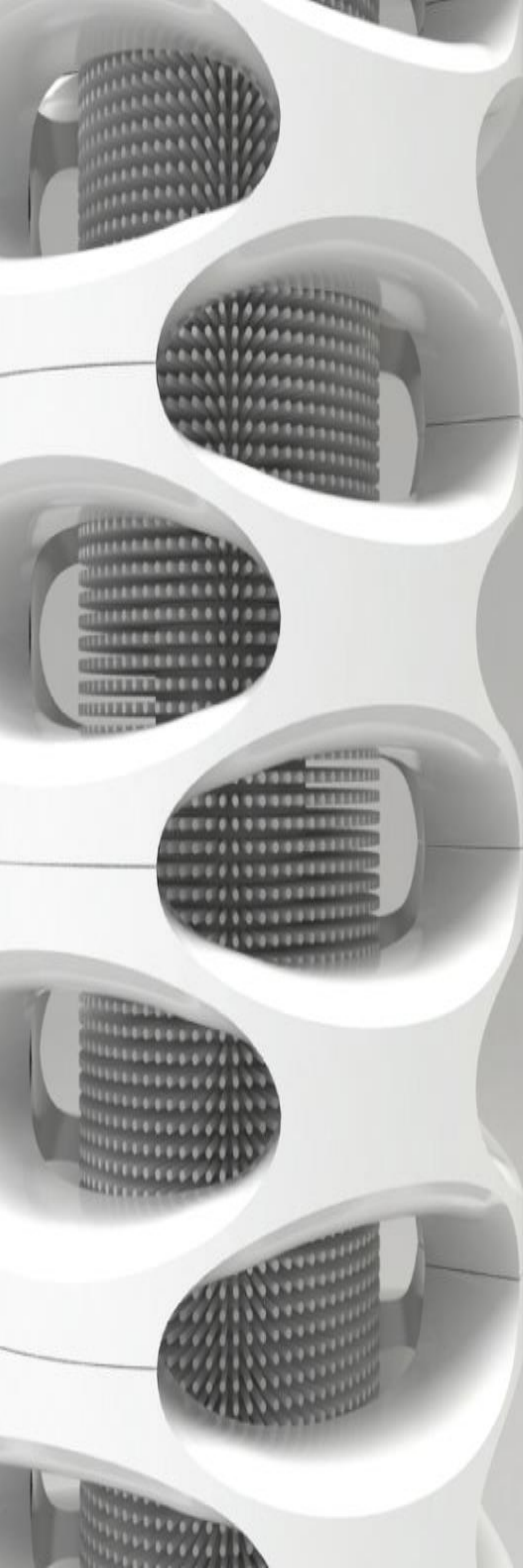

VANA™

ZERO ENERGY SOLUTION FOR GLOBAL WATER SCARCITY

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Proposal Narrative

Technology and Value Proposition

VENA is a low-cost, scalable, zero-energy and zero maintenance water harvesting solution for the developing world's critical need for drinking water. Being a bio-mimetic design modeled after the cacti, it extracts water from air by transferring cool, below –ground temperatures to an elevated network of copper alloy filaments, around which latent air-borne water condenses and is collected (Figure 1). The technology is made feasible through examining how condensation works from a cold glass of water. Taken out of a refrigerator into an environment being 5-15°C warmer, water from the surrounding environment is condensed on the exterior of the glass[22]. Functioning through geothermal technology, VENA replicates this by bringing the below ground temperature of the earth to the interior of the above ground portion of the unit, making it at minimum 5-15°C cooler than the surrounding atmosphere of the desert regions in which the unit is placed[7,17,18] (Figure 5). When air flows through VENA's open apertures, water is condensed and dropped to a reservoir to be pumped for use (Figure 1,4).

VENA is designed to function without the need of electricity or maintenance, a concept that separates it from other water condensers. To achieve this, VENA's assembly is free of moving, complex mechanical parts, and polluting coolants. VENA requires only the embodied energy of its materials and installation, and once in place the laws of thermodynamics and gravity enable the components to serve their purpose. That is, there is only one initial cost for VENA, after which it has no operational costs, such as electricity. Because VENA is small-scale, the modular design allows potable water to be delivered directly to localized areas of need, thus eliminating the need for expensive conveyance infrastructure. Furthermore, VENA is openly scalable, allowing the number and placement of VENA units to address the size, location, and need of the community (Figure 8,9,10,11).

