Jordan Energy Alternative

Mobilized Solar Array

Mobilized Solar Array and Energy Storage Vehicle to Offset Base Operations and Provide Reliable on Demand Power for Forward Positioned EVs

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Abstract - Technical Abstract: Jordan Energy Alternative's Solar Array is a solar and battery solution that offsets power demands of Military on-base operations while the vehicle is not deployed in forward positions and provides an immediate solar charging solution with battery power storage for forward deployed military electric vehicle fleets. Overview: The Air Force Sustainment Center needs to increase mobile renewable energy usage, both on installations and in the field. Our solution will dramatically reduce the cost of solar systems and make them portable across multiple installations. JEA will trailerize our plug-and-play solar panel system and study the feasibility of applying a battery storage solution so users can offset power demands and have solar power readily available to transport to locations as needed. Technical Merit: JEA's retail solution, Simple Solar, provides quick and easy solar power wherever a user needs it. Our solar panels install via a plug and play system, fold, are highly mobile, and are cost-effective. Team: Principal Investigator Jason Jordan has developed, tested, and deployed mechanical and electrical solutions to improve many household systems including dryers and HVAC, and has experience designing automation techniques and developing small, functional networks. Our university partner, Megan Ellis (Ohio Wesleyan University) is an executive director with the business experience to bring large scale projects to life. Commercialization: We have launched the pilot stage of a retail version of Simple Solar, without battery capability, and we have received USAF STTR Phase 1 contract to examine the commercialization of larger scale models for base and field deployments.

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Introduction

The backbone of the future army mobilized supply chain will be the electric vehicle. As the U.S. military transition from traditional fossil fuel vehicles, one of the largest problems to solve will be of what method will logistic chains supply electric vehicle charging capacity. JEA was founded on the technology of mobilized micro-grid, solar and wind, energy generation. JEA is working on solving the problem of providing electrical services in remote locations and places for disaster relief. By developing the integrated systems for mobile energy provision, JEA can participate in minimizing suffering by assisting in basic human energy needs and supply the future U.S. Army EV fleets. We designed a product to solve the problem of localized, remote power generation. JEA wants to evolve this product to supply the future electric vehicle fleet in forward positions where grid-charging is prohibitive, or energy is scarce. The goal is to design and develop an autonomous vehicle which can deploy a solar array for local energy generation, storage, and charge EVs.

In 2019 and out of a response to a very large electric bill, I investigated adopting solar to off-set my energy costs and usage. At the time, the cost thru local solar installers were too high which led me to buy and install the system myself. I initially realized and later validated that there is a large population of individuals not willing to adopt localized micro-grid energy generation because the initial cost was too high, or they were planning to move to a different home or did not own the property which they lived. This led me to develop a small solar array which could be folded up and moved on wheels. This device required no installation for offsetting the homes energy usage because in plugged into a standard wall outlet. This mobile unit was very practical because early adopters could “try out” solar without a huge investment. The unit traveled with the owners to relocating to new homes and renters could offset their energy usage without making altercations to properties.

In 2020, I participated in the Cleantech Open Nation cohort where I refined my product, business model, and who was going to be my customer. During this same time, I began to learn that mobile micro-grids would serve mankind better in places where energy is scarce and critical human services were not being provided such as water pumps, cooking apparatuses, communication and many more. One problem with the current design was in was only

able to produce 800W per hour. In disaster relief, the foldable array had to be larger and built on a trailer platform. Many of these deployable arrays would provide the energy necessary to contribute significantly to the disaster rescue but valuable resources would still to be used to drive the solar arrays to the areas in need. This would tie-up trucks and drivers. In addition, future fleets of electric vehicles in forward positions would have a great deal of difficulty continuously supply electricity for charging vehicles. To reduce resources necessary to support forward positioned of solar arrays, the idea was to have the solar arrays drive themselves.

About This document

This document is intended to provide a fundamental understanding of the physical hardware features and capabilities of a future autonomous, self-driving solar array. This document will also contain a fundamental process of the hardware design and the evolutionary approach of capability and capacity improvement towards future versions. Features not contained in this document include the software design, development, and deployment with only exceptions to include such details that reference hardware specifications.

