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Union County Solar Energy Awareness

Amanda Pennett

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A fellowship project of Bucknell University's Center for Sustainability & The Environment:

Amanda Pennett '24, Shaunna Barnhart, PhD.

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Abstract

Rural communities in Pennsylvania, such as Union County, have a historical and political reliance on traditional fossil fuels like coal, oil and natural gas. Solar energy, an alternative energy source, is a renewable form of energy that is environmentally beneficial to the community, localizes energy production and provides one with energy independence from primarily relying on grid-provided electricity. Raising awareness around the potential of solar energy in Union County requires an understanding of the historical view of energy and collection of data on current perspectives around solar to determine the most effective way to communicate its benefits. The path to solar energy looks different for everyone, with residents of Union County facing barriers unique to their state, neighborhood or home. Through survey and interviews, personal challenges and journeys are collected to analyze what tools residents and businesses need to participate in solar energy. Therefore, it is not a sudden switch to solar energy that should be sought after, but an understanding of energy consumption, through conservation practices, with the installation of a solar energy system after these practices have been incorporated. Public Awareness Materials, including a digital infographic and social media posts, as well as physical double-sided version of the infographic that communicate the general benefits, steps to install solar and resources were created for the Union County Department of Planning and Economic Development.

Introduction

Solar energy has been rapidly expanding across Pennsylvania in recent years as awareness grows as well as local and federal incentives being made available to help finance and make solar energy accessible. With the recent adoption of the C-PACE program in Union County and federal Solar Investment Tax Credits, solar energy in Union County, Pennsylvania has the potential to become widespread and offer energy independence to local residents, businesses and farmers (Union County Government, 2022). In order to make an impact on carbon emissions, statewide adoption and awareness of renewable energy is essential, therefore social acceptance in rural communities and counties has become a key aspect in the progression of renewable energy in Pennsylvania.

In rural communities, such as Union County, attitudes around solar energy and other renewables can be unique from the average perspective, as the issue of land use as well as the

history of coal mining and reliance on oil and natural gas, lead to a variety of strong attitudes towards renewable energy. Examination of Pennsylvania's energy production history, case studies on modern attitudes toward solar energy and the study of federal and local programs and incentives inform the questions that were asked of subjects both in survey and interview. Social acceptance and awareness around solar energy offers environmental, personal and financial benefits that, with widespread adoption, can allow for a reduction in carbon emissions, localization in energy generation and energy independence in rural communities.

In this study, Union County residents' perspectives and experiences around solar energy are explored. Interviews of residents, businesses and institutions with solar in or around Union County shed light on the individual and unique journeys to solar energy and are used to give insight on the process of installing solar. The levels of awareness and the barriers citizens of Union County face in participating in solar energy is examined. Analyzing the results, public awareness materials were created to inform residents of the benefits, incentives and resources available to implement solar energy. Social acceptance and awareness around solar energy offers environmental, humanitarian and financial benefits that, with widespread adoption, can allow for a reduction in carbon emissions, localization in energy generation and energy independence.

Literature Review

Pennsylvania's Continued History of Fossil Fuels

Pennsylvania's current main sources of energy are from natural gas, nuclear and coal production, all of which are highly volatile in price, and availability (Alves, 2022). In order to understand the barriers to social acceptance of solar, and thus its expansion, the region's historical production of energy must be examined. Coal mining is at the center of this production, which has given way to many detrimental climate and environmental changes. In 2020, Pennsylvania was third in coal production by state (Garside, 2022). Pennsylvania coal had a significant role in the industrial revolution, and provided an economic boom from the mid 1800s almost through to the 21st century. Another more recent energy boom comes from the vast Marcellus Shale across the state of Pennsylvania that is used to produce natural gas through hydraulic fracturing. Both energy production methods have proven to have drastic negative impacts on the surrounding environment and human health conditions, whether in air quality, water contamination or in contributing to climate change (Levri 2019). According to data from

2017, Pennsylvania was determined the country's third largest emitter of CO2 (Garcia, 2022). In a state with so much carbon dioxide emissions and fossil fuel reliance, it is evermore pertinent to spread awareness around solar energy.

Why Solar?

Solar energy is sustainable and 100% renewable, unlike the dominant forms of energy today that have caused environmental, medical and ecological damage. The energy the Earth receives from the sun is more than enough to meet our global energy needs, and is not in threat of depletion, with 1 hour and 25 minutes of the sun's energy having the potential to provide the amount of energy we currently consume in a year (IEA, 2011). There is no concern of air pollution and the release of toxic gasses during the energy production from solar panels, or influence on water resources, as water shortages have been linked to the demand for extreme amounts of water to power gas-fired plants (Kabir et al., 2017). As solar energy use expands, reduction of greenhouse gasses in the United States is possible and states like Pennsylvania can have a big impact in the effort to meet climate action goals. The National Renewable Energy Laboratory analysis reported 8 billion square meters in roof-tops that could be utilized for solar installations in 2016, representing over a terawatt of potential energy in the U.S. Of these rooftops, an estimated 3 million roofs must be replaced every year, offering up 33 million gigawatts of potential energy growth yearly (Department of Energy, 2022).

While solar and other renewable energy forms seem to be an expensive investment, there is a substantial payback on investment for residential solar installations due to the unstable cost of fossil fuels as well as net-metering possibilities. According to a report on Union County in Energy Sage, a resource that allows those interested in solar to view average costs, the average 20-year savings for residential solar energy is $25,318.00, with the average cost of $3.06 per watt to install solar (2022). Besides the general financial savings of renewable solar energy, Federal Tax Credit Incentives also reduce the initial cost of installment. According to the U.S. Department of Energy's "Homeowner's Guide to the Federal Tax Credit for Solar Photovoltaics", there is a 26% reduction in the price of installment on systems beginning to be installed through the end of 2022. After 2022, the solar energy tax credit percentage will begin to decline and cease to be available in a couple years, making it an opportune investment period. Making this factor known to Union County residents will potentially speed up the expansion of

solar energy in the near future and push the development of solar energy technology and future governmental programs as more residents look to participate (2022). At the beginning of this summer, the C-PACE program was adopted by Union County, giving local businesses the opportunity to apply for financing of solar projects with Union County commissioners having the right to review and halt a project if needed. Some examples of eligible organizations include community centers, hospitals, theaters, schools, religious facilities, etc. (Union County Government, 2022).

Net-metering is another outlet for residents to reduce expenses in the initial payback period and beyond. In a net-metering system, the customer generating solar energy from their photovoltaic system is billed for their net use of energy during a selected period (i.e. monthly). During this process, a bi-directional meter is rolled out when the customer-generator is pulling energy from the grid to supplement their energy, and the meter is rolled back toward the customer when their excess produced energy is being exported to the grid. This exported energy is valued at retail pricing, allowing the customer to offset the initial cost of installment for their PV system (Barnes, 2013). Having this energy independence and efficiency is another draw to solar energy for those who desire more independence from the electrical grid. Aggregate net-metering is another form of net metering which allows customers to have a variety of options in managing their PV system sites and/or obtain solar energy from a nearby site. In Pennsylvania, virtual aggregate metering is allowed in which customers may subscribe to an organization that controls the net metering of its PV system, however for multiple-site aggregate net metering, properties must be located within 2 miles of the generating facility.

Another route often chosen by established institutions or those who own a large quantity of land is a PPA, or power purchase agreement, a type of leasing available in which a solar company leases and installs a particular space or plot of land for a solar energy system. The customer has no up-front costs and does not have the responsibility of caring for the system (Thurmann & Woodroof, 2021). The consumer agrees to purchase the energy produced by the system from the company managing it. Inflation of energy cost still occurs under a PPA, however it is outlined as predicted for 10-20 years, giving those in the agreement a clear insight to expected costs that are not provided for the typical inflation of the grid electricity (Thurmann & Woodroof, 2021). Larger solar projects, or utility-scale solar installations tend to go hand in hand with PPAs, as more land and panels mean more management. For residential solar, a power

purchase agreement is possible, and a convenient investment if there is ample space and the property is generational. This is an important opportunity to be aware of for the Union County population, as many residents own farms and operation is passed down for generations.

