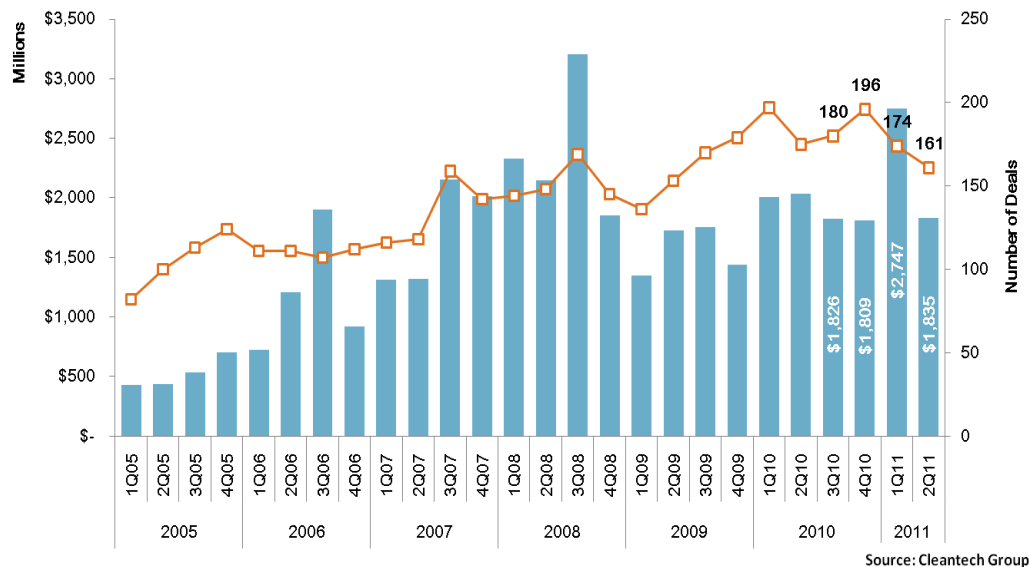
Venture capital (VC) is a form of financial investment provided to early stage, high potential startups. VC investors provide cash for the company to grow in exchange for an equity stake. The concept of venture capital blossomed during the Internet boom of the late 1990s when dozens of VC firms helped new Internet-based companies go public and contributed to the growth of this new industry. In a traditional investment cycle, VC firms provide the company with funding to develop their product and begin manufacturing. The firm then expects to take the company public within three to seven years of the initial investment and reap huge dividends on its investment.

Despite the attention paid to the VC industry as a source of funding for startups, VC funding is actually quite limited and unusual. Venture capital investment commitments for 2009 amounted to roughly 0.08 percent of the value of the stock market. The U.S. Small Business Administration (SBA) reported in 2009

that roughly 600,000 new businesses are started in the U.S. each year. Meanwhile, Venture Source, a venture capital research organization, reports that roughly 1,000 businesses receive their first VC funding each year. Mathematically, that equates to only 1/6th of one percent of new businesses obtaining VC funding. While VC backing is not driving the majority of small business creation, it is highly successful at helping companies go public. Sixty percent of companies brought public through initial public offerings (IPOs) since 1999 were VC-backed.¹

The Cleantech Group, an industry research firm, provided sector-specific background in July 2011 when they found that clean energy investments during the second quarter of 2011 were down over 33 percent compared to the first quarter. The group also found that most investments were in later-stage companies as opposed to recently launched startups. While investment in the clean tech sector boomed in 2008, many VC firms now realize that their exit strategy will take longer with clean tech than other sectors and, therefore, have moved their capital elsewhere.

Global Cleantech VC Investment



Business Incubators

Every new business starts off as an idea, which must be sharpened and reevaluated until it becomes a viable business. Business incubators provide

¹ It Ain't Broke: The Past, Present, and Future of Venture Capital, Steven N. Kaplan and Josh Lerner, December 2009 available at <http://faculty.chicagobooth.edu/steven.kaplan/research/kaplanlerner.pdf>

companies at the early “idea” stage with the resources necessary to transition from an idea into a fully functioning business. Incubators assist in this development process by offering companies access to affordable office space and professional services (such as legal and technical consultants), and introducing them to potential funders.