Current Technology

The current method of providing emergency electrical power in distressed environments is diesel power generation and very small, specialized solar systems. Gas and diesel power generation is an obvious solution in crisis situations. One significant bottleneck with this type of localized power generation is its consumption of fuel. Fuel supply logistics are often disrupted due to hazardous environmental conditions. These generators are mobile but also suffer from needing to be used in tandem of other valuable services such as labor and transportation. The number and speed to operation of these systems is critical. Diesel and gas generators are not as abundant as they could be because these systems are infrequently used. Abundance and the need to have transportation restrict the speed of deployment in some of the most critical times

This innovative technology is the combination of well-developed cutting-edge systems. Robotics, Artificial Intelligence, and renewable power are 3 of the top five fastest growing and emerging fields. The contribution of these emerging markets in elevating human society and minimizing suffering will be as impactful as the development of the phone, manufacturing process, and the growth of the internet. This technology possesses the qualities of these new technologies but also benefits society in the moments where human suffering is at its height. Since these systems can contribute to clean energy generation during the times when there isn't a direct need for localized solar power, this solar array will participate the progression of energy independence. The most impactful is when these systems mean the difference between life and death.

In the short term when early adoption is taking place, National Guard operations and power providers would have small fleets of these vehicles. Each vehicle could potentially produce 10 kW/hr. this is enough energy to providing emergency electricity to 1 or 2 homes. A small fleet could provide the electrical resource for a centralized human shelter where large amounts of hot water, food preservation and cooking equipment is necessary. As the qualities of autonomous self-drive solar arrays is highlighted, this technology could potentially grow to hundreds of thousands of vehicles distributed anywhere in the world actively generating solar power and waiting for the moment where emergency services are required and continuously supply logistic lines with the energy needed to operate where infrastructure is scarce or nonexistent

Technology and Merit

Mobile Plug-and-Play Solar Panels

Simple Solar is the culmination of our effort to offer affordable, universal access to solar energy. One unit plugged directly into a standard 110-volt outlet provides 800 watts of continuous power. That is

enough to recharge 550 iPhones from 0% to 100% every day.

Our system is mobile, and easy to install and adjust. When users move, they can fold up their solar array and take it with them. Aside from the commercial benefits, this key feature also allows us to deliver silent, reliable solar energy from a military installation to the site of disaster response, no installation required, while providing immediate power.

The panels themselves are rugged. They operate in warm and cold conditions and can sustain high winds, heavy snow loads, and hail. They are lighter than glass.

Our system automatically matches the frequency of the local grid without the need for converters. It stacks to meet power demands and folds for ease of transport. This feature will allow military customers to generate power on base while the system is in 'storage,' and bring the system to the point of need in the case of a disrupted power situation.

I expect to have fully designed each of three prototypes over a two-year period. During this time, I will be utilizing the military SBIR/STTR programs. I am currently approved for USAF Phase 1 STTR. The objective with this funding to secure the agreement of the Air force participating command. I would then qualify for a phase 2 contract award of $750K. This funding would be there to deliver the fully functional small 4.8kW foldable array on a car-pulled trailer. I will be eligible to bid for this contract in June 2023. Additional milestones of the larger towed trailer and autonomous vehicle would be successive years 2024 and 2025. The design of these systems would take place in 8 month increments where each technology is built on the pervious iterations. During this 8-month Cohort participation, I would expect to deliver a fully design prototype of the small vehicle-pulled trailer array and be moving forward on the design of the next prototype, the larger vehicle-pulled trailer array.

The primary purpose of Jordan Energy Alternative is to participate in the advancement of a more robust, decentralized energy network. We plan to do this by providing individuals and organizations with the products and services to meet their needs in achieving a more efficient and distributed energy supply. For the retail market, customers would have a viable and affordable alternative to the traditional roof-top solar installation. Customers who once passed on adopting alternative renewable sources because they didn't own their own home, plan to move soon, or just couldn't afford the entry price can now have an option to adopt and try micro-grid power generation. JEA will also be serving the government and non-profit organizations with products that can serve during disaster relief. This dual-purpose product structure provides JEA the flexibility to develop and industrialize these products utilizing a dual revenue model.

The governmental SBIR/STTR programs are designed to fund new technology through the different stages of development for the purpose of dual use in the public and privet markets. Programs like AFWERX assist small businesses through 3 stages of funding. Phase 3 contract approval industrializes the small business for government contract future demands. JEA has currently been awarded Phase 1 for the small trailer solar array and will continue to work with the U.S. government through the different stages.