Perspectives on Solar Energy

Given the prominence of fossil fuel reliance in Pennsylvania's energy production, the transition to renewable energy is both promising and daunting. According to one study, solar energy is the most positively regarded form of renewable energy and in general, Americans are willing to pay more for clean energy (Carlisle et al., 2015). The state of Pennsylvania could have a big impact on the reduction of the United States' carbon footprint, however widespread adoption of solar energy becomes a challenging endeavor due to the reluctance to transition from traditional energy sources that have historically provided jobs and economic growth. In order to meet energy demands, one option could be large-scale solar energy systems or solar farms. However, this raises the concern for disruption of local scenery and ecosystems. Visibility and size generally relate directly to the support or opposition of solar projects, as less support is garnered for larger or more easily seen projects. However, power plants and coal mines can pose a similar issue that disproportionately affects lower-income communities, and beyond scenery, can lead to health issues affecting the surrounding area of the coal-fired or natural gas power plant.

The root of the NIMBY, or "Not in my backyard", attitudes can stem from a variety of socio-political demographics and psychological associations one has with a place. If one has a stronger connection to the environment around them, they are more likely to be concerned with its state of health, and if one has an attachment to the visuals of the land around them, they will be more concerned with the implications of any change that will be made to the land (Carlisle et al., 2015). General demographics also play a role in awareness and support of solar energy, as a study done on a Southwestern portion of the U.S. shows women as being more concerned over the environment and more supportive of solar energy and other renewables than men. However, men showed greater awareness of the implications of solar energy and more support for solar, wind and nuclear projects. Urbanicity was also found to be a significant factor of whether residents support solar energy projects in their county, as those living in more rural counties tended to support solar projects less than those in urban counties (Carlisle et al., 2015). Although

Union County is overall rural, the results of this project's survey could show a distinction of support between those who own a farm and/or live around rural farmland versus those who live in towns. Political identity may or may not match up with the support or opposition of expansion of renewable energy, and deeper personal beliefs and connections with the environment will have the most effect on how someone views environmental policy, in general.

The competition for land use often creates disapproval for utility-scale solar in agricultural communities like Union County, however a developing perspective of 'agri-voltaics', solar farms constructed to work with agricultural production, is starting to expand in utility-scale projects (Pascaris, A. S. et al., 2021). This can be implemented in crop production, where the vegetation requires shade, or in using the land as a grazing field for certain livestock. Beyond utility-scale solar energy projects, solar technology can be utilized in a variety of ways on farmland. Using solar dryers, freshly harvested crops can be dried using solar energy. Livestock and dairy operations require particular maintenance of heating, thus solar energy can be utilized on farmland roof-tops to offset the farmers' heating costs that are essential to keeping the livestock healthy. Water pumping PV systems are also possible and a cost-effective way to supply water to remote pastures (Chikaire, 2010). Spreading awareness around these ways to incorporate solar energy into farmland activity can change the perception of solar energy as a threat to agricultural communities. Social acceptance and the study of attitudes around renewable energy is paramount to the expansion of solar energy in rural counties like Union.

Methodology

This study utilized a mixed methods approach to understand solar awareness, attitudes, and experiences in Union County, Pennsylvania. Review of primary materials and secondary studies, including case study review, provided insight on attitudes involving solar energy and its expansion. Examining these studies allowed for an overview of general attitudes toward solar energy in the U.S. and informed how certain demographics may align with the support or opposition of solar energy and other renewable energy projects. This in turn informed the development of the survey and interview questions with the goal of understanding the most effective ways to communicate to the general public of Union County. The survey and interview protocol were approved by Bucknell University's Institutional Review Board under number 2122-132.

Surveys

The goal of the survey was to assess the general awareness of Union County residents around solar energy as well as to understand how a variety of groups of people view solar energy. The survey was divided into several sections including general perspectives on solar energy, perception of economics of solar energy, personal experience with engaging in solar energy and finally, demographics. The numerical results of the survey are recorded based on a 5-point likert scale. The other questions included were in the form of open responses or collection of demographics. A full list of questions can be found in **Appendix A**.

The formal data collection of perspectives was acquired through surveys and interviews that were collected from June 28 to July 26, 2022. The survey was distributed to three public libraries across Union County, with the goal of county-wide sampling. The libraries surveyed include The Public Library for Union County in Lewisburg, Herr Memorial Library in Mifflinburg and West End Library in Millmont. Surveys were distributed to the libraries either through printed copies (Herr Memorial; West End) or through posters referencing the google form of the survey through QR code (The Public Library for Union County) on July 5, 2022. The survey was also physically distributed at the Laurelton Dollar General, New Berlin Post Office and the Lewisburg and Mifflinburg YMCA locations through small cards of approximately 3 by 5 inches that included the QR code to the google form of the survey. Additionally, the survey was posted online through Community Zone Lewisburg, an organization and website that advertises community events and connects residents to one another, as well as on the New Berlin Facebook Page.

Interviews

Interviews were semi-structured, and based on positionality of the interviewee, certain questions were asked, as shown in **Appendix B**. The categories of questions include general perspectives around solar energy expansion (asked of all interviewees), questions for residents with solar installed at their residence, questions for businesses with solar installations, and questions for institutions with large-scale solar projects installed or in development. Those who were interviewed outside of the main categories of resident, business or institution, were asked only questions pertaining to their general perspectives on solar energy.

The interviews were conducted through snowball sampling, beginning with my advisor Shaunna Barnhart, Ph.D. 's contacts of local Union County residents and Bucknell faculty who are involved in solar energy. From there, contacts were acquired by asking each interviewee at the conclusion of the interview if there was anyone they thought I should reach out to pertaining to their experience with solar energy or a solar energy project.

Results

The surveys and interviews collected provide a wide variety of perspectives from various demographics. Business-owners, farmers, politicians, and residents were represented, whether in survey or interview.

Interviews

A total of 8 interviews were conducted with 9 persons in total, including 2 residents, 2 civil servants, 1 business, 2 institutions and 1 electric company. These participants ranged in their experience and engagement in solar energy. All persons interviewed were asked their general perspective on solar energy expansion in Union County and across Pennsylvania, their personal motivation for engaging in solar energy, and the barriers they believe residents and/or businesses in Union County face in participating in solar energy. A summary of these results between the residents, business and institutions is provided in **Table I.** The institutions interviewed offer a perspective on large-scale solar projects and how they are developed. In developing these projects at universities, the main barriers are quite different from the ones faced by typical residents, reflected in **Table I.** One business, Burkholder's Market and one institution, Susquehanna University interviewed are located outside of Union County. Burkholder's Market is located in Centre County, a neighboring rural county that faces similar challenges in widespread solar energy adoption. Similarly, Susquehanna University is located in Snyder County, another neighboring rural region.

Table I.

Motivation and Barriers to Engage in Solar Energy of Residents, Businesses, Institutions.