According to the National Business Incubator Association (NBIA), the number of business incubators in this country has grown from approximately 12 in 1980 to over 1,100 in 2006. NBIA has reported that 87 percent of all firms that have graduated from their member incubators are still in business. This almost doubles the national average of 44 percent startup success rate that the SBA has reported.

Many business incubators support a variety of companies, while a few new entrants have focused exclusively on clean energy technologies. The New York State Energy Research and Development Agency’s Clean Energy Business Incubator (CEBI) has created six regional incubators across the state, with each region focusing on a particular technology. For instance, the Syracuse region focuses on new building technologies, while the Long Island region concentrates on energy storage advancements. The program estimates that through 2010, after only 18 months of operation, the CEBI has created several hundred net new jobs at start-up companies, and member companies have attracted \$16 million in private capital and \$11 in federal funding. Having invested only \$2.5 million in program costs to this point, the state has seen a 10 to one return on its investment so far.

Green Patents by Small Firms

One indicator of activity in a particular industry is the number of patents held. A recent study by the SBA Office of Advocacy, *Analysis of Small Business Innovation in Green Technologies*, examined patenting trends in the green technology field and found that small, innovative² firms were excelling in this emerging sector. While small, innovative firms typically account for eight percent of all patents, in the green technologies sector, these small firms account for 14 percent of the patents held. In the solar energy and smart grid markets, small firms accounted for 32 percent of total patents.

Importantly, the patents held by these small firms are cited³ 2.5 times as frequently as those held by large firms, leading to the conclusion that small firms are inventing important new technologies in this field.

² The study defines an innovative firm as one with 15 or more patents granted between 2005 and 2009.

³ High citation rates have been correlated with outcomes such as inventor awards, increases in sales and profits, stock price appreciation, and greater licensing revenues.

Authors of the study also found that while large, innovative firms were four times more likely to hold a green patent than small firms, most large firm patenting is only ancillary to the company's primary business. Among small firms holding green patents, the green technology patents comprised an average of 20 percent of the company's patent portfolios. In large firms with green patents, the percentage of the portfolio averaged only 1.5 percent. Small firms that patent a green technology are more likely to build their business around new technologies.

Sustainability Efforts by Small Manufacturers

A new study by the American Small Manufacturers Coalition found that sustainability efforts are increasingly important to manufacturers, with 59.2 percent of manufacturers reporting that sustainability is important or highly important to their future, up from 35.1 percent in 2009. Despite the importance executives have assigned to sustainability, 57 percent of small manufacturers said they have little or no strategy to become sustainable.

The recent corporate sustainability push has seen large manufacturers distance themselves from their smaller counterparts by leveraging their available capital and hiring outside experts to direct their sustainability efforts. Smaller firms have struggled to find the resources for new capital projects; 42 percent said they have no measurement or review system to track sustainability efforts, compared to only 25 percent of the largest firms. Finding opportunities to connect existing manufacturers with new entrepreneurs could help small business sustainability efforts and encourage the growth of energy startups.

Company Profiles



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Like most entrepreneurs, Alphabet Energy CEO Dr. Matthew Scullin is optimistic about his company's potential for growth. In fact, he believes his firm can develop and produce waste heat recovery devices on a massive scale. The San Francisco-based company has developed a new thermoelectric material they believe can be produced at a low cost and deployed across a wide variety of applications.

Thermoelectric materials are semiconductors with no moving parts that generate electricity when the material is subjected to a temperature difference between the two ends. The thermoelectric effect occurs when one end of a material, such as a wire, is heated. Electrons travel to the colder end, producing an electrical current. To effectively and efficiently use the heat, the temperature difference between the two ends of the wire must be preserved. To maintain this differential, a distinctive material is required; ideally the material would have excellent electrical conductivity but poor heat conductivity.