Although governmental prototyping and deployment funding is important in delivering a quality product, research and development funding is just important in keeping with an aggressive product schedule. This is a big reason for applying for CRI funding. Designs for physical structures, electrical drawings, programming for machine vision are just some areas of design where large amounts of engineering time are needed in the early part for the product life cycle. For this reason, a 2-year R&D funding will support the business model until revenue allows for hiring machinists, engineers, and assemblers. This early business model provides the best possibility for success in deploying a new, innovative product that can serve both public and private markets.

Cargo Trailer Solar Array

The Cargo Trailer Solar Array will be designed and deployed for power conversion and storage for

off-grid locations. Remote renewable energy-based power systems deployment is growing in popularity around the world to address energy access challenges. They provide flexible and efficient supply of energy to off-grid communities. However, the lack of in-depth design considerations has resulted in some failures in some off-grid communities. The product solution is to develop advanced PCS that can seamlessly integrate various types of storage and renewable technologies and provide sustainable power solutions for disadvantage communities such as on Native Tribal lands. The advanced PCS must be affordable, flexible, and easily deployable for remote communities. The desired PCS rating is approximately 1.5 kW (single user) and 240V ac single-phase output. The final design would show a significant increase in performance, flexibility, adaptability (i.e., ability to sense and connect various types of storage and renewable technologies with ease), cost reduction, and decrease in footprint compared to a traditional off-grid power conversion design for remote communities. The PCS would also demonstrate flexible parallel operation to increase power level, as needed, and show advanced control capability that supplies the power to the load continuously while optimizing all power sources requirements.

Tractor Trailer Solar Array

The Tractor Trailer Solar Array will be built on the technology of the smaller Cargo Trailer design. Advancement in the automated deployment of the solar panels and method of storing energy for the use of 24-hour periods, this design would deploy a PCS rating of 30 kW (community systems) and 240V ac single-phase output. The significant advantage in utilizing a larger solar collection and storage system would be to support a large set of critical devices with less support resources.

Self-Driving Solar Array

The Self-Driving Solar Array would be the 3rd evolution of the conceptual mobilized energy generation system. These autonomous vehicles would mobilize in caravans of energy providing logistical supply chains in efforts of rescue support for localized energy generation and storage.

Commercialization

Ability to Commercialize

Company founder Jason Jordan has established partnerships across the United States. His expertise lies in several fields including development and testing of mechanical/electrical devices, development of network components, server design, and the deployment of automation techniques using programmable logic controllers (PLCs), Python (programming language), and LabVIEW (systems engineering software).

Jordan Energy Alternatives has partnered with Mark Snow, owner of Drum Runner to support manufacturing efforts and the fabrication of prototypes. We have advisors with a range of experience in finance, supply chain, business development, marketing, and manufacturing/assembly. This team is highly knowledgeable and capable of scaling our business as we expand nationwide.

Megan Ellis is our university partner at Ohio Wesleyan University, where she serves as executive director of the career connection center. There, she has built a network of industry experts and entrepreneurs that serve students and provide early-stage business advice.

Commercialization Potential

Solar power is more affordable, accessible, and prevalent in the United States than ever before. Since 2008, U.S. installations have grown 35-fold and supply an estimated 62.5 gigawatts (GW) today. This is enough capacity to power to 12 million American homes.

Meanwhile, the number of Americans renting their homes has been steadily climbing. In 2018, 36.6% of households were renters, the highest rental rate since 1965.

While many renters say they would be interested in offsetting their power draw with solar, the cost and permanence of the installation is prohibitive, ranging between $15,000 to $25,000 on average. The high upfront cost of installation is the #1 reason homeowners give when asked why they have not invested in solar panels (67.1%).

Simple Solar is an inexpensive and mobile solar solution that installs in seconds and starts working immediately. The price of a single Simple Solar unit is $2150. Users can purchase panels one at a time and incrementally build an on-demand solar array that provides more and more of the electricity they consume. With the addition of a battery unit, users will be able to store energy they generate and deploy it as needed.

Ours is the only affordable, mobile solar solution that targets both homeowners and renters. This gives us an advantage in the commercial markets as well as the DoD.

End-users in the Air Force Installation and Mission Support Center will be able to use Simple Solar to generate energy on base, store excess energy in batteries, and then transport the panels to the site of a disaster to provide essential power immediately.

