



“Perceptions and Impact of Solar Energy in the Context of Philadelphia”

Corey Crews-Williams, McNair Scholar, The Pennsylvania State University

McNair Faculty Research Advisers:

Jeffrey R. S. Brownson, Ph.D.

Associate Professor of Energy and Mineral Engineering

Department of Energy and Mineral Engineering

College of Earth and Mineral Sciences

Nicole Webster, Ph.D.

Associate Professor of Youth and International Development

Department of Agricultural Economics, Sociology, and Education

College of Agricultural Sciences

The Pennsylvania State University

Abstract

In all its greatness, Philadelphia continues to struggle with poverty. To properly address such issues, we must first understand the value system of our stakeholder community. This entails engaging with the people of the community to thoroughly understand their beliefs, desires, and disparities. In the context of Philadelphia, I want to understand the perceptions of solar energy and the impact new methods of energy have on a community. The methodology to achieve this is one that includes productive conversation. This project will include the results of surveys/interviews conducted with Philadelphia stakeholders who attended the Philly Green Ambassadors Orientation held in West Philadelphia.

Understanding such constituents will lay the foundation for a socially equitable future. As these results are illustrated, we will be able to enable Philadelphia communities to have better access to clean energy sources by having projects that are more compatible with their diverse cultural systems.

Introduction

A socially equitable future is more achievable for disenfranchised communities like Philadelphia once barriers to renewable energy are overcome. Perceptions of new energy methods must be properly analyzed to ensure programs/initiatives that have the intent of encouraging such methods achieve long term success. This makes it vital for engineers who work in the community development field to know how to properly engage with their stakeholders and apply the knowledge gained to project design. Highlighting the impact that the renewable energy industry has had thus far on your community can be used as an aide for educating people on the benefits of such systems. This research paper will be focusing on the perceptions of solar energy in Philadelphia to discover what existing barriers prevent residents of Philadelphia from gaining access to clean energy.

Furthermore, this paper will address proper ways of engagement to extract necessary information from the stakeholder community. Solar energy can be used as a vessel for community development but only when the interests of the community are included in the design process of solar energy programs and initiatives. The benefits of this energy method are exemplified through developing communities internationally.

The city of Philadelphia, located in southeastern Pennsylvania, is home to over 1.5 million people (2018). This city, rich in history and culture, is home to the Liberty Bell and was once the capital of our nation. In addition to these great features, this city is also home to the Philadelphia Eagles, the 2018 Super Bowl champions. In a unique way, this city encompasses a plethora of cultural values and views that differ from neighborhood to neighborhood. From fashion to food, the interests of such an urban context are expressed in the fabric of its built environment. An important thing to note is how different this city is from others. Mention specifically how it's different from other cities

Juxtaposed to these beautiful features are conditions that exemplify Philadelphia's issues with poverty. Philadelphia, like most large cities, has trouble with crime, homelessness, unemployment, and pollution. Each of these downfalls pose a significant threat to the city's natural resources. At a poverty rate of 26%, Philadelphia remains the poorest of America's most populous cities according to the 2018 Pew report (U.S. Census Bureau, 2018). Economically, Philadelphia shows continuous improvement, but social measures do not reflect this progression. Although the city adds 715,900 jobs each month on average, approximately 400,000 residents still live in poverty. These conditions are exemplified in poor health, housing, and in many other ways. The effects of poverty are most felt by communities of color. Latino-Americans and African Americans experience the highest rates of poverty at 37.9% and 30.8%, respectively (U.S. Census Bureau, 2018). Issues related to poverty can be addressed in numerous ways. This research project will address these issues through the lens of energy poverty. Currently, there is a lack of access to clean and renewable energy sources. Furthermore, the city's current energy methods contribute to the pollution of vital resources that support the community. Disenfranchised communities experience the worst effects of these malpractices even though they contribute the least.

Although much effort and resources have been spent supporting the remediation of these circumstances, there is still tremendous progress to be made. Currently in Philadelphia, there are many projects, programs, and initiatives that are underway that have a mission of making renewable energy more accessible and applicable in urban contexts. The organizations that guide such endeavors consist of professionals and scholars from various fields of academia. Some initiatives are led by those with backgrounds in social or political sciences, while others may lead with a background in stem fields. As an Energy Engineering student, this research project will be conducted through the lens of an engineer. To have a successful project, engineers must be inclusive to the value system of their clients. As previously mentioned, the diversity of Philadelphia is accompanied with a variety of views and opinions toward solar energy. This makes it necessary to have proper and ongoing engagement with your stakeholders. A benefit of doing this is the possibility of discovering latent needs. This entails providing solutions to clients for issues that were previously overlooked. The skills and experience needed for this type of engagement are non-traditional to the engineering discipline.

Methods

Participants.

The participants of this study are community members and leaders from Philadelphia who attended the Philly Green Ambassadors event held by Overbrook Environmental Education Center in West Philly. In total, participants were a convenience sample of thirty-six individuals who range from ages 18 to 72. Demographically, the key characteristics that the survey focuses on are household income level, race/ethnicity, and gender. There was no inclusion or exclusion criteria for this engagement.

Procedure.