Alphabet says its innovation is in both the choice of material and proprietary technology that gives it low thermal conductivity, making it adaptable enough for use in small devices yet scalable for efficient production in large power plant exhaust towers. Once commercially deployed, the device will connect to a plant's electrical system or to the grid itself and instantaneously turn waste heat into electricity, improving the efficiency of any industrial heat-producing process.

Dr. Scullin began developing the new thermoelectric material while he was pursuing his doctorate at University of California, Berkeley and working at the Lawrence Berkeley National Laboratory. After receiving his doctorate, Dr. Scullin licensed the technology he had been developing at the national lab and formed Alphabet Energy in 2009. Among the first steps he took was to apply for several SBIR grants to try and commercialize the lab technology. Alphabet Energy was able to win four out of the five SBIR Phase I grants it applied for and by the end of 2009, the company was working on SBIR-sponsored thermoelectric projects for the U.S. Army and the U.S. Department of Energy (DOE). In early 2010, the

U.S. Air Force selected Alphabet Energy to begin work on thermoelectric materials to benefit its military operations.

Leveraging the success of its SBIR-backed projects, Alphabet Energy obtained \$1 million in seed financing from Claremont Creek Ventures and the California Clean Energy Fund's Clean Energy Angel Fund. The financing allowed Alphabet to manufacture commercial prototype devices using existing semiconductor manufacturing processes. This "lean" start-up model enables Alphabet to produce their new products on existing manufacturing lines, eliminating the need for a huge capital investment in the form of a new manufacturing plant. Dr. Scullin attributed Alphabet Energy's success in acquiring venture capital funding in a particularly harsh funding environment to the technological validation that the SBIR program provided. While Scullin believes Alphabet Energy's technology would eventually have proven itself without SBIR-backing, the SBIR program helped minimize the technology risk that concerns investors and enabled Alphabet to validate their technology much faster.

In early 2011 Alphabet's advancing research led to Phase II SBIR contracts from the U.S. Army and the U.S. Air Force totaling \$1.48 million in funding. Under the Phase II contracts, Alphabet will deliver products that generate electricity from the military's many waste heat sources, including boosting the energy efficiency of mobile auxiliary power generators. Dr. Scullin anticipates meeting the goals of these Phase II contracts and then developing pilot projects with commercial partners in 2012, including companies in the transportation, manufacturing and power generation industries. Alphabet Energy's goal is to become the leader in a potential \$100 billion global market for sales of its products for the conversion of waste heat into electricity.

Recently, Alphabet has hired a vice president of manufacturing and several new engineers. The company also has raised \$12 million in venture capital funding to continue its development and expansion. For a two-year-old startup founded by a newly minted Ph.D., Alphabet Energy's rapid rise could lead to the continued growth of the waste heat recovery industry.



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While many energy industry startups like Alphabet Energy focus on revolutionary new technologies, one company has resurrected and updated a machine originally created in the 19th century: the Stirling hot air engine.

Cool Energy, Inc., based in Boulder, Colorado, has rebuilt the century-old device into a 21st century technology that can save businesses and the military money by producing on-site electricity using only waste heat as a fuel. With recent waste heat studies estimating that more than two-thirds of the fuel used to generate power in the country is lost as wasted heat, there is abundant potential to improve efficiency and exploit this resource.

For entrepreneurs, ideas and inspirations can be found anywhere, at any time. Likewise, the idea for Cool Energy's SolarHeart® Engine was not formed by a team of Nobel Laureates at the National Renewable Energy Laboratory, but rather around the kitchen table of a Tennessee home following a family dinner. The Weaver family is more technologically savvy than most, with patriarch Dr. Samuel Weaver holding a Ph.D. and M.S. in Metallurgical Engineering and nine patents for advanced materials, and brothers Sam and Dan each having sophisticated, technical backgrounds. Following dinner, the conversation turned to ideas for new energy sources, and the group discussed the potential of using waste heat. High temperature heat already was being recycled but could low-temperature heat be effectively used. With that conversation, the basic idea for a company was formed and Cool Energy was founded in March 2006 with Sam Weaver as its new president.