Commercialization Strategy

To make clean, renewable energy accessible to everyone, we have reduced the financial entry point and targeted a group other solar providers ignore renters and homeowners who plan to eventually move.

By making solar energy simple (no installation, plug-and-play), mobile (foldable, lightweight, easy to move), and affordable ($2150 for an 800-watt unit), we expect to establish a beachhead into an untapped sector of the solar power market. In performing the feasibility study, we will determine adaptations that will make our product even more mobile, such as a trailerized version with battery storage, which will provide an even better value for the price.

Apart from individuals, we will commercialize our mobile solar solution by marketing to EMS and first responders who operate in disaster relief areas. Our solution could play essential roles both in everyday power generation and in the setup of mobile hospitals, water purification, and reestablishing communications networks.

Opportunity

Significance of the Problem and Opportunity

Col. Hans Boulter and Col. Bud Boulter at the Air Force Research Laboratory, and Col. Kevin Nalette at the Air Force Materials Command have expressed the need for the USAF to employ alternative energy sources like solar to meet energy demands while decreasing carbon emissions. These systems must be resilient and provide reliable power, both on-base and at the site of a disaster response when grid systems are knocked offline.

Aside from cutting emissions, resilient renewable power will decrease dependency on large, centralized grids, left vulnerable by aging infrastructure and cyberattack, while increasing USAF's speed, reach, and ability to operate in any environment.

Solar energy is not new. For years companies have supplied solar energy and solar-powered battery solutions. These systems are prohibitively expensive. For a single building, a solar array costs between $15,000 - $25,000. Once installed, the solar array becomes a permanent fixture, making it unresponsive in a disaster situation, and a poor long-term investment for consumers who rent or plan to move within the next decade. Aside from that, solar panels often rely on parts supplied by countries with which the US is in direct competition, such as China.

JEA can produce a system that offers the same performance as permanent solar panels for a fraction of the cost. Our system is plug-and-play and does not require a complicated install. It is rugged,

built in America and built to last. It folds for ease of transport to create agile and responsive energy directly at the point of need. Users can stack their system and slowly build it up over time.

Simple Solar provides a source of energy 24/7 while on standby for mission deployment. Our battery solution will allow users to store excess energy to offer additional resilience in meeting energy demands.

This dual use makes Simple Solar a responsive tool that is useful 365 days per year, both in disaster relief and at rest.

The Impact

A fully realized, large scale manufacturing of autonomous solar arrays presents the situation of providing many of the key metrics for positively impacting U.S. energy and manufacturing. The headline metrics of U.S. jobs and productivity, localized salary and property tax increases, and the creation of centers of innovation; this technology deployment also has many vertical positive impacts. First, added demand for solar generation cells and integrated circuits will only promote U.S. based manufacturing. Vendors such as solar cell providers First solar located in Ohio. Also located in Ohio is SMART Microsystems which have the capability of printing integrated circuit boards. These are just two potential partners which would benefit in added demand for growth. These two organizations are great examples of potential in environments where foreign supply chains are disrupted. U.S. based solar, battery, and electronic sectors would all benefit with additional demands for their products.

The beachhead market will certainly be customers in the disaster relief and operating in remote locations. Retail markets would add to revenue and lower base product cost but piercing the retail market depends on higher marketing and longer lead times to customers. Not until adequate marketing budgets can fully penetrate the targeted customers will volumes justify additional expansions to the manufacturing process. The ideal customer is a large organization or governmental agency who can support larger batches of orders to minimize supply component costs. Secondary would be the retail customer market until again customers learn and understand the value proposition of local energy generation.

JEA's desire is to produce these products in the U.S. for the primary reason of ESG. Working with U.S. based suppliers greatly reduces the social and governance risks when working with foreign suppliers. This practice also supports one of JEA's goals of positively impacting local economies. Creating an employment environment which high-paying technical positions are needed to grow, JEA has also been activity working with Marion Technical College thru their Smart Manufacturing program. JEA's Phase 1 STTR is partnered with Ohio Wesleyan University who is concurrently investing $10 Million into a new advanced sustainability program. Both partnerships provide access to potential future technicians and engineers. JEA will source suppliers, distributors, and manufacturers locally.

