Viability of Solar Power on Jobsites

Braden J. LeValley
California Polytechnic State University
San Luis Obispo California

The use of solar energy has slowly been on the rise over the past few decades, the full potential of solar energy has not been realized in the realm of construction. Solar power in construction has been slow to catch on, as many of the upfront costs associated with solar power has created a feeling that investing in such systems will ultimately not be worth the investment. This paper attempts to address the issues of upfront costs, the willingness for contractors to invest in renewable energy both now and in the future, and will also identify possible uses for solar power on the jobsite. Through the research conducted in this paper, it has been proven that there are viable options for solar power on jobsites in the future. The research details current costs of solar, why solar has not been selected as a means of providing power at this point in time, and what future research is necessary to create an environment where solar power use is ubiquitous throughout the construction industry. Ultimately, this paper will provide a pathway for future contractors, investors in renewable energy, and developers to both reduce their environmental impact and save costs on jobsite power.

Keywords: renewable energy, solar, sustainability, photovoltaic, cost savings

Introduction

"The cost to install solar has dropped more than 70% over the last decade, leading the industry to expand into new markets and deploy systems nationwide." (Solar Energy Industries Association, 2019) The reduction in installation and maintenance costs for photovoltaic energy has spurred ever increasing investment into these technologies, making the use of these systems cheaper, more efficient, and ultimately more accessible for all parties. The Union of Concerned Scientists (2014) state, "The U.S. solar industry employed more than 140,000 people in 2013, a 53 percent increase over 2010, and is investing almost $15 billion in the U.S. economy annually. There are currently more than 6,000 solar companies in the U.S., spread across all 50 states." The information provided from the previous statement further exemplifies the trend in the solar industry of exponential progression and advancement. Through the research conducted to produce this paper, the same sentiment is ubiquitous throughout the industry; that sentiment being solar will eventually become a major source of energy production. Very few industry professionals interviewed throughout the research conducted did not believe solar would eventually play a major role in the construction energy, specifically to provide temporary power and solar powered generators as the interviews were tailored toward those categories. As the trend toward renewable energy becomes increasingly inevitable, investors in the renewable energy industry are trying to find new and innovative ways to implement solar energy systems into all aspects of society, and one major focus has been the field of construction. According to the U.S. Energy Information Administration (2018), "Renewable energy is energy from sources that are naturally replenishing but flow-limited. They are virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time." The idea of renewable energy is vitally important for a sustainable future, considering the levels of consumption compared to resource depletion are at an imbalance with our consumption far outweighing our resource availability. In a separate article from the last, the U.S. Energy Information Administration (2019) states, "In 2018, the residential and commercial sectors accounted for about 40% (or about 40 quadrillion British thermal units) of total U.S. energy consumption." The massive amount of energy consumed through the building process in the United States presents an opportunity just as massive to reduce our consumption through the use of renewable energy. At this point in time, solar has only just begun to be used on jobsites. Most of these system implementations come in the form of solar generators. These are defined in the article written by the Solar Alliance (2018) as the following, "A solar generator is a small box that has components connected together in it: the batteries, the charge controller, and the inverter. All three are necessary components to making sure your solar energy power works. This solar generator, once activated and gaining the energy from the solar panels (which get energy from the sunlight), can

power whatever you need (depending on the amount of power you're getting and the size of power you need, of course)." These generators are not extremely efficient and require constant sunlight throughout the building process to maintain proper energy output. Although inefficient, these sort of systems epitomize the state of solar energy systems in the building process; they are a great start and provide a pathway for innovation and technological advancement in the field of construction. This paper address why solar has not been able to gain traction in the construction field until recent years, where future research can be done to help facilitate the advancement of solar energy systems, and analyzes the trends of cost reduction within the solar industry and how those trends will help bring about investment and ultimately innovation.

History of Solar Power

Although the installation and use of solar power as a financially viable source of energy came about relatively recently, its birth and discovery came much earlier. Beginning in 1839, its discovery marked the beginning of an energy revolution that would impact the world for hundreds of years. Many scientists played key roles in allowing solar energy to make the progress it has made throughout the last 180 years. Han (2014) details this history:

Solar photovoltaics were first used in 1839 when a French physicist, Alexandre Edmond Becquerel, discovered that light can be converted into electricity when he experimented with metal electrodes and electrolytes. In 1873, Willoughby Smith made a discovery of photovoltaic effects in selenium. In 1887, Heinrich Hertz discovered that voltage can be changed at which sparks between two metal electrodes would be initiated, via ultraviolet light. The first silicon solar cells were not discovered until 1918, when Jan Czochralski, a Polish scientist, discovered that a monocrystalline silicon can be used for solar cell production upon the discovery of the method of the production of monocrystalline silicon itself. The first solar cell using silicon monocrystalline was constructed in 1941 (p. 1).