The dynamically formed, robust ceramic discs serve double duty: protecting the internal systems from solar heat gain and channeling prevailing winds through the conical body[20]. The copper alloy cable, the key thermal conductor, stretches from a below-grade well along the entire height of the above ground structure. VENA's angled copper alloy filaments go a step further by being 5-15°C cooler than ambient air temperature throughout the day[7,17,18]. When air comes in contact with the filaments, the dew point is triggered and air-borne water condenses, dripping down the copper alloy cable into the reservoir continually throughout the day (Figure 3). Based on preliminary analytical models and experimentation, VENA's standard ten-foot tall unit will yield approximately 18-20 liters of fresh water per day without the use of mechanical refrigeration (Figure 2,7).

Kilpatrick Townsend has done prior arts search, and their findings indicate we are in a good position to patent VENA's technology. We are currently in the process of filing our provisional application, giving us freedom to operate. We have currently undergone VENA's proof of concept, which is a small-scale version of our VENA technology, and establishes scalable models of design, cost estimation and productivity. Our proof of concept is capable of collecting less than 1 liter of water a day, and has been tested in lab conditions that allow experimentation of varying atmospheric temperature, humidity, and wind flow (Figure 12).

VENA delivers the values of sustainability, independence, time, money, and health to developing regions lacking access to potable water. VENA solves the problem of high capital and operational costs associated with funding conventional methods of water delivery for non-profits, governments and corporate sponsors donating aid to developing regions (figure 6), as well as offsetting the conventionally unsustainable methods of water delivery currently in place. NGO's, non-profits, and corporations are currently funding continuous water supply to these villages. From our research, our customers would prefer a one-time unit cost, with zero maintenance costs. Furthermore, they would prefer ownership of the means of producing the water, rather than service based or aquifer-contaminating oil based water-delivering systems, creating stability and security amongst the villages. Currently, customers are paying for water that must be delivered from remote locations through bottling or piping, or welled unsustainably.

The largest impact VENA presents is the amount of lives that can be saved. Each VENA unit is projected to sustain ten people with clean water. According to Unesco's 2003 study "Water for People, Water for Life", by the year 2050, 4 billion people globally will experience water shortages, and 3.4 million people die each year from water related illnesses[21]. These shortages cast a wide net of deleterious effects, ranging from obvious, immediate health consequences to broader economic impact. The most prominent, significant result of not having access to potable water is degraded health. Compromised health problems are further engendered by overtaxed aquifers from well usage. When aquifers are depleted through over taxation, the aquifer collapses making the aquifer unable to recharge and hold water. Depleted to provide drinking water, the aquifer source is unavailable for agricultural applications, causing a critical gap in the food production chain[9]. This directly impacts the health of a community and forces people into an impossible choice between drinking and eating.

Lacking ready access to potable water taxes a community's other resources as well. The daily effort to acquire water requires time and/or money, which are limited resources unavailable for other purposes. In much of the developing world, a comparatively high proportion of household income is spent on water – in parts of rural Peru that number can be as high as 70% [8,11]. Many people must travel large distances back and forth every day to get water. VENA presents a favorable solution over water piping and bottling, which are unsustainable, create dependency, and have a very high capital and operational cost that these regions cannot afford. There are multiple large-scale impacts that result from VENA, including sustainability. A single 1-liter water bottle emits 1.66 Kg of $C0_2$, making water bottles an incredibly unsustainable option for these regions. With an expected production of 18-20 liters/day, each VENA unit is offsetting between 10,096-12,118 Kg of $C0_2$ a year[16].

Business Model and Market

The market for fundraising sustainable technologies in developing countries is very large, especially for water. Inhabitants of arid regions in developing nations constitute the core beneficiaries of this new technology (Figure 6). However, our primary customers will be from non-profit organizations and corporations funding environmental causes for developing regions. Cumulatively, corporations donate billions of dollars annually to social and environmental causes. The largest of these are Wells Fargo, Sanofari Foundation, Bank of America Charitable Foundation, The Wal-Mart Foundation, JP Morgan Chase Foundation, and GE Foundation, who in 2013 cumulatively donated over 1.3 billion dollars annually to social/environmental causes[6.23]. In addition to these large sponsors, in 2013 PepsiCo donated 6 million dollars to water development for developing countries and the CocaCola Foundation donated 8.8 million dollars to help develop sustainable communities[1,10,12,13]. Our engagement approach is to present corporate partners with an opportunity to label their brand and gain positive PR with a sustainable technology in exchange for purchasing units from VENA. Our belief is that VENA's value propositions would present positive PR for these companies and that they would consider funding units. When conducting interviews with non-profit organizations, we indicated that we are in a good position to sell our technology to this customer segment. On our website www.letsgrowfoundation.org, we have received numerous inquiries from non-profits in India, China and Africa looking to adopt our technology to combat water scarcity. Potential non-profit partners we have talked to include "A Drop In the Bucket" "Aqua Para La Vida" "Blood: Water Mission" "Blue Legacy" and "Clean Water For Haiti". We intend to engage non-profits through a partnership development team, in which we would partner in fundraising campaigns, which would include obtaining grants from corporate foundations, as well as mass-market fundraising. Our intent is to sell units to these non-profits to be installed in specific regions. After conducting interviews, surprisingly individuals who are advocates of sustainability located in San Diego and Los Angeles highly considered adopting VENA, especially commercial businesses for promotional purposes. Redondo Beach Auto Spa, has agreed to adopt VENA as a display for its customers. Redondo Union High School has also agreed to conduct fundraisers for VENA's adoption in the developing world.

