ABSTRACT

A variety of strategies and programs can be used by local governments to promote distributed solar installation. These programs or goals can be attempted in tandem or in a stepwise fashion. First, a goal for solar should be set to provide an example of solar installation benefits to the community. Then, solar permitting should be improved to allow for less time and money spent in the permitting process. After that, outreach programs for solar energy should be implemented to spread information regarding solar to the community. As part of this outreach, educational programs can be offered to inform the public about solar benefits and financing options. After these steps, collaborative purchasing and financing programs should be considered to reduce up-front costs and simplify the process of solar installation. Finally, all these programs should identify the social, political, and economic considerations of the area and factor these considerations into program design. All these actions will promote a successful solar program. A one page document that outlines the actions along with links to relevant websites is available in Annex A.

INTRODUCTION

Citizens and local governments have an important role to play in the adoption of solar energy. Local governments can promote solar through setting renewable energy goals, simplifying solar permitting, providing solar outreach to the community to educate citizens about solar energy, and organizing collaborative purchasing programs for wide scale solar installation. A study done by the National Renewable Energy Laboratory (NREL) in 2010 found that “Local governments can play an important role in developing an environment conducive to clean energy adoption… and can craft policies aimed at the unique needs of an area” [1]. Local solar policies allow for greater variability in programs that target the specific need of the community. Local policies can also be used to lead social change and frame the issue to get citizens motivated in solar adoption [1].

Scope and Methodology

A strong focus has been placed on options that can be implemented by local city sustainability employees or city energy managers. More politically polarizing options have been omitted in the scope of this paper. This refers to any action that would require state or federal legislation or utility commission ruling to empower the city to act. Recommendations will revolve around options readily available in Arizona as of the writing of this paper. Because recent politics in Arizona have leaned toward conservative and free market initiatives, special focus will revolve around cost savings and market actions to promote solar in an effort to remove political bias from discussion regarding solar. Also, many renewable energy mandates have been set on utilities called renewable portfolio standards. This process is managed through the Arizona Corporation Commission, the regulatory agency that regulates electrical utilities in Arizona, and is outside the scope of this paper.

A combination of document analysis and seven interviews with energy experts in the solar field will provide the research basis for this paper. A wide variety of experts were interviewed to provide different perspectives. These experts include a utility sustainability director, solar industry members, solar advocates, governmental employees, academic peers, and local citizens to achieve a breadth of perspectives. The purpose of these interviews was to ascertain the opinion of each member of the role local government to promote solar energy. Recommendations for sources and programs to consider in the scope of this paper was one of the main benefits from these interviews. Also, experience in setting up these programs and some of the social demographic considerations was inferred from these interviews.

Benefits of Promoting Solar

Installation of solar modules can reduce spending on electricity for local city operations and can promote local job creation. Depending on the financing option, solar energy can provide cheap electricity and set electricity rates for many years through solar service agreements (SSA). An SSA is a contract that a government or non-profit entity can enter with
a solar installer to purchase solar electricity at a set price for a set amount of years. SSAs have allowed for local governments to install solar energy while avoiding up-front costs, which hamper the installation of solar. SSAs also allow for governmental agencies to plan on a set price for electricity for 15-25 years, while traditional electricity market prices remain much more variable. This is valuable for budgeting and financial reasons. For example, local Maricopa county solar installations expect, per 1 Megawatt project, to save $28,000 per year, with these savings increasing as electricity prices increase.

Solar energy installation can prevent electricity rate increases by avoiding capital investments for new power plants, which is passed onto consumers. Homeowners and businesses can reduce yearly electric bills and save money over the life of the solar array. A Lawrence Berkeley National Laboratory found that solar installation increases the sale value of a home by $5,911 per 1 kilowatt (kW) installed [2].

Growth in the local solar market can lead to job creation if measures are taken to use local solar contractors. Growth in solar jobs has declined recently in Arizona recently due to a removal of incentives and state policies that been unfavorable to the solar market in the region. This has negatively impacted the solar market as further installations are being hampered and large scale solar projects are reaching completion [3]. Without new strategies to promote solar even more jobs will be lost in this growing market.

Distributed solar can prevent the need for large transmission lines and power plants to be built, both of which take up large amounts of land. Traditional power plants require a large amount of water to operate, while solar requires very little after installation. This is especially important in Arizona where water laws limit the amount of water available in an area, while the local population continues to grow. With solar, home owners can provide their own power and potentially separate themselves from the utility grid, if they so choose. Solar can also reduce emissions from power plants that have been shown to be hazardous to human health.