These discoveries paved the way for future research in solar energy production. These men discovered, not one, but three ways of harnessing solar energy. One of which is still used today, though in a modified and modernized version, that being monocrystalline silicon. Although the discovery was groundbreaking considering the future implications and progress, the early pioneers of solar energy production were unable to create efficient methods of harnessing the energy. Throughout the century following the initial discovery, major leaps in efficiency were made. These advancements are detailed by Han (2014) as he details the progression:

Early silicon solar photovoltaic sells did not, however, have good efficiency. In addition, running them were a bit costly. However, as time passes, efficiency increased while the cost decreased. In 1955, Hoffman Electronics-Semiconductor Division introduced photovoltaic products with only a 2% efficiency, with an energy cost of $1,785/Watt (USD). In 1957, Hoffman Electronics were able to introduce cells with an increased efficiency, at 8%. The same company's solar cell efficiency was increased to 9% in 1958 and 10% in 1959. The efficiency skyrocketed to 14% in 1960. In 1985, researchers at University of New South Wales, Australia were able to construct a solar cell that has over 20% efficiency. A 20% efficiency solar cell were patented in 1992. In the 21st century, the efficiency continues to rise and and the future forecast shows that there are no signs that the efficiency would stop increasing. In addition, the cost of solar energy has been decreasing (p. 1).

The constant cycle of progression seems to be a major theme in the renewable industry, which, obviously, is a positive trend when it comes to replacing all current energy systems with renewable energy systems. The final remark of the previous citation is the most promising piece of information in regards to facilitating further progression in system efficiency. This is due to the statement about the ever-decreasing cost to produce solar energy.

The cost of producing solar energy has historically been the aspect of the industry that has been off-putting to potential investors and those who wish to install systems in their projects. Until recently, the upfront costs of installing solar systems did not allow for preferable payback periods. Solar Energy Industries Association (2019) states, "Prices as of Q4 2018 are at their lowest levels in history across all market segments. An average-sized residential system has dropped from a pre-incentive price of $40,000 in 2010 to roughly $18,000 today."

Massive reductions in cost as detailed by the previous quote and seen over the past decade have been the catalyst for innovation and investment into renewable energy systems. Solar energy innovation has seen some of the greatest progress compared to other forms of renewable energy in that short amount of time, especially in states like California and Arizona, along with the other states in the southwestern region of the United States. Companies like

Tesla have pushed the envelope, developing their PowerWall system that allows homes to store solar energy and provide ample power to run systems that are typical for residential homes. These sorts of innovations and the potential for profit has driven investors that may have been typically in the business of natural energy resources, such as gas or coal, to begin to abandon the unsustainable industries of natural resources and focus their investing efforts into renewable energy. It is the culmination of increased system efficiency, cost reduction, sustainable culture, and potential for profit that have created an environment where renewable energy now has the opportunity to progress and solidify its position as a viable option as a means of providing energy for the country in the future.

As stated, renewable energy has the potential to have a major impact on the way we provide power to the country. According to the research conducted, many professionals believe one of the largest areas of potential growth is in the construction industry, as the industry does account for nearly 40% of energy consumption, as stated previously. The purpose of this research paper is to detail the outlook by industry professionals on the role renewable energy will have on jobsites, identify current costs of solar energy systems, and provide a pathway for future research in hopes of creating an environment where solar power can be used on all jobsites.

Research Methodology

This paper details the qualitative research determined through personal and email interviews with industry professionals. All of the industry professionals have primarily worked in the commercial electrical field for the majority of their careers. The level of responsibility of these professionals range from president of the company to foreman, and each individual had at least 10 years of in-field experience. The questions posed to the participants began with direct questions to determine level of experience, areas of expertise, and whether or not they have worked with solar energy systems at any point in their career. The latter part of the interviews consisted of open ended questions regarding the role solar power plays currently in the industry, where they see solar fitting in in the near future, and the timelines for which they believe solar will begin to play more important role in the construction process. (See Interview Questions as listed in Appendix A.) The open ended questions allowed for the participants to respond with more nuanced answers and allowed them to make considerations and assumptions from their experience as an industry professional.