Positionality	Motivation	Barriers

Resident	Environmental concern, Reducing carbon footprint	Financial concerns, Infrastructural concerns
Business	Economic benefits	Financial concerns, Space available for installation
Institution	Demonstration of commitment to reducing carbon footprint	Visual concerns from surrounding residents, Space available for installation

Motivation

The primary motivation of both residents that were interviewed was environmental concern and a passion to reduce their carbon footprint. Each resident had the means to engage in solar energy and solar energy incentives that were available to them. Sandy Field, Ph.D., one of the residents with solar installed, was able to invest in a prepaid lease option and subsequently purchase the panels up-front. As seen in **Figure I**., Sandy Field, Ph.D. was able to install solar panels on her south-facing roof, the optimal orientation for solar installations. The second resident interviewed, Dr. Peter Jansson, was able to build a shed oriented optimally to host his solar array, shown in **Figure II.**

Russ Burkholder, of Burkholder's Market, stated the primary motivation for the solar project that was installed over the market's parking lot, seen in **Figure III.**, was mostly an economical one. The goal was to offset the market's electricity expenses, which was the biggest expense, beyond payroll. Utilizing a grant available from the USDA at the time, Burkholder's Market was able to install the project in the spring of 2019. The panels selected were of the most efficient quality that would reduce the market's carbon footprint as much as possible.

Both Bucknell University and Susquehanna University have engaged in large-scale solar energy projects. Susquehanna University is located in a neighboring rural county, Snyder County, that faces similar challenges around solar energy as Union County. For institutions such as these colleges, solar energy projects not only offer economic benefits, but also demonstrate the environmental commitment both universities have made. For Bucknell, this solar project is a big

step to fulfilling the promise of reducing the university's carbon footprint, as Energy and Utilities Specialist James Knight stated. In May 2010, the Climate Action Plan to reduce emissions was put into place (Chou et al, 2010). The first steps included switching to LED lighting and upgrading old AC units. When asked about the beginnings of the solar farm developed at Susquehanna University, Christopher Bailey, the Assistant Vice President for Facilities & Campus Safety at Susquehanna University, stated the importance of environmental health to the university and upholding the university's values by committing to the solar project. Susquehanna University chose to engage in a power purchase agreement for their solar farm, as Bailey states "It acts as an energy hedge for us because it is generated here unlike buying off market" (Interview with Christopher Bailey, July 12, 2022). Both of the projects incorporate the concept of agri-voltaics, implementing farming or agricultural practices with the presence of solar panels. Through the same local farmer, both universities have, or plan to have, a local farmer's herd of sheep seasonally graze around the solar panels.

Barriers

Both Sandy Field, Ph.D., and Dr. Peter Jansson expressed the energy conservation barriers many Union County residents face in general, as energy efficiency practices are the first step to sustainably installing solar energy systems, or photovoltaic arrays. Another barrier discussed was the infrastructural integrity of houses in Union County, as many of the roofs in Dr. Peter Jansson's neighborhood, including his own, have limited space to host solar panels or are not oriented in the right direction for optimal energy production, which is why his solar array is hosted on his shed location in the backyard of his residence. In terms of legislation, Sandy Field, Ph.D. believes in order for maximum participation in solar energy, there must be more options available for low income households, such as community solar. When I brought up the solar energy industry, in terms of installation companies, Sandy Field, Ph.D. stated trust is an important factor and in this community, who people choose to work with and invest in often depends on word-of-mouth of fellow residents, as solar energy is a relatively new industry.

When speaking with Russ Burkholder, he informed me that, from a business perspective, solar energy is often too much of an expense to install, however solar energy provides major economical benefits for businesses. With the recent adoption of the C-PACE program in June

2022, this significant barrier is potentially alleviated for businesses in Union County. Spreading awareness of this program is key to the commercial engagement in solar energy.

In developing large scale solar energy projects at universities, the main barriers are quite different from the ones faced by typical residents. Because of the scale, regulations and zoning ordinances of the local area must be modified or complied with when developing a large-scale solar array. In achieving approval for the solar array at Bucknell University, East Buffalo Township Supervisors had to develop an ordinance for the zoning of the project and come to an agreement to approve the project (Scicchitano, 2021). The push-back from nearby residents also often delays the development of large-scale solar projects, as discussed in interviewing Christopher Bailey, of Susquehanna University. The time it takes to meet project approval as well as resolve concerns of surrounding residents, is the most prominent challenge in institutional solar projects.

Solar Energy in Rural Communities

Union County, Pennsylvania has a unique positionality relating to solar energy, being a rural community with an economy based partly around local agriculture. According to Union County Commissioner, Stacy Richards, Union County has 80 megawatts of potential energy if utility-scale solar was developed, however this land is prime farmland of class 1 or 2 soil. Use of solar energy in agricultural areas continues to be controversial for this reason, with large-scale solar projects often facing backlash. Christopher Bailey stated the development of Susquehanna University's solar farm was met with criticism from nearby residents who overlooked the large field. Bucknell University's solar array on West Campus faced similar backlash when the particular site for installation was being chosen.

These attitudes can often culminate into a negative perception of solar energy in general, when use of solar energy in agricultural settings can economically benefit farmers. As Knight states, "Farming is a tough business and if they can supplement their income with solar then they should be able to" (Interview with James Knight, July 1, 2022). Even large-scale solar arrays can incorporate agricultural practices, such as using the land for grazing of livestock or in cultivating low-lying crops that need shade. Sandy Field, Ph.D., shares a similar perspective, stating that there are legitimate concerns about companies taking advantage of leasing contracts and we

should support farmers, however there are ways to bring farming and solar energy together (Interview with Sandy Field, Ph.D., July 1, 2022).

At an individual level, the barriers to solar energy adoption are more present in rural communities, as these places have a greater frequency of reliance on older forms of energy, such as oil. As Sandy Field states, “It is a transition, not a switch” to renewable energy in these communities due to the energy conservation and evaluation that must first take place in many homes (Interview with Sandy Field Ph.D., July 1, 2022).

Figure I.

Photovoltaic Array: Residential Roof-top; located at Sandy Field, Ph.D.’s residence.

Figure II.

Photovoltaic Array: Residential Roof-top; located at Dr. Peter Jansson’s residence.

Figure III.

Photovoltaic Arrays: Elevated Over Parking Lot; located at Burkholder's Market.

Surveys

There were 51 responses collected for the Union County Solar Energy Awareness survey, 46 of whom are residents of Union County, and 7 of whom are business owners. T-tests were performed in different cases based on age, gender, political affiliation and location of residence, on many of the survey questions. If the T-test result was below 0.05 for the select questions, the groups sampled were proven statistically different. Correlation tests of a variety of questions were also performed to deeply evaluate how people in Union County view solar energy. It should be noted that most respondents identified themselves as democrats. The responses are also assumed to be mostly gathered from the Lewisburg area as the responses increased in volume most right after being distributed at the Lewisburg YMCA, located at the Miller Center.

These tests are carried out with the goal of understanding the most effective ways to communicate to the general public of Union County. The numerical results of the survey are recorded based on a 5-point likert scale. This data was examined under a variety of conditions to determine how demographics play into the perspectives of respondents. A full list of survey questions can be found in **Appendix A.**

General Perspectives

The first section of this survey included general questions about environmental concern, familiarity with solar energy and energy use. As seen in **Table II.**, the degree of local environmental concern has a weak positive correlation with the degree of support for solar energy installations in one's community. Comparing this correlation to the one between the degree of familiarity with solar energy and the likelihood of the respondent to install solar, a slightly higher positive correlation is revealed. This indicates that awareness of solar energy is a better predictor of going solar than is environmental concern. This lends support for doing awareness campaigns.Approximately 75% of respondents stated that they were either moderately or extremely concerned when asked "What is your level of concern about local environmental conditions?", and the percentage rises pertaining to global conditions.

Table II.
The Correlation Between Various Questions, All Respondents.