The challenge facing Cool Energy was how to update the Stirling engine to produce more electricity while relying on lower temperature heat as an input. The original Stirling engine was constructed in the early 1800s and it relied on cycling a heat source through hot and cold engine chambers to generate electricity. The temperature differential between the two engine chambers drove pistons to create the electricity. Traditional Stirling engines required temperatures above 932° F, but Cool Energy wanted to produce electricity using 392° F waste heat and thus widen the market for potential customers.

To develop a new engine, Mr. Weaver sought funding and found that the National Science Foundation (NSF) was interested in the potential of waste heat as a clean energy resource. Working initially under a Phase I SBIR grant from the NSF, the

team at Cool Energy built a new prototype engine that used non-traditional ceramics and plastics to reduce heat loss and improve engine reliability. These new materials also lowered the cost of constructing the engine and improved its efficiency.

Cool Energy received a Phase II grant from the NSF that enabled continued improvements to the engine design and started the company down the path toward commercialization. During this period, Weaver found additional funding from the DOE and the State of Colorado Governor's Energy Office. Cool Energy also won the 2009 Clean Tech Open Regional Sustainability Award worth \$50,000.

When used in conjunction with a traditional diesel generator, Cool Energy's SolarHeart® Engine can utilize the generator's exhaust heat to produce electricity and boost the total electricity generated by the diesel generator as much as 20 percent. This efficiency improvement represents significant value for those in industry, the military and remote locations where the cost to deliver fuel can be as high as \$15 per gallon. In these high fuel cost scenarios, the payback time for the engine could be less than a year. A 20kW engine operating at 80 percent in a traditional industrial setting would see payback times ranging from 2.9 years in locations with high electricity prices of \$0.25/kWh to 7.2 years in more traditional \$0.10/kWh electricity markets.

In a commercial context, many industrial and manufacturing facilities use extreme heat to convert raw materials into usable inputs and any heat leftover from the process is simply vented into the air. By installing one of Cool Energy's engines they could process this waste heat and turn it into usable electricity for the industrial facility. Cool Energy believes the most promising businesses for their technology are metal processors, brick makers, petroleum refiners, food processors and cement and textile manufacturers.

Cool Energy recently deployed two engines in Europe. An electrical equipment manufacturer is using one in an industrial context. The other engine is being used in Italy in conjunction with a large solar thermal array where the heat to run the engine comes from solar-heated liquids resulting in truly "clean" electricity. The company also hopes to land a military contract to significantly improve off-the-grid base efficiency and reduce the amount of fuel required by these remote locations.



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Another company looking for new, efficient sources of energy is Hydrovolts, a Seattle, Washington-based business that specializes in hydroelectric turbines that can be deployed quickly at a low cost. Burt Hamner, a marine technology specialist, founded the company in 2007. Mr. Hamner previously worked on clean technology issues with the United Nations, the Asian Development Bank and the U.S. Agency for International Development (USAID). While most hydropower projects are large scale, Hydrovolts set out to find a hydropower solution for smaller sources such as canals and irrigation channels.

Hydrovolts grew out of the most advanced study of tidal power feasibility in the country to date. In 2005, the City of Tacoma, Washington proposed a 16-megawatt (MW) renewable tidal power project in the Tacoma Narrows of Puget Sound. Mr. Hamner was hired to conduct the study; after examining the results he determined that the most cost effective source of hydropower was in currents that flow in a single direction. While this was the end of Tacoma's push for tidal power, it led Mr. Hamner to form Hydrovolts, entering what he believed was an untapped market. With a serious focus on convenient, small-scale hydropower, Hydrovolts adopted the business goal of deploying in-stream generation in just one hour.