Limitations

The full cost of realizing this innovation includes manufacturing facilities, labor, and equipment. With large scale manufacturing, millions of dollars would ultimately be needed to invest to realize that potential. But for the cost of developing a progression of prototypes, the cost of each porotype would be $750K for each prototype for a 9-month product-cycle period. The progression of design would be small 4.8kW foldable array on a car-pulled trailer, next would-be tractor trailer sized array intended for semis and large cargo vehicles. The third prototype would be the self-driving vehicle which would have the capability to follow lead cars. Each design life cycle would cost $750K in labor and materials.

The reason for the request for a 2-year financial and technical support is for the engineering labor to perform early-stage research and development. This cost $240K over two years. This is the resources needed to generate the engineering virtual models and technical documents necessary to realize the future investments. To reach the full potential of a mobile, localized energy model for a fleet of military

logistics, the technology will have to evolve from the present small solar array to a full autonomous driving vehicle that can deploy a large solar array.

Risks

Polling data reflect the sentiment, of all the technologies being used, the largest risk is a vehicle which has no human driver and will malfunction. This is actually a very important risk in the larger field of self-driving autonomous vehicles. The very best experts in the industry are still not deploying large number of self-driving vehicles because of this same concern. Mitigating this risk within the design of this product, the intention would be that these vehicles would travel in caravans of fleets. Each self-driving vehicle would follow one another in long lines of mobile solar arrays. The lead car would be controlled by a human and monitored both in the lead car and a remote location. This situation minimizes the large technological risk because the situation greatly reduces the edge cases which result in poor performance. The payoff of this technology is year-round usage of mobile solar micro-grids and increased speed and concentration of energy generation in crisis situations

The Role of Partner Universities and Institutions

As the JEA STTR project proceeds, Ohio Wesleyan University will play a critical role in achieving project goals. Staff will provide technical expertise as it pertains to battery design and longevity, as well as supportive testing of battery design.

Key contacts with the University include Jeff Davids, Megan Ellis, and Nathanael Rowley Ph. D..

These individuals have the proven backgrounds of producing advanced engineering solutions that fit closely within a practical business model.

Steve Flaherty will lead these University contacts to prioritize tasks and measure project development. This partnership will help JEA meet technical, financial, and commercialization goals.

Objective and Key Metrics

Objective 1 - Engage in conversations with potential end-user Col. John Tryon (Tyndall Air Force Base ‘The Air Force Base of the Future’) to ensure a deep understanding of energy needs for disaster response as well as energy offset on-base. Engage in conversations with potential customers Col. Kevin Nalette (Air Force Sustainment Center) and Col. Hans Boutler and Col. Bud Boutler (Air Force Research Laboratory).

Objective 2 - Determine further adaptations customers and end-users may require for Simple Solar to achieve maximum portability and utility in the case of disaster response.

Objective 3 - Work with Col. Tryon, Col. Nalette, and the Col. Boulter to determine milestones for a Phase II Simple Solar prototype.

Key Metric 1 - Jordan Energy Alternatives will emerge from conversations with a meaningful understanding of the scope and scale of mobile energy demands for disaster relief. We will assess the feasibility of creating a trailerized version of Simple Solar to solve this problem.

Key Metric 2 - Jordan Energy Alternatives will investigate effective ways to perform adaptations and measure project success.

Key Metric 3 - Jordan Energy Alternatives will have a clear outline of milestones which will help us gain approval for continued explorations into adapting Simple Solar to solve energy concerns for DoD customers.

Related Work

Commercial Simple Solar

The first JEA stand-alone system will be a self-contained, plug-and-play, portable solar energy array. It will deliver all the energy it produces directly into the property owner's electrical grid with no professional electrical installation. The unit plugs directly into a standard 120V power outlet.

The system will offset energy usage and reduce costs by supplying energy to the property grid to power devices that would otherwise use energy pulled from the networked electrical grid.

To achieve this, we use true-sine micro-inverters that monitor and match the electrical grid frequency. The system is also outfitted with safe-sense technology that stops delivering energy in the event of unsafe conditions. This portable system will communicate directly with local JEA WIFI terminal which will display metrics such as wattage produced, dollars saved, and CO2 emissions avoided.

Waste Recovery

We have generated a prototype of waste recovery units that focus on the use of thermoelectric technology. A thermoelectric generator (TEG) converts heat flux (temperature differences) directly into electrical energy through a phenomenon called the Seebeck effect. JEA has also developed a waste recovery process for non-producing flare-off natural gas wells. By providing on-site flare gas recovery operation, JEA could provide a revenue generating method of recovering the otherwise wasted energy in the natural gas industry.

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