Submission #45565321: el-sol

Making Solar Panels Cleaner to Make Our World Greener

Introduction

Imagine a single solar panel. Seemingly insignificant, this contributes to the fastest-growing market within the energy sector, proving vital to our never-ending need for energy. Although solar energy can potentially revolutionize our renewable energy usage, solar farms generate only 20% of their potential capacity because of dust exposure; for a **single solar farm**, one day's wasted energy can **power a house for 9 years**! Furthermore, current cleaning methods are **water and labor-intensive, and abrasive**. To address this need for an efficient cost-effective cleaning mechanism, our team designed **el-sol**, a solar panel cleaner utilizing electrostatic biasing to remove dust from panels in a waterless non-abrasive, automated manner that communicates efficacy remotely for analysis. Using el-sol, corporations with solar farms can significantly lower their energy consumption and maintenance costs in a sustainable manner.

The Problem

Low-emission renewable energy sources such as solar panels are crucial to reducing the overall carbon footprint, which can help us reach greenhouse gas level goals suggested by **COP27** and the United Nations Sustainable Development Goals. Although solar panels are primed to make up **50 percent of our renewable energy by 2035**, it currently takes up a mere 2 percent of our global energy usage. This is due to their inefficiency, as current solar panels only generate **15 to 22% of their total energy** capacity. **Dust accumulation** reduces energy output by up to 50 percent via its effect of covering the panel surfaces and hindering solar absorption and is seen as the primary culprit for this issue. Currently, most solar power plants rely on manual cleaning processes using a large amount of water: approximately **10 billion gallons of water annually.**

As the world's ten largest solar plants are all located in remote desert regions such as the Tengger Desert Solar Park, mainstream methods to clean panels are not only labor intensive but also heavily wasteful. With many firms in the service and infrastructure sectors promising to use renewable energy and relying on solar panel plants, this problem is largely exacerbated along with the influx of solar panels required to meet high energy demands.

Our Solution: el-sol

El-sol is a solar panel cleaner that sweeps across a row of panels; it cleans dust using electrostatic biasing, a waterless and energy-efficient process applying high-voltage, low-frequency charges produced by the panel itself, removing dust particles **electrostatically** via a **Coulomb** force. The machine implements an aluminum bar attached to a conductive track in conjunction with heat-resistant and transparent fluoride-doped tin oxide (FTO) coating, ensuring **durability** even in desert conditions. Furthermore, efficacy is monitored via an energy output detection device, allowing remote functionality. This product has the potential to improve solar **panel efficiency by up to 25%**, allowing individual solar panels to provide more energy, reducing overall greenhouse gas emissions from energy by approximately 300,000 pounds annually.

Current Progress

Market Research: Upon initial interest in the idea, we conducted market research to confirm the market opportunity. We interviewed Roy Li, the President of UpSolar, who explained the necessity for a universal cleaning device since most cleaners have yet to be marketed widely.

Designing the MVP: We decided to develop our product using electrostatic potential energy to remove debris, which has yet to be developed for commercial solar panel use. Based on more literature review on electrostatic biasing, we concluded our product will use the standing wave, composed of the FTO layer in conjunction with a moving aluminum bar to transmit a Coulomb force to the panel to repel debris.

Subsequently, we created a detailed digital mockup of our final product, identifying all parts of the design and displaying how the electrostatic biasing system will function. Once the testing process is finalized, we hope to patent our design and begin developing corporation connections. The mechanisms of the aluminum bar moving across a solar panel have been tested through our product build, with our team obtaining parts and assembling a motor-powered track for the aluminum bar to move across the panel.

Target Market & Market Size

El-sol uses a **B2B business model**, selling directly to large corporations. Businesses become more cost-efficient by keeping their existing solar panels and the solar panel turnover rate decreases, minimizing waste. With the market size of the global solar panel cleaning industry predicted to hit **$1.4 billion** by 2027 and expected to inflate at a compound annual growth rate of 8.98%, we are confident there is a viable market opportunity.

Demographics: companies with a market capitalization of at least 2 billion that have invested in utility-scale level solar farms.