Variable 1	Variable 2	Correlation Coefficient	Relationship
How familiar are you with solar energy?	How likely are you to install solar panels on your residential property?	0.37	Moderately positive
What is your level of concern about local environmental conditions?	I support solar installation in my community.	0.24	Somewhat positive
I support solar installation in my community.	Solar panels, pertaining to solar farms, ruin local scenery.	-0.40	Moderately negative
Solar energy is too expensive for me to implement at my residence.	I am aware of federal policies and/or programs that support installation of solar power.	-0.49	Moderately negative

How much would you agree or disagree that you would like to reduce your energy consumption?	How likely are you to install solar panels on your residential property?	0.16	Weak correlation

The T-tests, shown in **Table III.**, performed pertaining to this statistic included a comparison of Republican v. Democrat perspectives, as well as a comparison of age groups 18-45 years v. 46+ years. The average Republican response to local environmental concern was 3.3, while the average Democrat response was 4.4. Considering age group, local concern was higher among those 46+ years old, at an average of 4.8, while the average recorded for those 18-45 years old was 3.8. This is an interesting statistic, as it is often assumed that younger generations have more environmental concern than older age groups, however this statistic could be indicative of the fact that older generations have observed more changes in the environment, simply because of age, and have more cause for concern.

Table III.

Comparing Demographics, T-test results.

Demographic	**Number of Respondents**	**Local Environmental Concern (Average value)**	**Global Environmental Concern (Average value)**	**How likely are you to install residential solar panels? (Average value)**	**I support solar installation in my community. (Average value)**	**I am aware of federal policies and/or programs that support installation of solar power. (Average value)**
Political Affiliation						
Democrat	29	4.4 **	4.9 **	3.5 *	4.8 *	3.4 *
Republican	8	3.3 **	3.3 **	2.4 *	3.9 *	2.6 *
Age						
18-45	20	3.3 **	3.8 **	3.78 *	N/A	N/A
46+	29	4.5 **	4.8 **	2.96 *	N/A	N/A

Note: T-test results will be discerned by * = below 0.05, ** = below 0.01.

Approximately 88% of respondents stated that they either agree or strongly agree, when asked "How much would you agree or disagree that you would like to reduce your energy consumption?". Surprisingly, the correlation between this question and the probability of residential solar installment, shown in **Table II**., was weak, showing wanting to reduce energy consumption does not relate to the probability one will install a solar energy array at their residence. This is particularly interesting as the first step to installing solar is to undergo energy efficiency audits and enhancements, thus presenting another opportunity for public awareness communications.

When asked, "How familiar are you with solar energy?", males, at an average of 3.7, were found to report they were more familiar with solar energy, than females, at an average of 3.14. It should be noted that this statistic is self-reported, with no concrete assessment to confirm respondents' familiarity with solar energy.

Perception of Solar Energy

This section addresses the level of support for solar energy installation in one's community generally as well as the level of support for solar energy installation in a variety of formats and locations, as shown in **Figure IV.** The initial prediction of utility-scale solar garnering the least amount of support throughout the county was incorrect. While 'Utility-scale: solar farm' was one of the types of installation with less support, the least amount of support was for the 'Residential: ground-mounted' solar installations, as shown in **Table IV.**, which compares average responses to support for each kind of solar installation. 88% of respondents stated that they either agree or strongly agree with the general statement "I support solar installation in my community." However, the responses between Democrats and Republicans were statistically diverse, as shown in **Table III.**, with the Democrat average being 4.78, while the Republican average was recorded at 3.87. Finally, another statistically significant difference was the level of agreement with "Solar panels, pertaining to solar farms, ruin local scenery" was asked and evaluated with a T-test. It was found that, comparing responses, Democrats responded with a much lower average of agreement, at 1.9, while Republicans responded with an average of 3.1.

Figure IV.

Level of agreement that one supports a certain format and/or location of solar energy installation. N= 51

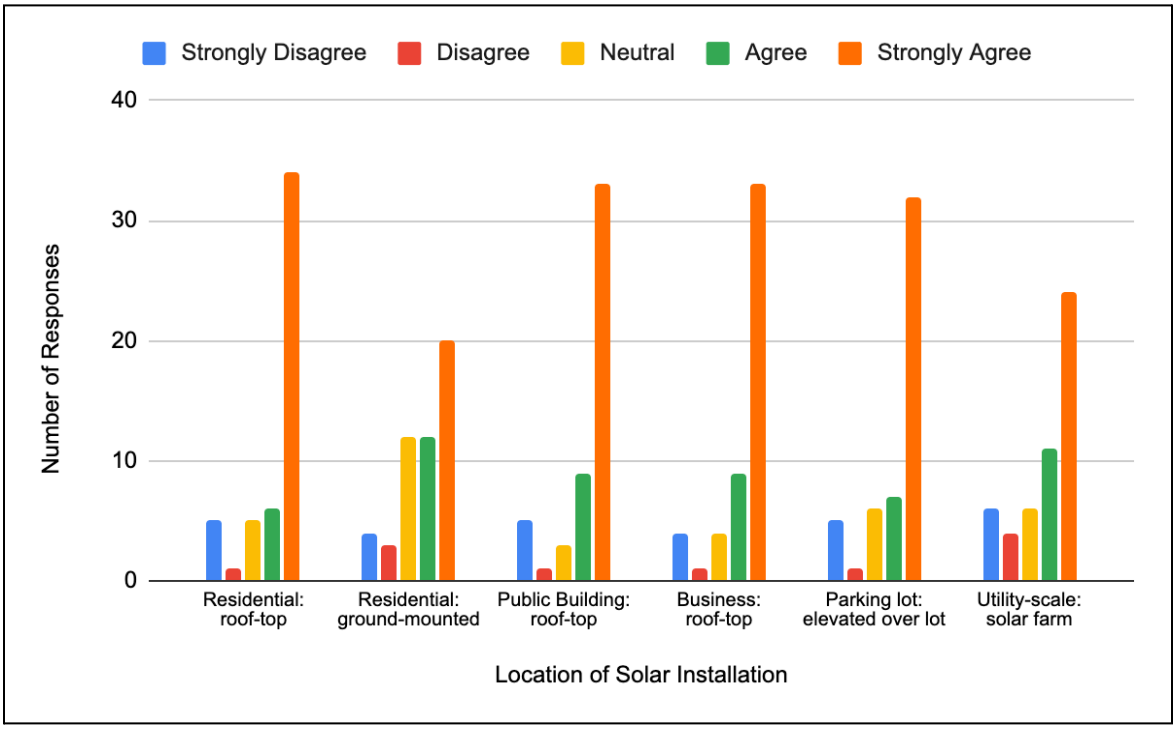


Table IV.

The Level of Support for Solar Energy Installations in Various Locations/Formats (on 5-point scale).

I support solar energy installation in my community in the following locations:	**Average**
Residential: Roof-top	4.24
Residential: Ground-mounted	3.80
Public Building: Roof-top	4.25
Business: Roof-top	4.29
Parking Lots: Elevated over the lot	4.18
Utility-scale: Solar farm	3.84