Population Sampling

The population used for this research would have ideally been from different regions of the United States, this would give more informed data with professionals in different climates, as climate plays an enormous role in the efficacy of solar energy systems. Unfortunately, the network of professionals available at the time of the interviews was limited. The requisites for participants were as follows:

1. Ten years or more of in-field experience.
2. Experience in commercial electrical construction.
3. General knowledge of solar energy systems, but experience working with the systems not required.

The professionals selected for participation were selected through two methods. The first being purposeful sampling. Palinkas, Horwitz, Green, Wisdom, Duan, and Hoagwood (2015) describe this sampling as, “This involves identifying and selecting individuals or groups of individuals that are especially knowledgeable about or experienced with a phenomenon of interest. In addition to knowledge and experience, note the importance of availability and willingness to participate, and the ability to communicate experiences and opinions in an articulate, expressive, and reflective manner.” This method was chosen to ensure the data collected from the participants was well informed and based on experiential knowledge. This method also ensures the participant is interested in the field of research and willing to give an articulate response.

The second method of sampling used was convenience sampling. Elfil and Negida (2017) define convenience sampling as, “In this method, the investigators enroll subjects according to their availability and accessibility. Therefore, this method is quick, inexpensive, and convenient. It is called convenient sampling as the researcher selects the sample elements according to their convenient accessibility and proximity.” This method was used because of the connections that were available due to personal relations with industry professionals in San Diego. This allowed for easy access to experienced professionals who were knowledgeable in the area of researc

Region of Focus

Due to previously established connections with industry professionals in the region, the research and interviews conducted were strictly within San Diego county. The regional culture in regards to solar energy proved to be beneficial, as San Diego is one of the leaders in installation and use of solar energy systems. This is detailed by Kinman (2016) as the article states, "San Diego has more solar panels than most major American cities, ranking 2nd nationwide—for the third year in a row—among dozens of metropolitan areas analyzed in a new report." The region has also legally committed to creating renewable energy sources to power the city, Kinman (2016) states, "In December 2015, the city of San Diego became the largest American municipality to adopt a legal commitment to transition to 100 percent renewable energy, including solar power, by 2035. This initiative builds upon state level policy passed in the fall of 2015 committing California to achieve 50 percent renewable energy by 2030." Focusing on a region such as San Diego will provide other regions with a road map for how to transition to renewable energy, and will highlight the eventual benefits. Granted San Diego has more sunshine than almost any other city in the United States, as solar energy efficiency increase over time, solar will become a viable option even in northern climates. Ideally, all other cities in the United States and abroad will view San Diego's initiative to transition to renewable energy as motivation to do though themselves.

Interviews with Industry Professionals

Throughout the research conducted in this study, a total of 13 industry professionals were interviewed. Of the 13 interviewed, 1 interview was conducted in person and the 12 other interviews were conducted through email correspondence. The personal interview was recorded and transcribed to allowed for data analysis, while that process was not necessary for the email interview responses given they were written by the participants. As touched on previously, the interviews began with demographic questions to determine the level of experience, areas of expertise, and level of experience when it came to working with solar energy systems. Again, as touched on previously, the interviews concluded with open ended questions to determine their subjective opinions on the current role solar power plays in construction, where they personally see solar playing a role in the future when it comes to jobsite power production, and the general timeline on which they see solar becoming more widely used for energy production on jobsites. (See Interview Questions as listed in Appendix A)

Data Analysis

The single personal interview conducted was recorded and transcribed to provide an accurate account of the participant's response to interview questions. The names and positions were later redacted to maintain a non-bias analysis of the responses. The approach taken towards data analysis was a constant comparative approach. Kolb (2012) defines this method as the following, "The constant comparative method is used by the researcher to develop concepts from the data by coding and analyzing at the same time. The constant comparative method combines systematic data collection, coding, and analysis with theoretical sampling in order to generate theory that is integrated, close to the data, and expressed in a form clear enough for further testing." To put it succinctly, the data provided by the participants through the interviews were compared and contrasted with one another in an effort to generate a possible theme or general consensus on specific ideas. These comparisons highlighted trends in thinking between the different participants. These trends help to create an informed theory as to where the role of solar energy production in construction will begin to take hold in the future. The open ended questions towards the end of the interviews gave the participants a chance to provide new insight and possibly innovative ideas not previously conceived of by the researchers. The congruencies in responses help guide future research in the field of solar energy systems with regards to their role in jobsite construction.