In this study, participants were asked a series of questions on their understanding and perspective of solar energy using a survey. The survey, as seen in Table 3.1, consists of 17 questions that are multiple choice, check-box, open-ended, and Likert scale questions. A purpose statement is provided at the beginning of the survey to provide background on the researcher and the intent of the research project. The first section of the survey has demographic questions that include race/ethnicity, gender, and household income level. These questions served as the variables of this study. More specifically, this study took a closer look at the results of the survey in relation to race and household income level. As for the rest of the survey, there are two multiple choice, four checkbox, two open-ended, and four Likert scale questions. Each of these questions address the awareness, behavior, and/or perceptions of each participant regarding solar energy:

- Awareness: Questions 7, 9, and 17
- Behavior: Questions 11, 14, and 15
- Perception: Questions 9, 10, 12, 13, 16, and 17

Table 3.1: Survey Questions

Question Number	Question
Question 1 (Written Response)	Name and Email
Question 2 (Written Response)	Neighborhood/City
Question 3 (Multiple Choice)	Household Income
Question 4 (Written Response)	Age
Question 5 (Checkbox)	Race/Ethnicity
Question 6 (Multiple Choice)	Gender
Question 7 (Multiple Choice)	Have you heard of solar energy before?
Question 8 (Checkbox)	If so, where?
Question 9 (Checkbox)	Solar energy can be seen as power from the sun. What does solar energy mean to you?
Question 10 (Checkbox)	Solar electricity is electricity that comes from solar power. Where do you see solar electricity being used in your community?

Question 11a. (Multiple Choice)	Have you considered solar electricity for your home before
Question 11b. (Written Response)	Please explain why or why not.
Question 12 (Checkbox)	Select the top 3 barriers that prevent you and other people from gaining access to solar energy in your community.
Question 13 (Likert Scale)	Rank how much you agree with the following statements: Solar energy has positive benefits for a community.
Question 14 (Likert Scale)	If solar electricity was cheaper, I would be more likely to consider it for my home.
Question 15 (Likert Scale)	I would attend a seminar to learn more about solar energy.
Question 16 (Likert Scale)	Solar is important for the sustainability of urban communities.
Question 17 (Written Response)	What are better ways of introducing solar to your community?

Surveys were distributed in paper format at a community event held in West Philadelphia by the Overbrook Environmental Education Center. If asked, a more elaborate explanation on the background of this research project was provided by the researcher. Participants were informed that if they were to provide their names, they would not be used in the research without consent. The surveys were also sent electronically to community contacts to be further distributed to residents of Philadelphia. There were a variety of incentives to encourage representatives to attend the event. These incentives included gift cards, free t-shirts, and community resource bags.

Measures/Materials.

The survey was generated using Google Forms. This format allowed the questionnaire to be distributed online and in paper format. They were distributed electronically and in paper format. The survey consisted of multiple choice, checkbox, and short answer questions. These questions were developed with the influence of community leaders in Philadelphia for clarity purposes.

Analysis.

The primary factors considered during this research are the intersection between energy and culture, perceptions of solar energy in minority communities. The secondary factors considered for this research highlight attitudes regarding whether people are optimistic or pessimistic towards the future of solar energy. The responses have been analyzed at the individual and collective levels to understand the underlying needs of the community and its members.

Literature Review

Literature reviews help to establish the importance of a topic and serve as entry points into ongoing conversations for different fields of research. To gain a fundamental understanding of community engagement in Philadelphia and the potential impact solar energy can have in this environment, a review of literature was conducted. To begin, this understanding entails studying the societal conditions and value system of Philadelphia. This city is unique and so are the people that live there. This city has a strong culture and their perspectives towards any and everything must be considered to understand who they are. Furthermore, previous methods of engagement must be analyzed and understood to make sure that the same mistakes regarding engagement aren't repeated.

Energy Poverty.

Poverty in the context of Philadelphia is exemplified in numerous ways. One form of poverty, and the lens of this research project, is energy poverty. Energy poverty refers to inadequate access to clean, affordable, and reliable energy sources that promote sustainable growth (McCauley, 2018). Those that suffer the most detriment from fossil fuel use are disenfranchised communities and communities of color although they contribute to carbon emission production the least (McCaughley, 2018). These conditions pave the way to injustices that especially plague developing nations worldwide. This phenomenon is very apparent in the city of Philadelphia, and so it is crucial that right steps are taken to begin mitigating such poverty.

In Philadelphia, those with moderate to high income backgrounds make up most residential solar owners. Being that solar is an expensive investment, it can be expected that those who are wealthier will have greater access to solar energy initiatives and programs.

Renewable energy can serve as a catalyst for community development and economic growth in disenfranchised communities. In urban communities across the United States, the positive effects of using renewable energy sources are very apparent. Regarding Philadelphia, there has already been a tremendous amount of effort towards establishing a framework for solar energy implementation throughout the city. The analysis on the effects of solar energy in urban environments entails showing the impact of renewable energy on health, education, and employment. The potential of solar energy to eradicate poverty in North and West Philadelphia is prevalent but not utilized. By incorporating this type of energy system in under resourced environments, stakeholders are in more control of their resources, thus strengthening their power on the development within the community. These energy systems, when guided by members of the community, encouraged others within the same environment to take initiative in doing the same.

Culture & Energy.

In the human experience, energy and culture are inseparable. The methods of energy that people use on a day to day basis, whether it be for cooking, lighting, or electricity production, are deeply rooted into the culture of the people. The first steps to understanding this dynamic relationship between culture and energy is to consider the historical perspective of energy transitions for a specific environment. The use of fossil fuels is so deeply integrated into our society that they have become a cornerstone for societal and economic growth. The over reliance on such energy methods has made our society, no matter rural or urban, more and more vulnerable to the negative effects it creates (Dooley, 2006).

The lifestyle that has been created from the use of fossil fuels has not only proposed many negative effects on health and environment, but also binds us to its use, creating an unhealthy dependency that is hard to break (White, 1943). The cultural significance of energy use in Philadelphia guides the perception and impact of traditional and alternative energy sources. This leads us to ponder how we must either change our consumption culture to that of which is more accommodating to renewable energy implementation or acclimate renewable energy technologies to better serve the consumption habits. This is not a black and white approach but more so invites an agreement to meet in the middle. To make progress in aligning culture and energy with sustainable development, there must be dialogue on what exactly is affected by converting to renewable energy resources.