Social, Political, and Economic Considerations

Social, political and economic considerations need to be addressed at the beginning of any solar program. Social demographics such as age, median income, and current solar penetration need to be considered to shape programs in a way that is suited for the community. Political aspects such as incentives, Arizona Corporation Commission rulings, and city council priorities need to be addressed to prevent challenges from politicians and legislation. Economic considerations need to be addressed to make sure solar installations make money for the user and for financing to be available for solar installation. High up-front installation costs have been a barrier to widespread solar installation so programs need to be aligned to remove this burden. Also, local governmental time and money needs to be taken into account for managing, implementing, and evaluating solar programs.

This paper will identify and summarize actions available for local governments in five sections: goals, permitting, outreach, education, and collaborative purchasing and financing models. A discussion around social, political, and economic consideration will follow those sections to identify sources of potential opposition and ways to address them.

GOALS

The first important step for any local government to promote solar is to set a goal for solar and create a plan to implement this goal. This can be through a specific solar target by a certain date, a plan regarding outreach and education to citizens, or a percentage goal to increase citizen solar installation. The important people to get involved in these discussions should be the city energy managers, city council members, the mayor, and local citizens. Each implementation strategy should be designed for the area depending on resources and demographics of the community.

Goal Considerations and Benefits

These considerations include the cost of electricity (COE) in the area, average age of citizens, and median income in the community. COE affects the economics of solar in that the more money citizens have to pay for electricity from a utility, the shorter time it takes to earn a return on their solar investment. Average age and median income for an area change the program’s effectiveness for solar based on available capital and home ownership. Solar adopters are older in age and are within the medium income bracket [4]. These demographics need to be considered in the program marketing strategies, along with innovative ideas developed to reach the other members of the community.

Setting a goal is important to provide an example for citizens of the benefits and need for solar installation. Also, without measuring the amount of renewable energy currently used and setting a goal, solar adoption will continue at the usual rate for an area, without other factors being included. This goal can be used to set the community priorities to promote solar adoption.

Implementation Plan and Communication

Once a goal is established for a city, then an implementation plan needs to be developed for that target. A survey needs to be undertaken to identify the available space and resources available to the city or residences for solar installation. A financial plan needs to be included as part of this process to determine if funds are available for installation or if the city needs to pursue a solar service agreement (SSA) with an installer. The citizens of the community should be involved in this process to make sure that all ideas are considered and to communicate options for this plan. The community is needed to ensure a smooth transition to solar and to spread the word of these programs to other networks and citizens within the community.

Recently Tempe, AZ adopted a solar goal of 20% of government operation electricity to come from solar by 2025. This goal was chosen with feedback from the city energy managers, the city council members, citizens, and local non-profit environmental groups. A city forum was held to identify the total amount of space that would be viable for solar. Also, during this phase a plan was created to identify a feasible strategy for implementation. Feedback from different sources led to a strong plan of action with projects going forward. This plan should be readily available and visible to the citizens of the community either through the city website and/or shared over social media. New solar installations
should be celebrated and made politically visible as well. Lessons learned and successes should be shared with other cities to promote best practices amongst the surrounding area. The cities of Tempe and Mesa have worked together to share contract terms with solar installers that allowed for the reduction of time in the installation process. This sharing was done through the local Sustainable Cities Network and will be discussed later in this paper. Also, cities can band together to negotiate deals with installers that will be discussed in the collaborative purchasing section.

Tools for Setting Goals

Once a goal has been set and is in the implementation stage, a community can work with organizations to further their renewable goals. This can be done through either governmental programs or private business solution. One governmental program is the Green Power Communities program through the Environmental Protection Agency (EPA). This program works with representatives from the EPA, the community, the local utility, and a network of other cities involved to reach a set goal for renewable energy through a voluntary green power market. Tools, lessons learned, and support can be received through this program in crafting this endeavor [5]. An example of a private business solution is Optony’s Solar Roadmap™ tool. This tool offers guidance on solar permitting, financing, and solar development programs to promote solar within a community [6]. This is one tool available in Arizona, but others may be more beneficial in different regions. Once a city has set a goal for solar energy, the next step is to make the up-front process of installing solar as simple as possible.