There are multiple methods of water delivery to developing regions, the largest competitor being well drilling. Although they pose a significant long-term environmental and agricultural issue for these regions, currently, they present the most immediate solution because of the lack of water transportation infrastructure and filtration technology to treat water being transported[3]. The largest issue with deploying wells is the contamination present. Due to contaminated aquifers, tens of thousands of people have been poisoned by arsenic contamination[25]. However, on average, a well for a village can cost between $10,000-$50,000 depending on the geography, aquifer depth, and supply needs of the village[4]. One non-profit, The Water Project, is currently installing 575 wells in Africa and globally in 2013 there were thousands of wells drilled in developing countries[14]. Although they are currently providing water for these regions, this solution is temporary, and at the point in which these wells run dry, villages are presented with massive food and water shortages. Therefore, VENA is an effective solution over the primary competition of well drilling and has consequently been price pointed at $5,000 to compete with the market. Vena is also designed to retrofit existing wells both dried and in-use, being able to use depleted aquifers as a reservoir to collect condensed water.

We are currently seeking $250,000 for VENA's commercialization and following we intend to require $500,000 to support the business development needed to propel VENA to a breakeven point (Figure 17). VENA is currently funded at $15,000, and recently received a $7,000 award through a first place award at the Zahn Challenge[19]. The next stage in our product's commercialization is to develop our scaled up proof of concept through using the Zahn Center resources, a proof of concept to test in controlled atmospheric conditions, which will serve as a solid stepping-stone to develop a full-scale system. From there we are seeking $15,000 for the development of VENA's full-scale prototype, which is to be installed in the Sierra Nevada Desert, which we are hoping to receive from the USD Social Innovation Challenge. We plan to conduct testing in various climates to support the findings of our product's proof of concept and to further optimize VENA's design for performance and feasibility. We plan to have VENA's full-scale prototype serve as a platform for fundraising to fully commercialize and fund VENA's operations.

In dealing with developing nations, governmental and NGO's, such as the World Health Organization and Doctors Without Borders, will be key partners to reach the beneficiaries of VENA. We have already established a working relationship with Farming Systems Kenya and PCI in order to aid in the logistics involved in both testing VENA's prototype and installing the units in these regions upon VENA's commercialization[2,5]. We also plan to create a product installation team for these target regions that are responsible for the successful installation of VENA. We plan to conduct manufacturing of VENA through Chinese manufacturing partners we have developed, including Hengli Metal Processing, Sincere and YSD. Distribution and marketing of VENA will be done through primarily a development team that targets key Non-profits and corporate sponsors related to the water sector for developing regions.

We are a for profit entity following a direct sales model. Each average sized VENA unit is capable of producing 18-20 liters per day and is expected to have a production cost of $2,500 (including materials, labor, storage, energy, etc.). From the positive feedback when conducting customer interviews, our target is to sell and install 100 VENA units within the first year for $5,000 to non-profit organizations within the water sector and corporate sponsors (Figure 17). VENA Corporation is currently a C Corporation formed in Delaware. We have considered a licensing agreement, however, considering the installation and logistics requirements in working with developing countries we feel that a licensing arrangement would not be a lucrative option.

The Team

John Walsh is the Chief Executive Officer of VENA, and is responsible for guiding the team in the technical and business model development, as well as fundraising, partnership development and recruitment. John is currently an SDSU student.

Thomas Kosbau VENA's Chief Design Officer, the original designer of VENA. He is responsible for VENA's design and technology development and aids in fabrication.

Robert Geiger is a student completing his PhD in Mechanical Engineering. He focuses his efforts on VENA's design, as he is experienced in heat transfer and geothermal technology.

Michael Connor currently holds his Mechanical Engineering degree, and is a student at SDSU finalizing his MBA in Entrepreneurship in winter of 2013. Being interdisciplinary and having been a founder of a water filtration technology development company acquired by GE Water, he focuses in technology and business development, as well as product design and commercialization strategy.