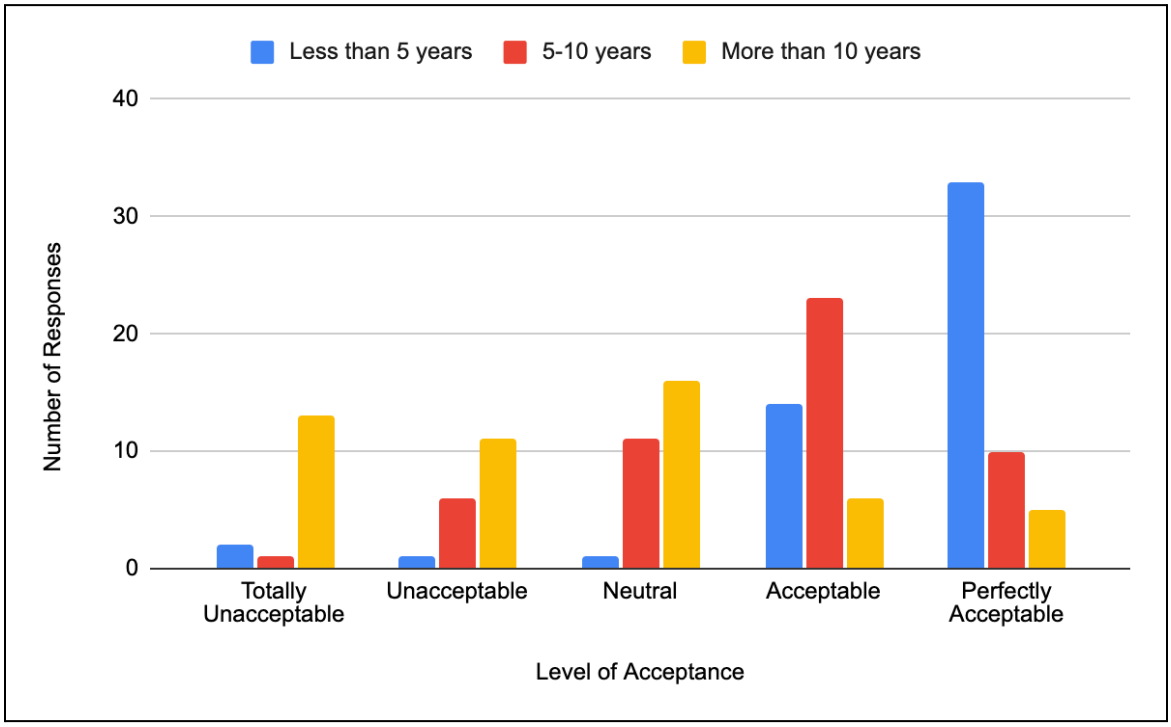
Perceptions and Awareness of Economics of Solar Energy

This section asked participants their level of awareness around policy, both local and federal, that supports solar energy installation. T-tests reveal, as seen in **Table III**., that

Democrats claim to have a greater level of awareness of federal policy around solar energy than Republicans. When analysis of the correlations was done on various questions, shown in **Table II**., the correlation between the statement "Solar energy is too expensive for me to implement at my residence." and the statement "I am aware of federal policies and/or programs that support installation of solar power." was moderately negative, or inversely correlated. This could indicate that those who rank solar as too expensive are unaware of solar support programs, reflecting the positive impact awareness materials could potentially have on Union County members. Respondents were also asked how acceptable a list of three different payback periods would be, that is, the amount of time it takes for the cost of installing solar panels to equal the annual energy savings and credits. The data collected from this question, shown in **Figure V.**, reveals most respondents find the payback period of 'Less than 5 years' perfectly acceptable or acceptable, while 45% of respondents found 'More than 10 years' to be unacceptable or totally unacceptable.

Figure V.

Acceptability of Different Payback Periods for Solar Energy Installation. N= 51



Personal Experience with Solar

The questions asked in this section include how likely the respondent is to install solar at their residence, if they know anyone with solar panels installed, and if they themselves have a solar array installed. The question of "How likely are you to install solar panels on your residential property?" yielded a statistical difference in comparing the 18-45 year age group and the 46+ year age group. As seen in **Table III.**, the average response for those 18-45 years old was 3.78, while those 46+ years old responded with an average of 2.96. This statistic is assumed to be in relation to the perception of the economics of solar energy, therefore a variety of correlations were conducted between the likelihood of one installing solar and various survey questions, pertaining to economics. As shown in **Table V. A** and **Table V. B**, the question "How likely are you to install solar panels on your residential property?" acted as a base to compare how the two age groups surveyed viewed the economics of solar energy. One difference in perception of economics between the age groups is seen in the correlation between the question "How likely are you to install solar panels on your residential property?" and the statement "Solar energy is too expensive for me to implement at my residence." For the age group of 46+ years, in **Table V. B**, this correlation is much more negatively correlated, than the correlation of these questions from the age group 18-45 years, **in Table V. A**, reflecting the impact of the belief that solar energy is too expensive having a stronger influence on those 46+ years old. Another distinction between the age groups is found in the comparison of correlations between the question "How likely are you to install solar panels on your residential property?" and the statement "I am aware of federal policies and/or programs that support installation of solar power." in **Table V. A & B**. For the age group of 18-45 years, this is a weak correlation, showing that awareness of federal policy around solar energy has almost no influence on the likelihood of solar installation. However, for the age group of 46+ years, the likelihood of solar installation is moderately positive with the awareness of federal policy around solar energy.

Table V.

Correlation Between Questions, Comparing Age Group 18-45 years to Age Group 46+ years.

Table V. A

Age group 18-45 years

Variable 1	Variable 2	Correlation Coefficient	Relationship

How likely are you to install solar panels on your residential property?	How acceptable would each of the listed payback periods for solar energy installation be? - Less than 5 years.	0.13	Weak correlation
How likely are you to install solar panels on your residential property?	How acceptable would each of the listed payback periods for solar energy installation be? - 5-10 years.	0.40	Moderately positive
How likely are you to install solar panels on your residential property?	How acceptable would each of the listed payback periods for solar energy installation be? - More than 10 years.	0.26	Somewhat positive
How likely are you to install solar panels on your residential property?	I am aware of federal policies and/or programs that support installation of solar power.	0.02	No correlation
How likely are you to install solar panels on your residential property?	Solar energy is too expensive for me to implement at my residence.	-0.22	Somewhat negative
How likely are you to install solar panels on your residential property?	How familiar are you with solar energy?	0.31	Moderately positive

Table V. B

Age group 46+ years

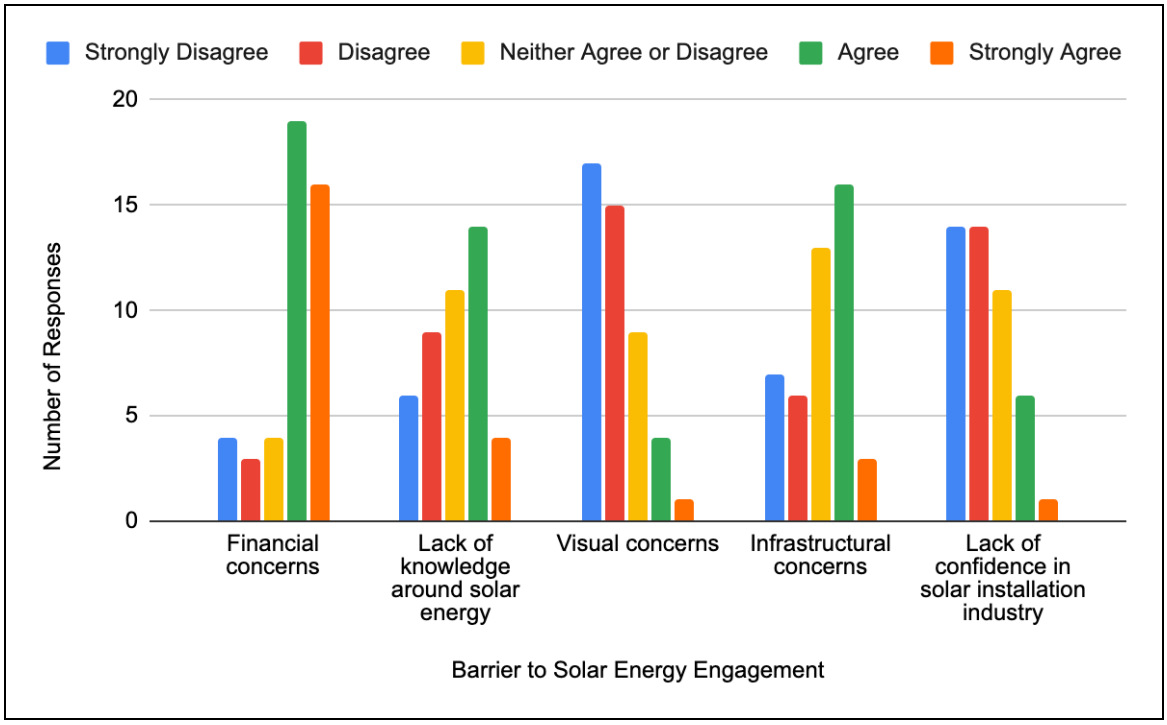
Variable 1	**Variable 2**	**Correlation Coefficient**	**Relationship**
How likely are you to install solar panels on your residential property?	How acceptable would each of the listed payback periods for solar energy installation be? - Less than 5 years.	0.33	Moderately positive
How likely are you to install solar panels on your residential property?	How acceptable would each of the listed payback periods for solar energy installation be? - 5-10 years.	0.29	Moderately positive
How likely are you to install solar panels on your residential property?	How acceptable would each of the listed payback periods for solar energy installation be? - More	0.29	Moderately positive