Geographics: companies based in the United States, which may have energy sources globally.

Psychographics: companies aiming to increase their renewable energy usage due to consumer and legislative pressures. The **Renewable Energy Act** passed by the 117th United States Congress requiring suppliers to generate 70% of renewable energy by 2030 and the Solar Investment Tax Credit deployed by the United States federal government as an incentive to increase solar energy use in larger corporations support this.

Total Addressable Market: $1.4 billion

Service Available Market: 15% of TAM ($200 million), Our SAM is based on the characteristics of our primary target market.

Service Obtainable Market: 5% of our service available market (**$10 million**)

Competitor Analysis

While a variety of solar panel cleaning techniques and devices have been developed, our product is more efficient is environmentally sustainable. One type of cleaner uses water to clean the panels, such as the Heliotex product. This uses large amounts of treated water purified through filters that must be changed frequently, making the cleaning process wasteful and inefficient. On the other hand, current waterless autonomous solutions include robotic arms, such as the Sunpower Greenbotics robot. However, these robots are costly to produce and maintain, heavy, and cause abrasions to panels. Human intervention is also required to start and stop cleaning. Given these drawbacks, non-contact solutions have been in development for over a decade, with the spearheads of the effort being “self-cleaning electrodynamic screens” developed by the Applied Electromagnetics Lab at Boston University. These screens involve embedding electrodes in the panels to create an electrostatic field. However, the process of installing electrodes is time-consuming, as each panel will require a meticulously-installed set of electrodes to function. Another competitor is the MIT panel electrostatic cleaner activated through a humidity sensor. We use a more durable FTO coating versus their aluminum-doped zinc oxide. With developed monitoring and nightly automated cleaning systems, our product is convenient and meticulous, allowing for increased panel efficiency. Ultimately, while other products involve untimed and manual initiation, a passive solution, our product conducts remote cleaning initiated nightly, ensuring that the cleaning process actively prevents dust accumulation.

Cost Structure & Revenue Model

We estimate it will cost about $900 to develop the electrostatic cleaner for one row of panels, due to the FTO coating and the customized aluminum adjustable bar and track. With approximately 35 rows per acre and 50 acres per farm, we concluded that the total costs would be about **$1.7 million per farm**.

However, this number is subject to change based on the exact number of rows per farm. For our revenue model, we decided to charge corporations an initial upfront fee of about $1350 per row of solar panels as this is a 50% markup from our cost of goods sold. This would equate to an initial **revenue of $2.5 million per solar farm**. We will charge a flat monthly maintenance fee of $500 to have a continuous stream of revenue, adding $6000 to our revenue per farm per year. Aside from our SG&A costs, our key operating expenses include legal fees, equipment, payroll, website maintenance, research and development, and inventory. After creating a projected income statement for the first five years of operations, we determined our break-even point would occur in our third year of business with a gross margin of 50% and a net profit of about $4.5 million. By the fifth year, we estimate revenue of about $90 million, a cost of goods sold of $60 million, total operating expenses of about 5 million, an EBITDA of about $26 million, and a **net profit of $23 million.** By our fifth year, our ROI is 35% and our IRR is 23%.

Funding Plan & Next Steps

We will first join **incubator** programs focusing on renewable energy such as Evergreen Climate Innovations and the Third Derivative, obtain funding from angel investors, and place sweat equity and personal funding of $2000 to develop a minimum viable product. Afterward, we will acquire funding from **Venture Capitalist firms** like ExxonMobil, which has pledged $15 billion to reduce carbon emissions and ask for **$800,000** in exchange for a 20% stake in our company. We will invest 25% of the costs into research and development, 15% in obtaining a patent, 50% in back office costs, and the rest in unexpected costs and emergencies. Finally, we plan on receiving recurring grants from environmental government agencies such as the US Solar Energy Technology Office to fund further research and development, and registering with the United Nations Sustainability Development Goals to help us land more investment funding and expand globally. With the solar energy industry only on the rise and efficacy becoming increasingly vital, the future of solar power lies in the hands of our product, el-sol.