In order to begin designing new turbines for smaller waterways, the company first needed a home. Hydrovolts was invited to join one of Seattle's best business incubators: the McKinstry Innovation Center. The Center provides businesses with an office, space to create demonstration projects, a conference room, access to professional services and various other perks. The office space enabled Hydrovolts to immediately project a professional image and establish the company's legitimacy.

While the new office at McKinstry put the company on the right track, the team at Hydrovolts knew they would need some form of financing to develop their technology and begin demonstration projects. After meeting with several VC firms in 2008, the company realized that it would have to seek out alternative sources of capital.

They began entering various business competitions and eventually won more than \$150,000 in prize money, including \$50,000 for winning the 2009 CleanTech Open. In addition to this critical capital, Hamner applauds the intangibles that

come from business competitions, including constructive feedback on the company's business model and pitch. These business competitions also typically provide access to high-quality mentoring and impose an organizational structure on participants that benefits the companies in the long term.

In addition to competition prize money, Hydrovolts also raised \$700,000 through angel and corporate investors. The team has worked with the Pacific Northwest Laboratory, a DOE lab, which has provided the company two grants for technical assistance on the turbine technology.

After two years of dedicated research, Hydrovolts created high-efficiency, in-stream, hydrokinetic turbines that generate electricity from water currents. The turbines are dropped into and secured in an open channel and produce one to 25 kW each, depending on the velocity of the current. By focusing on small waterways with single-direction currents, Hydrovolts' technology can be deployed quickly with low installation costs.

The company has applied for several SBIR grants from the DOE to refine its technology, but has run into various stumbling blocks. After spending dozens of hours on their first SBIR application, their submission was rejected because it was missing a few small pieces of information. Following this learning experience, Mr. Hamner sought the assistance of the Seattle Small Business Development Center and received helpful guidance to minimize or eliminate application rejection.

This year Hydrovolts sold its first turbine, a 25 kW model, to a corporate customer who also has invested in the company. The company hopes that with a renewed focus on hydropower by the federal government, they will be able to deploy more demonstration projects. In the current capital-constrained market, the company believes that if it can show guaranteed returns from demonstrations, then the long-term risk of investing in its turbines will be reduced. Although the potential for in-stream hydropower exists, finding the capital to grow the company remains Hydrovolts' biggest obstacle.



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Oscilla Power, a startup with offices in Seattle, Washington and Salt Lake City, Utah, has taken a different approach to harnessing energy from water bodies through a new power generation unit with no moving parts. Various researchers have estimated that the usable energy potential of wave motion is over two million megawatts worldwide, which by comparison would effectively double the U.S.'s entire current generating capacity of just over one million megawatts.

Oscilla Power aims to become a leader in this potentially huge new industry through its patented iMEC™ technology platform. This new technology uses low-cost magnetostrictive alloy-based devices to convert the mechanical energy of vibrations or oscillations into electrical energy.

Oscilla Power began its trek from technology development to utility-scale deployment only two years ago. The iMEC™ technology was developed by the company's chief technology officer, Dr. Balakrishnan Nair. After a large ceramics manufacturer acquired Dr. Nair's previous company, EmiSense, he began laying the groundwork for Oscilla Power's new technology. Along with co-founder Rahul Shendure, Dr. Nair began technology development by seeking funding for an initial test project. They sought out angel investors who were willing to put a small bet on a potentially breakthrough product. Several angel investors signed on and the company ultimately was able to prove the science behind its technology for less than \$150,000.

After the first successful trial, the company needed additional funding to begin developing prototypes that would demonstrate the technology's potential. Through an affiliated company, Oscilla applied for SBIR grants from the NSF and the National Oceanic and Atmospheric Administration to test the effectiveness of the technology in producing electricity from ocean waves. The company won both SBIR Phase I grants and received new technology development funding of approximately \$250,000.