In Philadelphia, this dialogue has already begun. The Philadelphia Energy Authority is an independent municipal authority that has the responsibility of developing energy projects, policy, and educational programs for sustainable development in Philadelphia (Philadelphia City Council, 2016). One of their initiatives is the Solarize Philly program. With this initiative, residents of the city are encouraged to purchase residential solar for their homes by enrolling in a group buying program. As more people enroll, the discount on the solar installation becomes greater (Philadelphia Energy Authority, 2018). This program has brought many benefits to the city including significant job growth and additional solar capacity to decrease pollution. Unfortunately, involvement in this initiative is low amongst low-income communities due to the high cost to participate. As this is the case, the approach for providing solar to residents from a lower socioeconomic status must be changed. This leads us to explore alternative ways of solar implementation and investigate what obstacles may still be present for members of the community.

Unforeseen barriers for solar energy implementation are often barriers that are associated with the value system and community conditions in place. These barriers can be explained as cognitive barriers, meaning there is no awareness or interest from the general public due to a lack of proper engagement and/or presence of solar energy (Dooley, 2006). These factors may not be properly understood but are critical to the process of designing a more applicable program. Contrary to traditional engineering thinking, the underlying factors that influence residents from low-income backgrounds to purchase solar make the design of the solar program unique.

Community Development & Engagement.

There are various ways to successfully engage in a community when it comes to starting dialogue around solar energy interpretation and application. In addition to understanding the value system of a community and the influence this has on solar energy perceptions, we must also consider previous acts of engagement in Philadelphia and the impact this has had on the community. How does one engage in communities of color and disenfranchised communities? Why is it important to understand the value system of the community before we engage? These are questions that act as a foundation for discovering how to have ongoing interactions and conversations in Philadelphia. In *Pushing Back the Gates* by Harley F. Etienne, these questions are addressed from the university perspective. College institutions in Philadelphia have a long history of engaging with their surrounding community. The history of interactions between these entities has not always been positive. In theory, the relationship between college and community, especially for community development, is one that should be symbiotic however, this is not always the case. This disconnect between community and the entity engaging the community is not shared solely with universities but also with professional entities i.e. engineers, non-profit, organizations, volunteer programs, etc.

The lack of understanding in conjunction with poor remediation for unsuccessful projects creates a sense of distrust between the community and community entity intending to help (Etienne, 2012). Building that sense of trust is essential for current projects and those to follow.

Co-Production of Knowledge.

Issues of energy poverty can be explained through the lens of various academic backgrounds. Deeper understanding makes it critical for those working in the community development arena to be able to work with people from different fields of academia. Understanding the many facets that go into implementing renewable energy in foreign environment enables engineers to be broader in the solutions they decide to develop. Thoughtful programming therefore requires an interdisciplinary approach to fundamental engineering studies. An inclusive suite of topics such as social sciences, communication, and stakeholder engagement might be included. An integrated approach may come by way of coursework or by working in interdisciplinary teams where each person brings a unique expertise to a project. For Philadelphia, this means modifying the approach of solar engagement in a way that is inclusive to the interests and abilities of people from different socioeconomic backgrounds. The champions of community engagement are those who are well versed in a variety of disciplines with a basic understanding of the importance of engaging communities properly. However, much more progress can be made as a team rather as an individual.

Results

The preliminary findings of this research will address the demographic questions from the survey. The significant results will follow the same order as the questions presented in the survey. The survey consisted of 17 questions that address the awareness, behavior, and perceptions of solar energy from Philadelphia residents. The purpose of capturing these perspectives is to improve methods of community engagement, especially regarding solar programs and initiatives to be implemented in Philadelphia. As previously mentioned, the culture and value system of a community must be thoroughly understood prior to dropping technology in their environment. Projects and initiatives fail without doing so because there is a lack of compatibility between the interests of the community and the design of the solar project. By having a greater consideration for the latent needs of the community, projects will have a better chance of long-term success.

Neighborhood/City.

The participants of the survey were mainly from Philadelphia. As seen in Fig. 4.1, the residents participating were predominantly from West Philadelphia (50%) with a smaller representation from North Philadelphia (25%). Participants of survey labeled as “Other” were residents from outside of the city, such as Wynnefield and Washington D.C. Three participants lived outside of North and West Philadelphia including: Northeast, Northwest, and Center City.

Household Income.

As stated before, the focus of this research focuses on residents from low to moderate-income backgrounds. The levels of income that participants could choose from can be seen in Figure 4.2. The poverty line for a family of four is \$25,000 according to the U.S. Department of Health & Human Services (U.S. Department of Health & Human Services, 2018). Fourteen percent of the participants have a household income of less than \$20,000. This indicates a considerable number of participants who are below the poverty line. In addition to this, 19% of participants remain in the \$20,000 to \$34,999, indicating that their household income is relatively close to the poverty line. These features further emphasize the low-income status in Philadelphia communities.

As for other household income levels, there is an even split between those who have household incomes above and below \$50,000.