	than 10 years.		
How likely are you to install solar panels on your residential property?	I am aware of federal policies and/or programs that support installation of solar power.	0.29	Moderately positive
How likely are you to install solar panels on your residential property?	Solar energy is too expensive for me to implement at my residence.	-0.64	Moderately negative
How likely are you to install solar panels on your residential property?	How familiar are you with solar energy?	0.43	Moderately positive

When prompted with the question, "How likely are you to install solar panels on your residential property?", respondents are given the option of selecting "I have solar panels installed". Based on their answer to if they have solar already installed, the survey takes them to 2 different sections. If the respondent answered 'Yes' to "Do you have residential and/or commercial solar arrays installed?", they are then prompted to answer 2 additional questions around their motivating factors when they chose to install solar and the benefits they saw after installing. If the respondent answered 'No' to the question "Do you have residential and/or commercial solar arrays installed?", they are then given a list of potential barriers to engaging in solar energy, and asked to give their level of agreement with how much each factor impacted their choice to not invest in solar energy. As shown in **Figure VI.**, 'Financial concerns' and 'Infrastructural concerns' were the 2 most prominent barriers preventing respondents from installing solar, while 'Visual concerns' were reported as the least prominent barrier. For those who reported that they had solar panels installed, some of the responses to the key benefits from installing solar include "Being able to get rid of oil burning furnace." and "Carbon free electricity."

Figure VI.

Level of Agreement of Impact of Barriers to Installation of Solar. N= 51



Demographic Comparisons

As shown in **Table VI.**, demographics ranging from political stance to location of residence were gathered from survey responses. From this data, differences in perspective between demographically diverse groups can be calculated, and used to understand the most effective way to communicate solar energy benefits. The survey had three options for residential setting as either 'In town', 'Residential suburban' or 'Rural'. About the same number of respondents stated they live 'In town' or in 'Residential suburban' areas, with only about 19 % respondents stating they live in 'Rural' areas. T-tests were performed to analyze the effect of urbanity on perception of solar energy, however there were no discernable differences between "in-town" (22 respondents) or "rural" (10 respondents) residency in responses. It should be noted that Union County is a generally rural area, therefore it is not a wide enough sample to determine if urbanity has a considerable impact. Business owners (7 respondents) in Union County compared to non-business owners (44 respondents) showed no significant differences in survey responses. Comparing age groups, there were a few statistical differences in responses, as seen in **Table III.** Further comparison of how each age group views the economics of solar is reflected in **Table V. A** and **Table V. B**, which lists how a variety of survey questions pertaining to economics compare to the likelihood of solar installation for each age group.

Table VI.

Demographic Representation of Survey Respondents.

Demographic	**Number of Respondents**
Political Affiliation	
Democrat	29
Republican	8
Independent	7
Other	7
Age	
18-45	20
46+	29
Business Owners	
Business Owners	7
Non-business Owners	44
Gender	
Female	28
Male	23
Location of Residence	
Rural	10
Residencial Suburban	19
In Town	22

Developing Public Awareness Materials

The combination of survey and interview data informed the creation of public awareness materials to be used by the Union County Department of Planning and Economic Development, shown in **Appendix C.** The journey to solar energy is a slightly different path for each individual, depending on finances, infrastructural integrity and the energy or solar companies one chooses to work with. Each of these factors can work for or against one's journey to solar energy

adoption. As learned through speaking with Union County residents who are knowledgeable and/or have experience in solar installation, one major barrier is the energetic integrity of many of the homes in the county. Many of the persons interviewed brought up the concern of the houses in Union County having not been updated since built and still relying on oil or coal for heating. Therefore, the first step to solar energy adoption is obtaining an energy audit or engaging in common energy conservation practices such as switching light bulbs to LED lighting or re-sealing the home, in terms of insulation or caulking.

The next steps, outlined in the created public awareness materials, include learning the local and federal incentives and policies around a variety of solar energy installations. This step-by-step format was inspired by the interviews conducted, in which each participant had a unique jumping-off point in starting their solar energy project, with similar general steps. The survey data indicated approximately 27 % of Union County residents as being unaware of federal solar energy policy, and approximately 65 % of respondents were unaware of local solar energy policy. While local policy is limited, this statistic reflects a need to communicate to the general public when policy is adopted locally, such as the C-PACE program. One of the public awareness materials, a double-sided infographic, includes the key benefits of solar energy adoption and the steps to engage in solar energy, along with specific resources, depending on the reader's positionality, on the back side of the infographic. There is concise information on the basics of energy efficiency, net-metering, RECs, the C-PACE program, and federal ITCs to give a general understanding of solar energy and the possibilities of investment. These online resources are listed with a QR code for direct access to each website. The infographic is digital as well as available to be printed and physically distributed. The public awareness material was created in partnership with The Union County Department of Planning and Economic Development to be used and potentially distributed to Union County residents who wish to engage in solar energy.

Discussion

Social Acceptance of Solar Energy in Rural Communities

Social acceptance is essential to advancing solar energy adoption, especially in rural communities like Union County, Pennsylvania which have historically produced energy from fossil fuels, such as coal and natural gas. In recent years, solar energy engagement has grown in the region, however much backlash has also been reported regarding development of large-scale

solar projects. The connection one has to the land around them can work for or against the case for solar energy, as concern for local environmental conditions was shown to have a positive correlation with support for solar installations in one's community. However, in interviewing both James Knight, of Bucknell University and Christopher Bailey, of Susquehanna University, large-scale solar projects often face push-back from residents because of the proximity of the array to their residence - the land directly around them. The survey results collected indicate ground-mounted residential solar arrays as having the least support from respondents. In this way the 'NIMBY' or 'Not in my backyard' mentality discussed in Carlisle et al.'s case study is reflected as change to the land directly around residents will garner the most push-back in solar development (2015). As reflected in **Table III.**, those who believe solar panels, pertaining to solar farms ruin local scenery are less likely to support solar installations in their community.

Agriculture and solar energy have been thought to be competing entities in communities such as Union County that rely on the local agricultural industry. While there are instances where leasing contracts for farmers are less than ideal and can end up taking away from the farmer's potential business, if solar energy is at a smaller scale, its adoption can tremendously aid farmers in meeting their agricultural needs as well as offer economic benefits. Agri-voltaics can become a widespread ideal, in which crops are grown, or livestock graze in conjunction with solar energy production. It is important that agricultural communities do not get left behind in the expansion of solar energy across the country (Pascaris et al., 2021).