While working on the ocean wave application, the founders also began brainstorming other potential uses for the technology. Oscilla management knew that the downturn in VC funding meant that they would need to look for other avenues of funding. They found that the oil-and-gas services industry was interested in the commercial application of Oscilla's technology as a way to power the sensors and electronics that the industry uses to monitor the progress of its

underground drilling operations. In this scenario, Oscilla's technology would convert the vibrations from the drilling equipment into the electricity necessary to run the sensors and other electronics that enable energy exploration firms to drill more productively and safely. Newly developed directional drilling requires more real-time sensors "down hole," including those that relay the drill's direction, speed, temperature, torque on the motor and even sensors to measure the geology of the surrounding rock formation.

Having proven the technical validity behind the technology, Oscilla was able to approach drilling industry companies with a solid indication of how the technology would perform in the "down hole" environment. The industry was receptive to this new technology that could improve sensor uptime while reducing the cost of the batteries traditionally used to power the sensors. Oscilla is now exploring collaboration opportunities with the drilling industry and expects that this market opportunity will enable them to fund the long-term development of Oscilla's ocean wave solution.

By remaining flexible and seeking funding opportunities outside of the traditional VC market, Oscilla has been able to steadily refine its technology while seeking long-term funding for large-scale technology deployment. The eventual installation of two terawatts of ocean wave-powered generation will not happen overnight, but the long-term potential for this resource remains consistently in Oscilla Power's sights.

Innovations in Energy Business Models as a Catalyst for Growth

While many companies are developing technologies that create new energy resources, other startups have introduced new business models that change how individuals and businesses think about their own energy use. Among these changes are an increase in the availability of alternative sources of cost-effective electricity and technological improvements to the appliances and equipment that are used on a day-to-day basis. Amidst this new dynamic, there are entrepreneurial ventures that capitalize on the new relationship consumers have with their energy consumption. While the standard electric utility model remains largely unchanged, these new companies are bringing their money saving propositions straight to consumers.



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"The real innovation now won't be in making a better panel that is 10 percent cheaper," says SolarCity CEO Lyndon Rive. "Widespread adoption will come if you can take away the complexity and hassle of installing solar."

Technological improvements to solar panels coupled with rising utility costs and a new concern for climate change have brought solar power to the mainstream. Many consumers, businesses and homeowners have researched solar only to find that its high up-front costs, which range from \$20,000 to \$40,000, were simply too expensive. Now, new companies have emerged that overcome this capital barrier by offering leases on solar panels for a set monthly fee.

Headquartered in San Mateo, California, SolarCity has introduced and patented the SolarLease, which has led to 15,000 new installations across the country since 2006. Established in July 2006 by two brothers who are self-described "serial entrepreneurs," SolarCity's total installations now account for 15 percent of the total number of installations in the entire country.

The company significantly reduced the "soft costs" of permitting and designing solar installations by using computer programs that interact with satellite images of the customer's rooftop and utility rate data to determine the appropriate system size and initiate the permitting process. The software also estimates the return on solar investment for each customer and remotely monitors power use.

While computer-based streamlining helped the company reduce costs, the truly game-changing innovation created by SolarCity was its new SolarLease. The leasing model opened their marketing base from only those who could buy the system outright to a scenario where almost every homeowner who wanted to lower their utility bills through a solar installation realize this dream. In a typical lease arrangement, the home or business owner agrees to pay a predetermined price each month to “rent” the solar photovoltaic (PV) installation, which usually inflates a small percentage each year, for a fixed length of 15 or 20 years. The company designs, installs and maintains the solar PV system throughout the length of the contract. Any additional electricity needed by the consumer is purchased from the local utility at the retail rate. When the contract ends, customers can purchase the system outright, continue their lease or have SolarCity remove it for free.

Solar City estimates that approximately 80 percent of its customers now choose the leasing option. Customers who lease solar panels typically see a 10 percent reduction in their monthly utility bill, according to the company. While the lease helps solar become a viable option for more consumers, the financing mechanism consumers never see is the vital cog behind the company’s success.