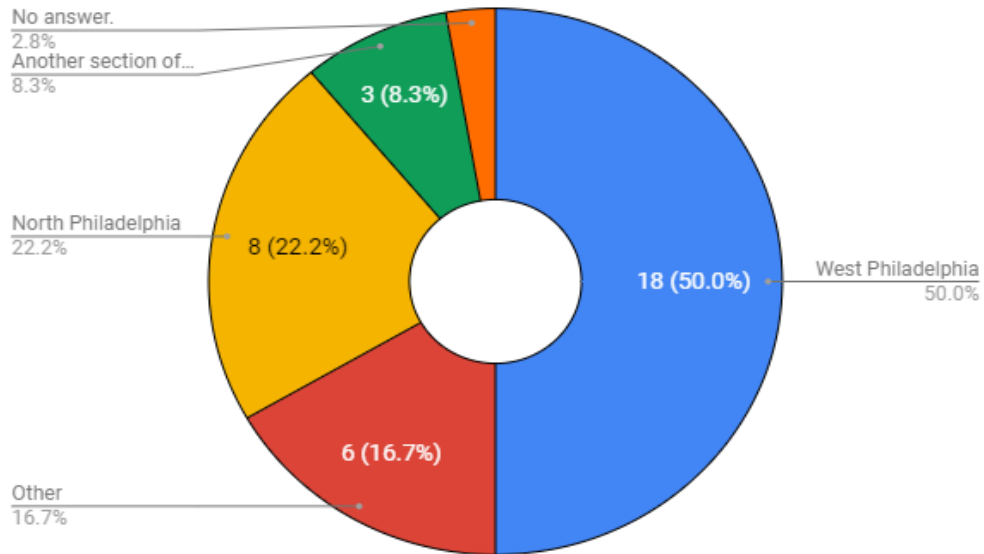


Figure 4.1: Neighborhood/City: 91% of the participants were from Philadelphia: 22% from North Philadelphia and 50% from West Philadelphia. One participant preferred not to answer. This question had 36 responses.



Figure 4.2: Household Income: This question had 32 responses. Individuals who did not respond were placed under Prefer not to say, thus making the total count 36. The most common household income level was the \$50,000 to \$74,999 range.

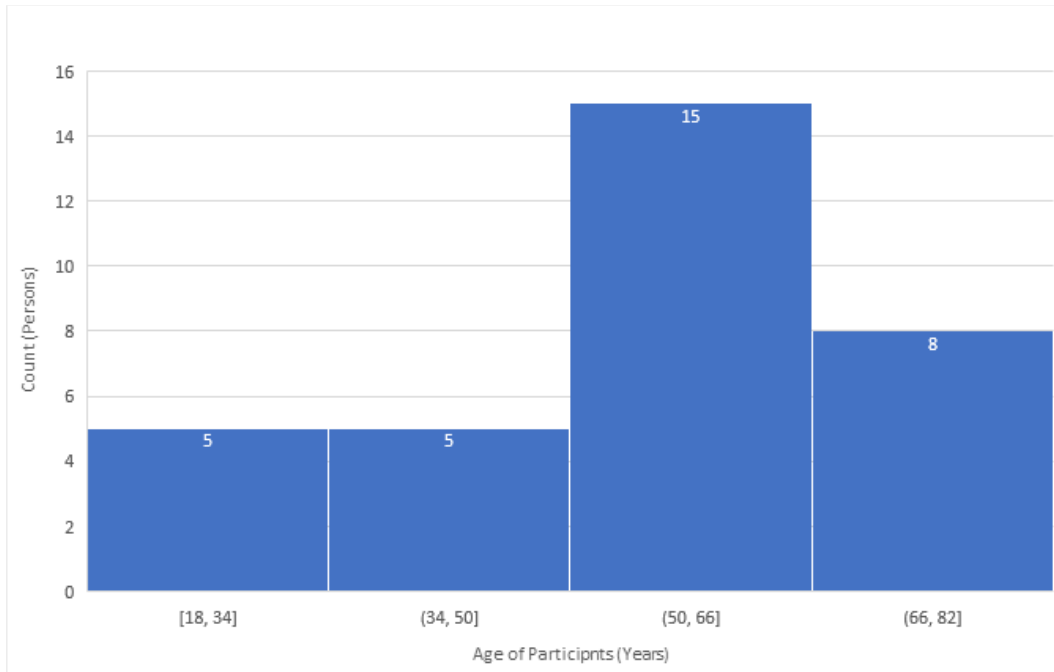


Figure 4.3: Age: Three participants did not provide their age. The youngest participant was 18 years of age. The eldest participant was 72 years of age. The average age of participants was 55. This question had 33 responses.

Race/Ethnicity & Gender.

As displayed in Figure 4.4, 32 out of the 36 participants were African-American. One participant identified as Hispanic or Latino. The ethnic spread of the surveys proved to be very beneficial for the results as the goal was to obtain the perspective from such groups. As previously mentioned, it is communities of color and low-income communities that experience the worst effects of resource mismanagement although they contribute to it the least. In this respect, resource mismanagement alludes to a lack of regard for the protection of natural resources: food, water, and energy, especially in the communities considered for this research. With this being known, it was important that the participants of the survey be from communities such as these to ensure that the results were representative of their interests.

As seen in Figure 4.4, most of survey participants were female. They made up 89% of the participants while males were only 8% of the participants.