The Journey to Solar Energy

It became clear, after the first interviews of this fellowship project, that solar energy adoption could not be sustainably accomplished without energy efficiency practices. A sudden switch to solar energy should not be sought after, but an understanding of energy consumption, through conservation practices, with the installation of a solar energy system after these practices have been adopted. The survey data indicates approximately 88% of respondents want to reduce their energy consumption and therefore, already have the motivation to explore their path to energy efficiency, and subsequently solar energy. In order to achieve the benefits of solar energy, such as clean and sustainable energy production, energy independence and financial benefits, energy efficiency practices must be understood and implemented first. The steps to reducing energy consumption save energy, which saves the customer money that can eventually be put

into installing a photovoltaic system on their residential or commercial property. As presented in an interview with Commissioner Stacy Richards, one example from her energy efficiency project, “Energizing Small Communities”, shows the most savings in electricity were achieved when energy efficiency was implemented and a photovoltaic system was installed and owned by the customer (Interview with Stacy Richards, June 28, 2022).

Engaging in solar energy requires an awareness of policies and economics around solar energy. As the survey reflected, many do not hold an awareness of current solar energy policy, whether federal or local. Through development of public awareness materials, residents and business owners can be made aware of the local and federal policies available to aid in solar installations. It is pertinent that residents are made aware of the Federal Investment Tax Credits, which will soon be declining after this year. Local businesses also have an opportunity to bring down their cost of installation through the newly adopted C-PACE program in Union County (Union County Government, 2022).

Solar energy offers a number of benefits, which any group of individuals can find value in. Whether for a passion for the environment and a want to reduce one’s carbon footprint, or strictly for the economic benefit of independence from the mainstream energy industry, or the grid, solar energy can achieve important energy goals. Solar energy is a way to renewably localize energy generation as well, as energy generation from fossil fuels negatively affects those who live near power plants and the surrounding environment (Levri, 2019). Solar energy not only has the potential to economically benefit residents, farmers, local businesses and other institutions, but adoption of solar energy brings about energy justice: localization of sustainable energy generation that does not negatively affect the health of the surrounding residents and environment. With solar energy awareness, community members of rural Union County, Pennsylvania will understand the tools available to them to engage in solar energy and begin their transition to a 100% renewable energy source.

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Appendix A: Survey

General Awareness

- What is your level of concern about local environmental conditions?
    - 1 – not at all concerned
    - 2 – Slightly concerned
    - 3 – Somewhat concerned
    - 4 – Moderately concerned
    - 5 – Extremely concerned
- What is your level of concern about global environmental conditions?
    - 1 – not at all concerned
    - 2 – Slightly concerned
    - 3 – Somewhat concerned
    - 4 – Moderately concerned
    - 5 – Extremely concerned

- How much would you agree/disagree that you would like to reduce your energy consumption?
    - 1 – Strongly disagree
    - 2 – Disagree
    - 3 – Neither agree or disagree
    - 4 – Agree
    - 5 – Strongly agree
- How familiar are you with solar energy?
    - 1 – not at all familiar
    - 2 – Slightly familiar
    - 3 – Somewhat familiar
    - 4 – Moderately familiar
    - 5 – Extremely familiar

Perception of Solar Energy
How strongly do you agree or disagree with the following statements:

- How much would you agree/disagree with the following statements?
    - I support the installation of solar energy systems in my community.
        - 1 – Strongly disagree
        - 2 – Disagree
        - 3 – Neither agree or disagree
        - 4 – Agree
        - 5 – Strongly agree
    - I support solar energy installation in my community in the following locations:

Location	Strongly Disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
Residential: roof-top					
Residential: ground-mounted					
Public Buildings: roof-top					
Businesses: roof-top					
Parking lots: elevated over the lot					
Utility-scale: solar farm					

    - I support local large-scale solar projects, such as ground-mounted solar farms.
        - 1 – Strongly disagree
        - 2 – Disagree

        - 3 – Neither agree or disagree
        - 4 – Agree
        - 5 – Strongly agree
    - Solar panels, pertaining to solar farms ruin local scenery.
        - 1 – Strongly disagree
        - 2 – Disagree
        - 3 – Neither agree or disagree
        - 4 – Agree
        - 5 – Strongly agree

Perceptions and Awareness of Economics of Solar Energy

- How strongly do you agree/disagree with the following statements:
    - Solar energy is too expensive for me to implement at my residence.
        - 1 – Strongly disagree
        - 2 – Disagree
        - 3 – Neither agree or Disagree
        - 4 – Agree
        - 5 – Strongly agree
    - I am aware of federal policies and/or programs that support installation of solar power.
        - 1 – Strongly disagree
        - 2 – Disagree
        - 3 – Neither agree or Disagree
        - 4 – Agree
        - 5 – Strongly agree
    - I am aware of local policies and/or programs that support installation of solar power.
        - 1 – Strongly disagree
        - 2 – Disagree
        - 3 – Neither agree or Disagree
        - 4 – Agree
        - 5 – Strongly agree
- How acceptable would each of the listed payback periods for solar energy installation be? That is, how long it takes for the annual energy savings and credits to equal the cost of installation.

Period of time	Totally unacceptable	Unacceptable	Neutral	Acceptable	Perfectly acceptable
Less than 5 years					
5-10 years					
More than 10					

years					

Personal Experience with Solar

- How likely are you to install solar panels on your residential property?
    - 1 – Not probable
    - 2 – Somewhat improbable
    - 3 – Neutral
    - 4 – Somewhat probable
    - 5 – Very probable
    - I have solar panels installed
- Do you know anyone, besides yourself, with a solar energy system installed?
    - Yes
    - No
- Do you have solar power on your residential and/or commercial property?
    - If yes, what were your motivating factors for installing solar panels? Select all that apply.
        - Environmental concern
        - Reducing energy cost
        - Energy independence
        - Tax incentives
        - Other _____
    - If yes, what is the most beneficial aspect of your decision to invest in solar energy?
        - _____ _____
    - If not, which of the following factors have contributed to you not investing in solar energy?

Factor	Strongly Disagree	Disagree	Neither agree or disagree	Agree	Strongly Agree
Financial concerns					
Lack of knowledge around solar energy					
Visual concerns					
building/infrastructure concerns, in terms of solar-mounting					
Lack of confidence in the solar installation industry					

Demographics

- What is your age group?
    - Under 18
    - 18-30 years old
    - 31-45 years old
    - 46-60 years old
    - 61+ years old
- Are you a resident of Union County?
    - Yes
    - No
- Are you a business owner in Union County?
    - Yes
    - No
- Which location best describes your living area?
    - In town
    - Residential suburban
    - Rural
- Do you own or rent your current residence?
    - Living at home
    - Own
    - Rent
    - Other _____
- Do you own a farm/farmland?
    - Yes
    - No
- What is your gender?
    - Male
    - Female
    - Non-binary
    - Other
- Are you of Hispanic, Latino, or Spanish origin?
    - Yes
    - No
- How would you describe yourself? Select all that apply.
    - American Indian or Alaska Native
    - Asian
    - Black or African American
    - Native Hawaiian or other Pacific Islander
    - White
- What is your political stance?
    - Republican

    - Democrat
    - Independent
    - Liberartian
    - Green party
    - Other _____
- What is your highest level of education?
    - Some High School
    - High School
    - Bachelor's Degree
    - Master's Degree
    - Ph.D. or higher
    - Trade School
    - Prefer not to say

Appendix B: Interview Questions

General perspectives - Asked of all interviewees

- Do you see a unique opportunity for solar energy expansion in Union County and Pennsylvania in general?
- What do you believe are some of the attitudes around solar energy in Union County?
- What are some barriers you see are keeping Union County residents from participating in solar energy?
- Do you have any suggestions for contacts I should interview next?