Even after their company Everdream was acquired by Dell in 2006, brothers Lyndon and Peter Rive could not personally afford the up-front cost to put solar PV on 15,000 rooftops. To deploy solar and reap the benefits of economies of scale, the company recognized that it needed banking buy-in. The financing mechanism they devised, which has since been patented, was to promise the banks a guaranteed rate of return for a fixed term in exchange for the up-front capital to purchase and install the solar PV systems.

For example, in February 2011, Citibank established a \$40 million fund to finance the installation of residential solar PV systems through SolarCity. These funds represent a financing entity’s commitment to put a fixed amount of capital into projects over a specific time frame. Citibank’s fund will be devoted to residential solar projects in five states: Arizona, California, Colorado, Oregon and Texas. Last year, U.S. Bancorp established a \$158 million fund to invest in commercial and residential solar projects. Recently, Google made its largest ever investment in renewable energy by creating a \$280 million fund with SolarCity.

According to CEO Lyndon Rive, the annual return on these funds tends to run six to 10 percent a year. To date, SolarCity has developed a dozen of these funds that have collectively financed almost \$1 billion in solar installations. Coupled with SolarCity’s direct system sales, the company has become a \$1 billion business since its formation in 2006.



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Would you let a company put brand new lighting in your business if they told you not only did you not have to pay for it but that you would receive a lower monthly utility bill as a result? Despite initial skepticism, some start-up companies have shown that a profitable business can be created just from lowering energy costs. Skyline Innovations, based in Washington, DC, is approaching businesses across the country with energy savings plans that allow companies to become more efficient with no up-front costs.

Skyline has recognized that advancements in technology have made it easier for companies to become more energy efficient. Replacing older, existing technologies with new, energy-efficient models, however, is a capital-intensive process that most businesses do not have the financial flexibility to undertake. Skyline Innovations has come up with a relatively simple solution to this dilemma; they pay for the retrofit and, in return, the customer makes monthly payments based on the energy savings. Skyline's value-sharing proposition enables their mantra, "We only get paid when you are saving money."

This new arrangement helps companies lower their utility bills while receiving new equipment, and allows Skyline Innovations to see a steady return on their initial investment. Skyline has targeted small- to medium-sized customers for their services and has focused on providing these customers solar thermal (hot water) and LED lighting retrofits. New customers first receive a comprehensive energy audit, including energy use monitoring, which sets the baseline for their energy consumption. Customers then agree to a fixed-term contract and the company installs and maintains the energy-efficient technologies the customer has selected. Once the installation is complete, Skyline Innovations takes over the customer's utility bills, and the business and customer split the cost savings according to the terms of the contract.

Skyline Innovations' new business model arose from founder Zach Axelrod's experience at GridPoint, an energy services company that focuses on providing efficiency solutions to large companies and utilities. During his time at GridPoint he recognized that most energy service companies were narrowly marketing their services to large businesses, universities and governments. While these clients helped Gridpoint build a booming business, Axelrod started Skyline Innovations to serve the small- to medium-sized businesses that the energy services industry was not targeting.

Skyline currently focuses its retrofits on two areas of energy savings: water heating costs and lighting costs. For businesses that use large amounts of hot water, they install solar thermal water heaters. These businesses include laundromats, restaurants, car washes and multi-family residential buildings. By using solar energy to preheat the water used by the business, the cost of the electricity or natural gas traditionally used to heat water would necessarily decline. These falling utility costs are then used to finance the new system.

Recently, Skyline also began performing lighting retrofits for businesses where its contractors perform a comprehensive lighting overhaul using high-efficiency LED lighting products to reduce electricity consumption. Skyline deploys a certified lighting auditor who determines lighting quality needs, evaluates existing lighting fixtures and assesses opportunities to improve energy efficiency. After installation, the business receives monthly statements showing energy savings and the payment amount to Skyline. These payments are based on a percentage of the actual savings, thus guaranteeing that the business saves money.