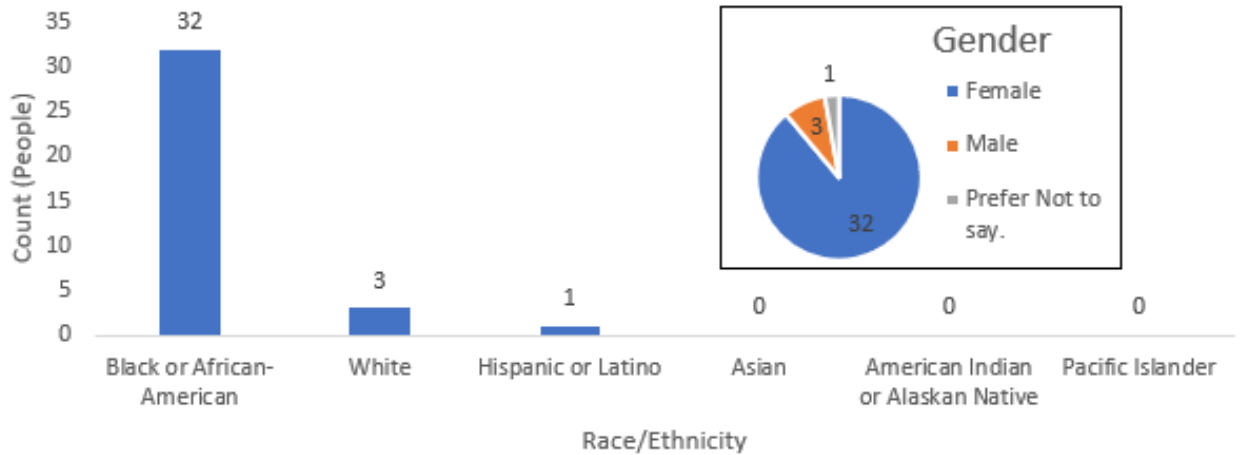


Figure 4.4: Race/Ethnicity and Gender. Race/Ethnicity: 91% of the participants were African-American. 9% of the participants were White. 3% of the participants were Hispanic or Latino. There were 36 responses to this question.

Solar Awareness.

The participants of the survey unanimously answered yes to if they had heard of solar energy prior to the survey. The purpose of this question was to establish an understanding of how familiar residents of Philadelphia are with certain terminology. Seeing that all the participants have heard of solar energy before, one can infer that solar energy is a familiar term in Philadelphia communities. Furthermore, it is important to know from where this familiarity is derived. Participants were also asked to provide where they had heard of solar energy. The top three sources as to where they heard about solar energy were TV commercials (49%), Internet (43%), and Family/Friends (40%). Each percentage correlates to the number of participants that selected the source as an option, explaining why the percentages do not add up to 100%. These results are also displayed below in Figure 4.5. Although TV and Internet are the best resource for information regarding solar energy, word of mouth from Family/Friends was the most common form of communicating about topic in Philadelphia.

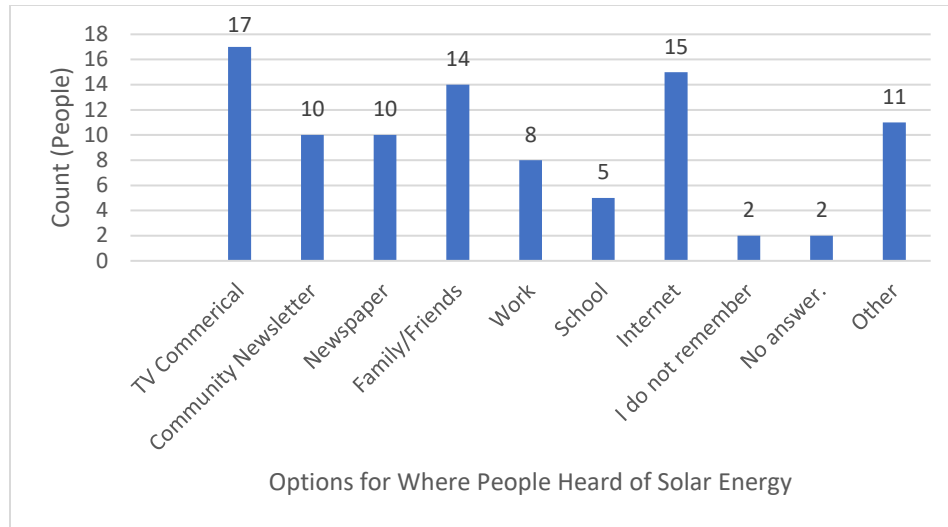


Figure 4.5: Where have you of solar energy?

The most chosen option was TV Commercials. The least chosen option besides “No answer.” and “I do not know” was School. There were 35 responses to this question.

Survey Synthesis.

Based on discussions held at the event and the survey results, one can conclude that the peer to peer passing of knowledge is very effective and applicable to urban environments of Philadelphia, specifically within North and West Philadelphia. This method of communication can be capitalized upon to increase solar energy awareness by placing a larger emphasis on the importance of communication within the community. It is through this communication that a logic of collective actions is created. This entails a consideration of joint welfare as opposed to individualistic efforts for shared goals (Ostrom, 2015). Improvements in collective communication can be achieved by better facilitating community events and seminars where solar energy topics are discussed. Furthermore, this encourages co-production of solutions as more than one perspective is being captured.

One thing learned from participating in the Philly Green Ambassadors Program is that despite one’s socioeconomic background, people still have ongoing access to the internet in some form or fashion. Where people access the internet was not asked in the survey but knowing that this is a valuable source for information in general can encourage the creation of better solar education tools. Furthermore, there are ways to create avenues of communication that encompass peer to peer interactions and the use of internet.

Question 9 addressed what people interpreted solar energy to mean with the basic understanding of solar energy being power from the sun. The most chosen representation of solar energy from the participants were natural heating (72%), natural lighting (72%), and solar panels (72%). These responses highlight what people’s initial thoughts are regarding solar energy. They also serve as a starting point for understanding how we should educate people on solar energy. There was a total of 7 options for different meanings of solar energy. One of these options was “Other”, allowing participants to write what solar energy meant to them. With a lack of solar options in Philadelphia, it was anticipated that natural heating, natural lighting, and solar panels would be the most apparent interpretations of solar energy in the city. Another point for consideration is to see which solar meanings were chosen the least.

This highlight can expose which methods of solar energy are least relevant in Philadelphia. This will also help to guide how community agencies propose solar initiatives. To further understand the interactions residents of Philadelphia, have with solar, another question was asked on the presence of solar in the city. In the survey, solar electricity is explained as electricity that comes from solar power. An electronic device converts sunlight into electric current, then sends it to a grid or battery for storage (Brownson, 2014). The applications of solar electricity greatly range. When asked where one sees solar electricity being used in their community, most respondents indicated that they have seen rooftop solar for homes and street lights in their community. Thirty-one (31%) of the responses indicated that they don't see solar electricity in their environments. The visual presence of solar electricity has a strong influence on what solar means to people. Representation serves in some ways as a definition to the technology. As the presence of solar options increases, people of the community become more familiar with its applicability to their lifestyles. The need for this presence was reiterated in discussions at the Philly Green Ambassadors Orientation.