Questions for residents

- When did you decide to invest in solar energy? What was your primary motivation?
- How did you choose your solar installation company?
- Can you tell me about the process of installation of your photovoltaic system?
- Do you believe having solar panels increases your property value?
- How do you know how much energy you are producing? What has energy production been like, in terms of consistency?

Questions for Businesses

- When did you install solar panels?
- What was your biggest motivating factor?
- How did you choose the company to work with? Did you utilize grants?
- How much energy does the solar array produce?
- What are some of the barriers you believe are prohibiting more businesses from participating in solar energy?

Questions for Institutions

- Can you talk about the institution's journey to energy efficiency and the role of solar energy on campus?
- Can you talk about the development of the institution's solar energy project and the challenges to getting the project off the ground?

- Does your solar project incorporate agricultural practices? How do you see solar projects and agriculture coexisting?
- How will the energy produced by the solar project be managed?
- Can you talk about the process of picking a site for the solar installation?

Appendix C: Public Awareness Materials Created

Infographic: Digitally and Physically Distributed

A GUIDE TO SOLAR ENERGY IN UNION COUNTY, PENNSYLVANIA

Do you have a south-facing roof?
Want to reduce energy consumption?
Have an unused plot of land?
Solar energy may be right for you.

ENERGY EFFICIENCY

The first step in engaging with solar energy is to save money through implementing energy efficiency practices. Each resident's starting point is different, and practices can range from switching the type of lighting used to air sealing your home.

What is energy efficiency?
Energy efficiency means using less energy to achieve the same goal and eliminating energy waste that is costing you excess money.

An **energy audit** outlines the actions that can be taken to conserve energy.

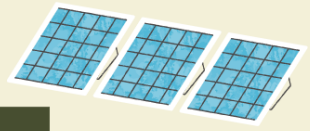
SAVE AND ENGAGE

The next step is to examine the current federal and/or local incentives and programs available for solar array installation. If you are unable to install a solar array of your own, buying RECs is another outlet to invest in renewable energy.

C-PACE
A program adopted in Union County June 2022, which can be utilized by local businesses to provide up to full financing of solar energy projects.

RECs
Renewable Energy Credits; A certification that a portion of the electricity bought and used came from a renewable source. Those with solar energy systems are able to sell these certificates to those who want to invest in solar energy and claim a portion of their energy is produced renewably.

Federal ITCs
Federal Investment Tax Credits apply to residents and are currently at 26% for installations begun before the end of 2022, then 22% percent through 2023.



BENEFIT DIRECTLY

The energy produced by your solar array directly benefits you economically and energy-wise. You gain energy independence, and reduce your carbon footprint.

The average payback period of residential solar installations nationally is 8.7 years. This varies by system and can be calculated via Energysage.com

What is net metering?
The process in which a bi-directional meter is rolled out when the customer-generator is pulling energy from the grid to supplement their energy, and the meter is rolled back toward the customer when their excess produced energy is being exported to the grid. This exported energy is valued at retail price.

Learn how to make the shift to solar energy and make your property a site for local energy generation!

Resources for Residents

Energysage.com
Enter your zip code and this site reports statistics pertaining to local residential solar installations, and allows one to compare installment rates.

Resources for Farmers

Energy.gov
"Farmer's Guide to Going Solar"; This section addresses common questions and ways solar energy can be incorporated into farming.

Resources for Local Businesses

Pacpacecounties.org
You can access up-to-date information on the C-PACE program as well as apply for funding.

Pasolarcenter.org
You can access a variety of information through this site to learn if solar energy is right for your business or nonprofit.

A Bucknell University Center for Sustainability & the Environment project, in partnership with the Planning and Economic Development Department for Union County. Funded by the William Corrington Renewable Energy Fund.

Social Media Posts: Digitally Distributed

Go Solar!

Union County, Pennsylvania

The Steps You Can Take to Solar Energy Adoption

Conserve your energy

- **Implement energy efficiency practices, obtain an energy audit.**

Evaluate solar energy policy

- **Federal Tax Credits for solar installments are available to residents at 26% through the end of 2022.**
- **C-PACE, adopted by Union County June 2022, can provide local businesses up to full funding for solar projects.**

Understand the economics

- **Through net-metering, you can sell back the excess energy you produce, at retail value.**

See the benefits

- **Solar energy is not only environmentally beneficial, but economically beneficial, with thousands of dollars in savings. Go solar today!**

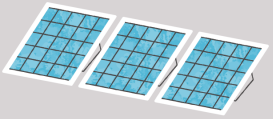
Helpful Resources

Learn how to make the shift to solar energy and make your property a site for local energy generation!

Residents:

Energysage.com

Enter your zip code and this site reports statistics pertaining to local residential solar installations, and allows one to compare installment rates.



Farmers:

Energy.gov

"Farmer's Guide to Going Solar"; This section addresses common questions and ways solar energy can be incorporated into farming.

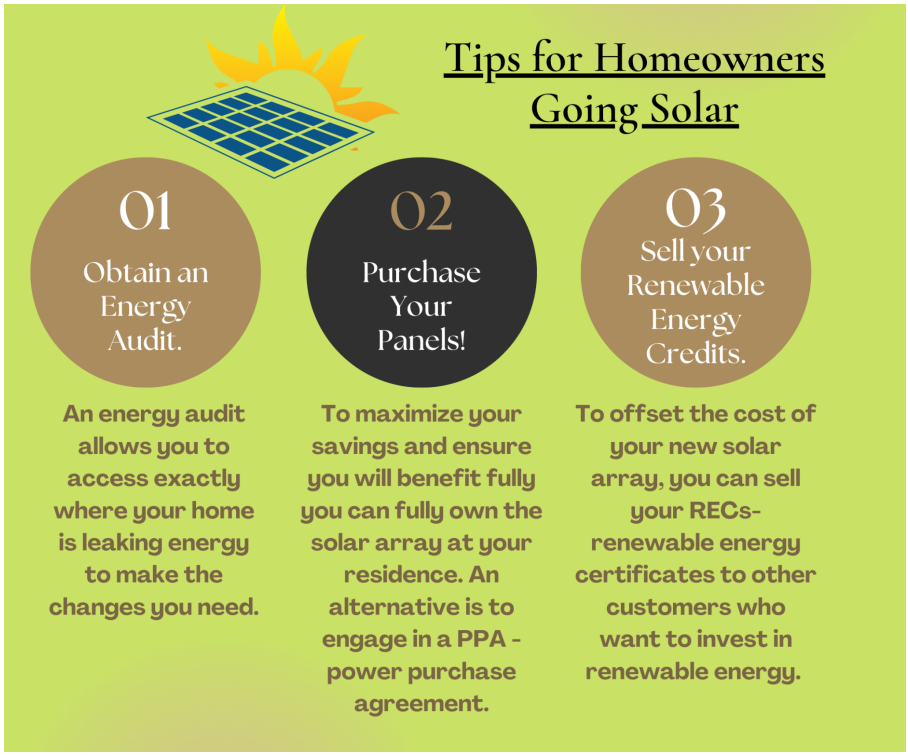
Businesses:

Pacpacecounties.org

You can access up-to-date information on the C-PACE program as well as apply for funding.

Pasolarcenter.org

You can access a variety of information through this site to learn if solar energy is right for your business or nonprofit.


Tips for Homeowners Going Solar
01
Obtain an Energy Audit.
An energy audit allows you to access exactly where your home is leaking energy to make the changes you need.
02
Purchase Your Panels!
To maximize your savings and ensure you will benefit fully you can fully own the solar array at your residence. An alternative is to engage in a PPA - power purchase agreement.
03
Sell your Renewable Energy Credits.
To offset the cost of your new solar array, you can sell your RECs- renewable energy certificates to other customers who want to invest in renewable energy.