Research Results

The thirteen industry professionals interviewed are a small group of individuals that represent only a small portion of the commercial electrical industry in the United States. Given their location in San Diego and the large presence of sustainable and renewable energy culture, the participants were assumed to have more knowledge than most commercial electricians on the subject of solar energy systems and potential. To produce a more informed outlook on the future of solar, industry professionals from different regions in the United States and beyond should be

interviewed. Ideally, professionals from solar energy companies will also be interviewed, as they would have a more informed view on the current capabilities of solar energy systems, as well as the capabilities of solar in the near future.

Demographic Information

As stated previously, the thirteen industry professionals interviewed were all working out of San Diego County. Some of the general experiential demographic information is detailed in Table 1 below.

Table 1

Participant Demographics

	Total Combined Years	Average Years	Most Experience	Least Experience
Years in Construction	390	30	43	18
Years in Commercial Electrical	332	25.5	43	10

Of the thirteen participants, only three attended and graduated college. Of those three graduates, only one had a degree in a field relating to construction, that being electrical engineering. All of the the participants had a minimum of a high school diploma or equivalent. Despite the wide range of educational backgrounds, all of the participants rose to their role in the traditional method of working their way up, each starting as an apprentice.

Current State and Potential Future Use of Solar Power Use on Jobsites

The participants of the study were all asked to identify potential uses for solar power on jobsites in the interviews conducted. The following information details the trends and similar ideas ideas brought forth from the interviews and attempts to synthesize the trends into succinct explanations of those potential uses. It is important to keep in mind the participants are from a small region and do not represent the possible uses in other regions, although some of those uses may be applicable in other regions of the United States. There may be limitations within the other regions that are not addressed in this research which is why further research is necessary to get a full view of the potential uses of solar power on jobsites in the future.

Current State of Solar Power Use on Jobsites

Mobile Solar Generators. With regards to the current state of solar power use on jobsites, many of the participants brought up the same subjects. One technology all of the participants responded with was mobile solar powered generators (See Figure 1). According to the participants, the use of these generators on jobsites has slowly been growing over the past decade or so. One aspect about these generators that was pointed out was the lack of efficiency and inability to provide ample power from just one generator. The participants noted that where one diesel generator would normally be used, multiple solar generators were necessary to provide the same power. The participants also noted that because of the energy replenishing system was facilitated through a mobile solar panel on top of the generator, these generators were only viable in regions with ample sunlight, such as the southwestern United States. Some of the participants highlighted the fact that with increased efficiency and greater power output capabilities, these generators would be much more useful and would then require a fewer number of them to provide equivalent power to a diesel generator.

Figure 1: Mobile Solar Generator.

Jobsite Trailers. Every participant in the study spoke about solar powered jobsite trailers (See Figure 2). According to the participants, these trailers, just like the generators, are becoming increasingly more popular on jobsites, especially in areas with ample sunlight throughout the year. The goal of the solar energy systems on these trailers is to supplement the existing traditional power system. Again, because of the inefficiencies of having only a small amount of solar panels on the trailers, the participants noted that the power provided to the trailers via the panels was limited, forcing the trailers to rely on the traditional power systems for the most part. Although some of the cost is offset by the solar panels, the participants noted that with the trends in solar power with regards to the increasing efficiency, contractors should see jobsite trailers in the future become self-sufficient.

Figure 2: Solar panels atop jobsite trailer.

Potential Future Uses of Solar Power on Jobsites

Portable Solar Batteries. All of the participants have, at some point in the past, worked in the field for a minimum of ten years. This provided them with the experience of working on the jobsite with a plethora of tools, many of which were power tools. A common practice in construction is to provide small generators to power these power tools, since they are mobile and easy to fit in small work spaces. All thirteen participants responded positively to the idea of using solar powered batteries sized similarly to the small generators they would potentially replace. Many of them noted that as long as the battery can provide the same amount of power with the same level of reliability, they would prefer to use such a technology considering the lack of emissions produced through solar power. This sentiment is uplifting in a sense, if small changes such as replacing small generators with emission-free batteries can be implemented, it gives hope for change on a much larger, utility-size scale.