The financing mechanism employed by Skyline is similar to that of SolarCity, but on a smaller scale. Their initial investors are individuals who are looking for a fixed return on their income, but are also happy to see their money put to use financing environmentally beneficial projects.

Recommendations

Ensure that the federal government gets the best return on its research investments.

Every few months, the battle over renewing the SBIR program repeats itself. This brinksmanship too frequently results in last minute funding or even retroactive funding. These repeated short-term extensions wreak havoc on agencies' ability to make strategic decisions in regard to the program, and have failed to provide potential participants and investors with a sufficient level of stability. SBIR should be fully reauthorized and extended for seven to 10 years.

Congress should encourage agencies to share best practices with each other. Some companies have suggested that their experience with different agencies has been inconsistent and that feedback offered by certain agencies is significantly more beneficial than that offered by others. By focusing on the methodology and practices that result in the most commercial-ready companies, all agencies can contribute to the eventual success of program participants.

Implement on-bill financing programs so existing small businesses can invest in new technologies.

By encouraging the growth of on-bill financing programs across the country, policymakers can increase demand for new technologies while helping existing small businesses improve their energy efficiency and lower their energy costs. On-bill financing programs are utility-run financing programs that enable small businesses to pay for energy efficiency investments through their existing utility bill. A small business utilizing this program would have their upgrades paid for up-front by the utility and the business would pay back the cost of the upgrade on their monthly utility bill, typically, over the course of a year or two.

On-bill financing programs for small businesses have enjoyed rather remarkable success throughout their short history with extremely low default rates and popularity that led some programs to receive more applications than they could accept. NSBA's 2009 report *On-bill Financing; Helping Small Business Reduce Emissions and Energy Use While Improving Profitability* found that small businesses, as a whole, could reduce greenhouse gas emissions by 259 million tons each year if they improve their energy efficiency by 30 percent. Remarkably,

this is the equivalent of the emissions from 51 coal-fired power plants. Although energy cost savings will vary greatly from one small firm to another, the report also found that an average small business could save \$5,000 each year – or more – on its energy bills.

By making energy efficiency upgrades both easy and relatively inexpensive, policymakers can create the demand for new energy efficiency products that will enable entrepreneurs like those highlighted above to continue their growth.

Reduce the “soft costs” associated with deploying new technology.

A recent report issued by solar-leasing company SunRun to the DOE claimed that permitting and other “soft costs” could increase the cost of a 5kw rooftop solar system by as much as an added \$2,500. These soft costs include the time spent by the installer to obtain building, zoning and fire department permits and waiting for the installed system to be inspected. The State of Vermont recently enacted a law that streamlines the permitting process for small rooftop solar installations that the industry believes should be the national model. Congress should explore ways to reduce the installed cost of new technology and maintains the safety of consumers.

Encourage state-sponsored business incubators that provide clean energy startups with the resources and information they need to develop commercially.

There is a wide gulf between the development of new technologies and the commercial viability of new energy technology companies. Encouraging the development of new technologies and business ideas is just one step along the road to becoming a viable company. States and the federal government should recognize that business incubators represent a relatively small investment that could reap large dividends in the long term.

By providing start-up companies with access to affordable office space, research and development areas, business counseling and professional services, governments can give local clean energy companies a boost. Developing business incubators that focus on the clean energy industry will further the development of commercialization routes and may encourage investment in a particular state over others.

Examine the potential for utility-financed demonstration projects.

The financial and technological risk associated with demonstrating these new technologies has left many investors on the sidelines. Before these new products can be deployed at scale they must be field-tested for reliability and safety. However, unlike Internet-based companies where Google+ can be deployed to millions simply through email, energy businesses are capital intensive and require a huge up-front investment to begin scaling. As utility companies across the country diversify their portfolios, those willing to take risks on proving new technology should be rewarded. A further examination of the potential for a symbiotic relationship between clean tech entrepreneurs and the traditional utility industry should be assessed.

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