To discover how people of Philadelphia feel about the applicability of solar to themselves, it was found that 75% of the participants have considered solar electricity for their home. The most common reasons for considering solar are as a form of energy is to save money by reducing electricity bills costs and it being a good investment for the environment. Although people may understand electricity produced by solar power, one cannot assume that they've considered it for their home. In opposition, those who did not consider solar expressed that they were not property owners, did not plan on living in their home for too long, or did not know enough about it. Consequently, these reasons discourage stakeholders from having an interest in solar energy. If we can remediate some of the reasons for opposition, it will be expected that people will have a higher consideration for solar. To begin remediation, we must first unpack the barriers that prevent people being more conscious of solar energy.

For Question 12, participants were asked to select the top barriers that prevent them and other people from gaining access to solar energy. These barriers are obstacles that discourage Philadelphia residents from implementing solar energy technology in his/her community. Finances was perceived as the highest barrier to solar access. Finances as a barrier entails solar energy being too expensive or too hard to finance. This barrier was expected to be salient in this research as the price of solar energy is a contested topic at the national level. To help bring this cost down, the Philadelphia Energy Authority has proposed a program where homeowners can enlist in a discounted solar installation program for their home. Unfortunately, even with this initiative in place, residents, especially from low-income backgrounds, still struggle to gain access due to the financial burden still being too large.

The second most selected barrier was Education/Awareness. For the survey, this barrier was explained as a lack of knowledge on solar energy options. This barrier is significant because it is directly correlated to how people perceive what solar energy means. As previously mentioned, there are numerous ways to introduce solar energy into a community whether it be through residential solar, community projects, or education programs for youth. To improve how people, adapt to these methods, they must first understand what they are.

The third most selected choice was Lack of Solar Resources. A lack of solar resources is not in regard to the amount of sunlight being provided in Philadelphia. It refers to a diverse application set of solar technologies i.e. residential solar, solar-powered street lights, and solar community projects. If options for solar implementation are not available, this limits the applicability of solar for Philadelphia residents. A person can be aware of different solar options although they are not present in the community. A lack of awareness for solar opportunities creates a detrimental disconnect as the lack of opportunity for solar engagement discourages residents of Philadelphia from partaking in solar initiatives. Opening more avenues for solar are the preliminary steps for a community to take on more initiatives, inspiring a positive momentum for sustainable development.

Questions 13-16 of the survey were Likert questions where participants were asked to rank how much they agreed with the statement provided, 1 meaning disagree, 5 meaning agree, and therefore 3 representing neither. The first statement, "Solar energy has positive benefits for the community." Seventy-eight (78%) agreed completely with this statement while 14% somewhat agreed. The second statement, "If solar electricity was cheaper, I would be more likely to consider it for my home." Seventy-two percent of participants agreed to this statement while 19% were neutral. The significance of being neutral to this statement is linked to the earlier question of if people have considered solar for their home. Even when the cost of solar energy is not a factor, there are other conditions that dissuade people from pursuing solar. Eighty-one percent and 16% of participants respectively either somewhat agreed or were neutral to the statement "I would attend a seminar to learn more about solar energy.". The response to this statement highlights the willingness of Philadelphia residents to learn more about solar. Participant responses reveal that although solar energy is something that may be familiar, they are open to taking the steps to learn how it may be more applicable to their lives. The fourth statement, "Solar is important for the sustainability of urban communities." Sixty-four percent of participants agreed with the statement while 19% were neutral towards it. Overall, the responses show that stakeholders from Philadelphia are generally optimistic towards solar.