Mobile Solar Powered Tool Boxes. The portable solar batteries stated above are geared towards corded power tools. Another concern on jobsites is the charging of cordless power tools. A common practice on jobsites is to provide a mobile toolbox with charging stations inside the toolbox. These boxes are plugged in to a local power source, as most objects on a jobsite that require electricity do. One participant brought up the idea of possibly creating a toolbox that serves the same function, but is powered similarly to the mobile solar generators, where a few panels on top, coupled with the other necessary components such as inverters and batteries for storage, could provide the necessary energy required to charge the batteries for cordless power tools. The participant noted, considering the small amount of energy required to charge these tools, a small panel system would easily be able to provide the power necessary. Since charging is generally done at the end of the work day, the box would be able to charge its own batteries throughout the day without energy being taken from the system. This idea seems to be one of the most viable options for further implementing solar power on to jobsites.

Solar Farm Power Provider. When conducting the interviews with the participants, one of the questions posed related to a business proposition created by the researcher. The business proposition (See Interview Questions as listed in Appendix A) touched on the idea of a third party company providing solar power batteries of multiple sizes as a means of providing power to specific parts of the jobsite. The response from all of the participants was positive, given that there was a cost savings attached to the proposition. Some of the costs taken into account when determining the overall cost were the cost to rent generators, potential maintenance cost of the generators, and cost of fuel to power generators. Again, as time goes on and the process of providing power through this business proposition becomes more efficient, cost savings will only increase for both the provider and client.

Areas of Concern

Regional Concerns. Some of the participant had some concerns when it came to being able to implement these sort of solar energy systems in the United States and around the world. The first concern and the most prominent concern was the difference in weather between different regions and climates. Those who were concerned about this noted that in areas like San Diego, Los Angeles, or Phoenix, the issue of sunlight availability would be of little concern. When it comes to other areas, such as Detroit, as one of the participants used to work, New York, or Milwaukee, implementing these systems really will not become viable until the solar energy systems become more efficient. These concerns are rooted in truth at this point in time, but as solar becomes more and more efficient as it has over the last one hundred and eighty years, implementing these sort of systems will eventually become a more viable option. Han (2014) details some increases in efficiencies brought about through the use of photovoltaic array systems (See Figure 3) as he states, “although most solar PV arrays currently use vary in efficiency from around 10-20%, efficiency values as high as 44.4% have been obtained in experimental settings by Sharp and NREL. However, most of the technologies at these high efficiencies have only been possible under laboratory settings and not at full scale production level. It is interesting to observe that on average over time, the efficiency for all the four technologies considered have increased proving that solar PV is on an upward trajectory as far as improving the efficiency is considered. On a final note, it is particularly revealing to identify that most of the technologies at efficiency higher than ~25% are those developed by large private corporations such as Boeing, Panasonic and Sharp possibly because of the financial resources available to them and the more tangible, short-term incentives of maximizing profits and cutting costs.” What this information provides is optimism based on statistics. As large corporate companies invest in solar energy because of their access to capital coupled with the decreasing cost to

invest in such systems, providing energy through solar to areas of historically low sunlight is becoming increasingly more viable.

Figure 3: Photovoltaic Array.

Trends Towards Sustainability

Environmental legislation passed in the United States and around the world as of late has pushed more and more people to become environmentally concerned. With states like California setting goals for renewable energy that have legal implications, citizens and companies are being forced to become innovative when it comes to producing and creating efficient renewable energy systems. Kinman (2016) details some of the sentiment in San Diego and California in general with the statement and quote from San Diego's mayor Kevin Faulconer, "'San Diego continues to lead the way in solar energy and remains a shining example to other cities when it comes to improving our environment through innovation,' Mayor Faulconer said. 'Increasing solar energy will help reach our goal of 100 percent renewable energy use in the city by 2035 – a key element of San Diego's landmark Climate Action Plan.' In December 2015, the city of San Diego became the largest American municipality to adopt a legal commitment to transition to 100 percent renewable energy, including solar power, by 2035. This initiative builds upon state level policy passed in the fall of 2015 committing California to achieve 50 percent renewable energy by 2030." Initiatives like the one passed in San Diego represent the changing world view when it comes to the way energy is produced for cities and nations as a whole. With such a heavy focus on renewable energy, finding new ways to implement those systems into everyday applications will become a sizable industry that will both allow our society to reduce its impact on the environment, as well as allowing companies to profit if the opportunity is taken advantage of.

Implementing solar energy systems in different ways throughout the construction process seems to be one of the first possible steps that will help facilitate further application of solar energy.