Kyle Kitzmer focuses in VENA's fabrication and installation, and aids in design of VENA's heat transfer mechanism. He finalized his Masters in Mechanical Engineering winter of 2013.

Partners: *The Zahn Center for Technology Innovation*: A San Diego State technology incubator, with access to multiple resources such as; office hours with MBA professors, an experienced mentor, office space, market studies from MBA students, a machine shop (Figure 13, 14), 3D Plastic Modeling (Figure 15), Electronics Lab (Figure 16), and design software[24]. We also have access to engineering prototype services, pro bono tax and legal resources including IP attorneys, and introductions to potential partners and investors. *Farming Systems Kenya:* An indigenous NGO focusing on food security, environment and natural resource management and water scarcity[2]. They have agreed to aid in the logistics of dealing with African culture and regulation, as well as the testing and installation of VENA. *PCI:* A San Diego non-profit focusing on preventing disease, improving community health and promoting sustainable development worldwide. They are willing to develop fundraising for VENA's deployment, aid in business development strategy, as well as aid in the installation and foreign logistics of installing VENA in developing nations[5]. *Dr. Richard Caputo:* He is a Mechanical Engineering professor at SDSU and a leading expert in manufacturing, materials and metallurgy. He worked for Jet Propulsion Laboratory for 20 years and was one of the lead engineers behind designing the power system for the Voyager. He is responsible for 24 patents and written the book "Hitting the Wall" [15]. He directly advises our team on VENA's design, materials, and manufacturing. *Josh Tickell*: He is an environmental activist and an Academy Award wining producer of the documentary Fuel. He is the advisor to multiple fortune 500 companies and is a PR and environmental Advisor to us. *Dr. Stephen Welter* is the Director of Research at SDSU, and is willing to provide his support in the development of the technology, from acting as a liaison to providing networking resources.

Our team intends to address possible barriers through our NGO partnerships. Both John and Thomas have traveled throughout Africa, Asia, and South America.

Work Plan and Outcomes

The following is an outline of VENA's steps to initial sales/success measurements.

Dev. Phase	**Work Plan Tasks**	**Performance/Cost Objective Outcomes**
Phase 1: POC ***10/1/13-1/1/14*** *(Funded* $7,000*)*	In Progress, lab scale water condenser built and tested. Positive results achieved resembling calculated performance and cost estimations	Proof of water condensation through artificial refrigerant. Replicates below ground temperatures to trigger dew point in artificial climates
Phase 2: Pilot (Alpha Prototype) System Design, fabrication and installation ***8-12 Months*** $15,000	1) Optimize design of alpha prototype based on findings of proof of concept. -This includes: calculate optimal geometry for maximum productivity, minimal maintenance, and minimal cost, Complete CAD drawings	Design created for optimal unit productivity, cost, performance figures, maintenance costs and installation
	2) Fabricate and Install VENA Pilot Unit: -Fabricate full scale alpha prototype of VENA unit -Install unit in Sierra Nevada, record and analyze performance and feasibility data	Projected standard unit production cost achieved: $1,500-$2,500. Installation cost: $500-$1,000
	3) Conduct Prototype testing. -Test performance of unit design in Sierra Nevada, record and analyze performance and feasibility data -Test unit in various climates of the US that resemble similar climates of developing regions, record and analyze data	Performance analysis: Performance: Productivity of 18-20 Liters of water a day achieved with either existing design or with design optimization ROI: Existing design or projected optimized design resembles roughly a 3-5 year ROI
Phase 3: Technology Optimization, fabrication and Installation ***12 Months*** $150,000-$275,000	-Fabricate beta prototype -Provide test unit in specific developing villages. Will provide performance data, as well as provide feedback on impact and indirect effects unit provides on villages. -Optimize design based on above findings to be fully commercialized	Re evaluate each step in Phase 2 to optimize system design, cost, performance, maintenance and installation based on findings of the pilot scale's real world condition performance Upper limit/optimal calculations of design efficiencies, performance figures, cost and maintenance achieved
Phase 4: Key Partnerships & Marketing Deployment ***6 Months*** $50,000-$100,000	Partnerships finalized: -Manufacturing, Distribution & Installation -Corporate partners -NGO/Governmental/Logistics partners -Financial Institutions Commercialized Unit sales begin	Partnerships developed that allow for successful manufacturing, distribution, installation, and funding of units to developing countries 100 Standard VENA Units (18-20 Liters/Day, Retail: $5,000) If above achieved, VENA expects to turn profit following year 2 (Fig 17)

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