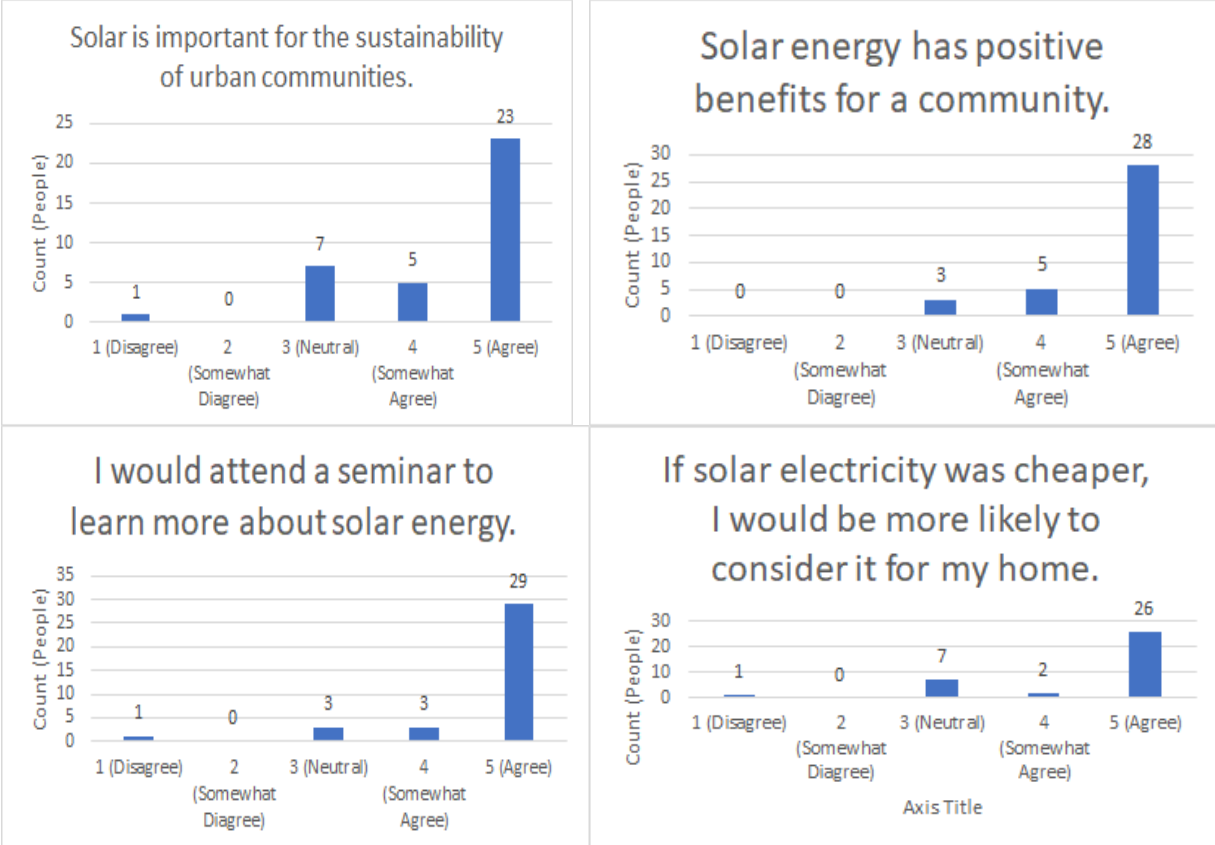


Figure 4.6: Likert scale questions. Y-axis: Count (People); X-axis: 1-Disagree, 2-Somewhat Disagree, 3-Neutral, 4-Somewhat Agree, 5-Agree.

Question 17 allowed people to write in what they thought were better ways of introducing solar to their communities. The overwhelming recommendation in this section was to have community meetings and/or workshops focused on learning about solar energy applications. Based on the responses from the survey and my discussions during the research engagement event, community meetings/workshops entail having in-person observations of solar panels in use on a home or other practical application. Two people suggested to have a presentation at the Civic Association Meetings on solar energy methods. Philadelphia Civic and Neighborhood Associations, are organized groups that work to keep their community informed (The Philadelphia Citizen, 2018). Overall, the responses from this question alluded to improving solar education and representation in their neighborhoods. Proposed ways to do this include having solar workshops or seminars at common meetings places for community members. Being able to see an active solar energy system seemed to be a viable way of educating Philadelphia residents on solar energy.

Discussion

Solar Energy Perceptions.

Based on the results, one can see that there are many avenues for engagement that will help communities in Philadelphia to be better informed of solar energy and how it applies to them. The first point to consider is that of education. This includes an understanding of what different solar resources are in the most simplistic manner. The aim is to shift thinking of solar as natural heating and lighting to a perspective that is more encompassing of solar technologies that can be used to improve their community. This education can come by way of community seminars, workshops, or other focal points for the community such as Civic Association meetings or local library events. However, even these avenues for education engagement come with speculation. How solar energy is proposed at these events always plays a large factor in people's understanding of the topic. Given this, there should be an investigation of potential communication barriers, especially with regard to solar terminology. Overall, solar energy has a bright future in Philadelphia. Based on the results, one can infer that residents of Philadelphia are very optimistic and open toward solar energy implementation. This optimism should and will be used to fuel solar engagements.

Perception of solar energy is also influenced by presence. The ability to see solar technology being used, whether it be residential or in a community format creates a sense of comfort for residents of Philadelphia as they grow a familiarity with its application. In informative seminars or workshops for solar programs and initiatives, it would be beneficial to provide tangible products and hands on demonstrations for attendees.

Neighborhoods of Philadelphia

As the results indicate, participants of the survey were from various sections of Philadelphia. The most represented sections were North and West Philadelphia. These two sections of Philadelphia serve as points of interest for this research due to their high levels of poverty. Although the West and North sections of Philadelphia are separated from one another, they have very similar characteristics as poverty-stricken environments. The conditions of poverty that they experience as aforementioned includes concerning levels of unemployment, pollution, and substance abuse (Pew Trusts, 2018). The urge to make these communities better is exemplified by the presence of representatives from these communities at events like the Philly Green Ambassador Orientation where they can gain resources that will help to make their environment better. In other words, the representation from North and West Philadelphia highlight a sense of civic engagement unique to these communities. The presence of community members from these sections signify the commitment such stakeholders have in improving their environment.

Women in Community Development of Philadelphia.

Most participants for the survey were women. This difference in gender was very apparent at the Philly Green Ambassadors Orientation. Based on the survey results and discussions held at the GSA Orientation, one can infer that women are integral to community development initiatives of North and West Philadelphia. At the event, women were the most vocal in creating solutions for community issues. This was an observation made while at the event. A female perspective was also true regarding the written responses provided in the surveys. Responses from women were more elaborate compared to those from men although there were not many responses from men. These women were block captains and representatives from community agencies. Block captains are the first level of local leadership for communities in Philadelphia. These positions may be assumed by someone who is heavily engaged in their neighborhood or by election. The significance of having their input in the surveys is that they directly engage in communities of interest for this research and are neighbors of residents to those who experience energy injustices.

When engaging in Philadelphia, block captains can serve as a good point of contact for beginning to learn about the community. Their perspectives and expertise of the community is unique since they live within the communities that are a focal point for this research. This is different than engaging with community leaders who are engaged within Philadelphia communities momentarily.