Conclusion and Discussion

Although the ability to harness solar energy was discovered 180 years ago, only recently has it become a truly viable source of dependable energy. Innovations in design of solar energy systems has been constant throughout that 180-year span, but application and implementation of these systems is still in it's relative infancy. Just in the last decade alone, the solar industry has seen the efficiency of its systems increase exponentially while the cost to produce those more efficient systems is magnitudes cheaper than the cost to produce the previous iterations of solar energy. The research conducted in this study detail the current state of solar and the possible applications, but more importantly this research proves there is plenty of room for growth and innovation. This research has shown that industry professionals see solar playing a much more integral role in the way we build buildings and the way we provide energy to jobsites. More research is necessary when it comes to increasing efficiency of solar systems as well as how to implement solar energy systems from a technical standpoint, but nonetheless this paper proves that implementing solar onto jobsites is an extremely viable option so long as professionals in the solar industry continue to innovate and make ultimately more productive solar energy systems.

To further the research done in this study, it would be recommended that commercial electricians from as many regions around the world as possible be interviewed. Along with commercial electricians, a key group to gain information from would be solar power contractors and companies specializing in the manufacturing of solar equipment. Getting insight from these two groups would allow for better understanding of the possible future capabilities of solar energy systems and how they may be implemented into construction. Some form of quantitative research would be viable if access to the people that know the systems best was an option, unlike in this study. Research is still necessary, but gaining information through studies like this paper is necessary to see where we stand both on the current physical capabilities but also where people want to see solar implemented in the future. This paper will hopefully serve as one brick in the wall of information needed to better our society and reduce its impact on the environment.

References

Elfil, M. and Negida, A. (2017, January 14). *Sampling methods in Clinical Research; an Educational Review* [WWW document] URL https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5325924/

Han, A. (2014). *Efficiency of Solar PV, Then, Now, and Future* [WWW document] URL https://sites.lafayette.edu/egrs352-sp14-pv/technology/history-of-pv-technology/

Kinman, M. (2016, April 8). *San Diego ranks 2ndfor solar power in nation* [WWW document] URL https://environmentcalifornia.org/news/cae/san-diego-ranks-2nd-solar-power-nation-0

Kolb, S (2012). *Grounded Theory and the Constant Comparative Method:Valid Research Strategies for Educators* [WWW document] URL http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.301.9451&rep=rep1&type=pdf

Palinkas, L., Horwitz, S., Green, C., Wisdom, J., Duan, N., and Hoagwood, K. (2015, September). *Purposeful sampling for qualitative data collection and analysisin mixed method implementation research* [WWW document] URL https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4012002/

Solar Alliance. (2018). *How a Portable Solar Generator Works* [WWW document] URL https://www.solaralliance.org/how-a-portable-solar-generator-works/

Solar Energy Industries Association. (2019). *Solar Industry Research Data* [WWW document] URL https://www.seia.org/solar-industry-research-data

Union of Concerned Scientists. (2014, August). *Solar Power on the Rise: The Technologies and Policies Behind a Booming Energy Sector* [WWW document] URL https://www.ucsusa.org/clean_energy/our-energy-choices/renewable-energy/solar-power-technologies-and-policies.html

United States Energy Information Administration. (2019, May 14). *How much energy is consumed in U.S. residential and commercial building?* [WWW document] URL https://www.eia.gov/tools/faqs/faq.php?id=86&t=1

Appendix A – Interview Questions

How many years have you worked in the construction industry?

How many years have your worked in the field of commercial electrical contracting?

What level of education have you received, both before and during your career?

Describe your level of knowledge when it comes to solar energy systems.

Have you ever directly worked with a solar energy system? Whether that been installation of a new system, repairing or maintain an existing system, or other work pertaining to solar energy systems.

In your opinion, do you think solar has become an increasingly more viable option as a means of providing dependable power?

Has the growth of the solar industry had an effect on your job responsibilities specifically?

Have you seen solar energy systems be used on any jobsites you have worked on? If so, explain.

Assume solar power was able to provide sufficient energy regardless of location and weather, what areas do you believe solar could be used on the jobsite where it isn't being used yet?

In how many years do you believe we could see such uses take hold on jobsites?

Would you like to see solar be used in that manner if it became a possibility? Considering the implications it may have on your job?

What are your general views on the trends toward the use of renewable energy resources on jobsites and construction as a whole?

Consider this scenario, if a company were to be able to provide jobsite power via mobile solar batteries and generators as opposed to traditional diesel or gas fueled generators for the same price, given that energy outputs were equal, would you prefer a solar based system or traditionally fueled system?

Do the environmental impacts of traditionally fueled systems play a role in your decision? Why?