Furthermore, this dynamic suggests that women may have a higher regard or understanding of disparities within their community. Strong representation of women in the results also suggests that women are more knowledgeable of the resources needed to build the community. During the event, Philly Green Ambassadors Orientation, a range of topics were covered such as climate change and renewable energy to pest and storm water management. Each of these topics served as good focal points for the attendees to. Being that women were the most represented at the event, they had more information that could be redistributed in their communities.

Intersection Between Race, Income, and Solar Energy Perceptions.

To get a better understanding of the perspectives of solar of people specifically from low-income backgrounds and minority backgrounds, the results from participants who were African-American and had an income range of less than \$20,000 or \$20,000 to \$34,999 were more critically analyzed. The reason for their importance is due to these income levels being the closest to the national poverty and serve as a formidable starting point for analyzing the impact of solar specifically in this community. For this group, who make up 12 of 36 participants, the trends of responses were very similar to the results of the surveys overall. Participants from this demographic were all African-American and female. The average age was 48 and eight of the participants were from North and West Philadelphia. The responses from this specific group were very aligned with the total response from the survey. They had drastically similar perspectives of what solar energy meant to them and where they saw it present in their communities. The only nuance noticed was that there was a slightly larger emphasis on education for solar energy and a lesser acknowledgement for a lack of solar resources. This nuance was apparent in the responses for Question 12 and in Question 17. This difference in perspective shows that in order to engage and assist these communities in their development, the first focus should be towards how to convey solar energy is presented in a clearly understandable and engaging manner. Furthermore, based on the results from this group, one can conclude that pilot programs would be the best way to engage individuals from low-income backgrounds. With education as a starting point, environmental groups can focus on scaling up efforts and making the best use of resources for community engagement.

Conclusion and Perspective

Although the approach for implementing solar energy in Philadelphia is unique, the framework is built on proven. Every location harbors a unique set of values and beliefs that influence how they perceive new technologies. The knowledge gained from this research project will help to transform methods of community engagement for implementing solar technologies. For engineers, this entails bridging the gap between their discipline and that of the social sciences. This adjustment will encourage more successful projects as engineers better incorporate the value system of their clients into project design.

The information gained from the survey responses must be properly assessed and understood before considering further steps. The purpose of this research is to take these responses and reproduce them in a way that is inclusive to the community and professionals working in this space. By returning what people said in this way, trust with the community is built. As earlier discussed in the literature review, this sense of trust is essential to the ongoing development of successful projects within Philadelphia. The truth is that we are not helping the community but rather revealing the present existing strengths and opportunities. There is rich potential in these communities to develop solar, however, it takes a collective effort to unfold feasible opportunities. This research attempts to bring light to this potential and provide avenues to bring solar ideas to fruition. As a Philadelphia native, I thought it would be important to highlight some of the disparities that residents of the city experience and use my academic background to address these disparities. In the community development arena, it is unfortunate that communities are taken advantage of for learning purposes without successful change within their community. In doing this research I've realized that it is crucial to always have some sort of return segment that will better help that community that has opened their doors to me.

This research is just another step in the right direction for understanding the latent needs of Philadelphia communities. To uphold the positive momentum Philadelphia has with regards to solar energy implementation, dialogue about solar applicability must continue. This entails having discussions with residents and community leaders of Philadelphia. The co-creation of solutions in this manner will help to ensure that future solar programs and initiatives are in fact sustainable. For a future researcher, the next steps for solar development is to continue to investigate what latent needs exist in disenfranchised communities. This research project was just one way of doing so but ultimately the goal is to have ongoing conversations to create mutual understanding not only for the sake of solar development, but also for sustainable relationships that will uphold such technology.

References

- Brownson, J. R. (2014). *Solar energy conversion systems*. Oxford, UK: Academic Press.
- Dooley, B. M. (2006). *Energy and culture: Perspectives on the power to work*. Aldershot, England: Ashgate.
- Etienne, H. F. (2012). *Pushing back the gates neighborhood perspectives on university-driven revitalization in West Philadelphia*. Philadelphia: Temple University Press.
- McCauley, D. (2018). *Energy Justice: Re-balancing the Trilemma of Security, Poverty and Climate Change*. Cham: Palgrave Macmillan.
- Ostrom, E. (2015). *Governing the commons*. Place of publication not identified: Cambridge Univ Press.
- P. (2016, December). Solarize Philly. Retrieved August 16, 2018, from <http://www.philaenergy.org/programs-initiatives/solarize-philly/>
- P. (2018, April 5). Philadelphia 2018: The State of the City. Retrieved from <http://www.pewtrusts.org/en/research-and-analysis/reports/2018/04/philadelphia-2018-the-state-of-the-city>
- P. (n.d.). Solarize Philly. Retrieved August 14, 2018, from <http://www.philaenergy.org/programs-initiatives/solarize-philly/>
- Philadelphia, Pennsylvania Population 2018. (2018, June 3). Retrieved August 14, 2018, from <http://worldpopulationreview.com/us-cities/philadelphia-population/>
- T. (2018). Philadelphia Civic Associations and Neighborhood Associations. Retrieved August 16, 2018, from <http://thephiladelphiacitizen.org/do-something/civic-associations-neighborhood-associations/>
- U. (2018, April 5). Philadelphia 2018: The State of the City. Retrieved August 14, 2018, from <http://www.pewtrusts.org/en/research-and-analysis/reports/2018/04/philadelphia-2018-the-state-of-the-city>
- U. (2018, January 12). Poverty Guidelines. Retrieved August 14, 2018, from <https://aspe.hhs.gov/poverty-guidelines>
- White, L. A. (1943). Energy and the Evolution of Culture. *American Anthropologist*, 45(3), 1st ser., 335-356. Retrieved July 25, 2018, from <https://deepblue.lib.umich.edu/bitstream/handle/2027.42/99636/aa.1943.45.3.02a00010.pdf?sequence=1>.