PERMITTING

Every solar array that is installed has to be permitted by the local jurisdiction having authority, which is generally the city, county, or municipality. A straight-forward, easy, and cheap permitting process will allow for a more efficient installation phase and reduce the time from conception of a project to its installation. A set of requirements for solar permitting needs to be determined by the jurisdiction to make sure that solar array designs meets electric, fire, and building safety codes. A key piece to ensure streamlined permitting is for the permitting standards to be easily understood and visible on the city website. This allows installers to know the requirements for permitting before starting the process. Once this process is in place, then a community can start to streamline the permitting process.

Project Permit Best Practices

Best practices for streamlining solar permitting process can be found at ProjectPermit.org, which is a Department (DOE) of Energy SunShot grant recipient [7]. Over the course of this program, the Interstate Renewable Energy Council and the Vote Solar Initiative identified seven best practices for solar permitting that are listed below:

1. Post permitting requirements online with an easy to use checklist.
2. Implement an expedited permitting process.
3. Enable online permitting for solar applications.
4. Require a fast turn-around time for permits and publish goal.
5. Implement reasonable permitting fees.
6. Offer a narrow inspection appointment window.
7. Eliminate excessive inspections [7].

Most of these items were identified to reduce time and money for solar installers and municipal workers during the permitting review stage. The scorecard for each of these items can be found in Annex B. A community is then ranked on this scorecard and their grade is listed on the website. Further explanation of these best practices can be found online at IREC.org/publications [8].

Streamlined Permitting Processes

Specific to Maricopa County, Scottsdale is currently the only jurisdiction that meets all the requirements for a “best” rating on Project Permit. Scottsdale’s permitting checklist also incorporates the best practices from the Maricopa Association of Governors solar checklist, which lists minimum requirements needed. It uses picture examples of solar installations to show the preferred installation practices [9]. If all of these requirements are met, then the permit can be expedited for approval to day-of and over the counter at the permitting office. This day-of permitting option has been popular with installers and has been used more than the online permitting process that the city offers.

Other cities offer prizes for solar designs that meet specified criteria. In Santa Barbara, CA solar designs are rewarded at the end of the year for various categories. These categories include building-integrated technologies, carefully designed and mounted systems, and solar design in the historic mission district [10]. All these challenges are described in their permitting requirements checklist along with educational resources for solar energy adoption. This reward allows for recognition and visibility to citizens for businesses and residents.

In order to streamline the solar permitting process, a local government must first simplify the process and make it visible to installers, often on the city website. After that is completed according to Project Permit and other examples, the city should look into building an online permitting process to allow for ease of permit application. Then the city should consider adding challenges and making rewards available for those designs that meet requirements, such as Scottsdale’s expedited permitting process and the Santa Barbara permitting reward. This will allow for the celebration of solar installations and make solar more visible to citizens in the community. According to a SunRun report in 2011, solar permitting fees account for roughly $2,500 nationally of a solar installers [11]. Taking these steps can reduce this number to further increase the economic benefits of solar.

OUTREACH

Another service that local governments can provide to its citizens is to organize solar outreach programs and materials. Three examples of outreach are solar champions, communications via social media, and local university networks. A solar champion can be an independent volunteer that speaks on behalf of solar rights for citizens. A solar champion’s main job is to educate and get citizens involved with solar. Whether this is one on one talks or giving speeches at civic clubs, their job is to be available for questions.
regarding solar. A large part of this is to provide education to citizens, but a more important role is providing a voice to battle misinformation regarding solar energy.

**Appoint a Solar Champion**

Solar champions can be recruited from within the local government, but it may often be best to pick a respected individual within the community. A local government or non-profit agency can look for people actively involved in the solar community in order to find a knowledgeable volunteer outside the solar industry. This trait is beneficial for removing potential bias concerns regarding the solar champion. This person could coordinate programs with local politicians and be used as a third party voice for educating citizens regarding solar policies and implementation.

This model has had success in Goodyear, AZ where a 55+ community went from two homes with solar to roughly nine hundred plus homes in the span of four years. The solar champion of that area, Dru Bacon, first started out by inviting the two home owners with solar to come and speak to the local environment club. Dru has been effective in his endeavor due to his volunteer status, his ability to use networks to promote solar programs, and keeping himself educated regarding the local solar market and policies. This first meeting he organized regarding solar focused on savings and the owner’s experience with their system. The popularity of this meeting led to inviting a local solar installer in the area to talk to the group. The installer educated the group and offered a limited time deal for the members. This model was copied amongst different communities in the area and continues to be a force of change within local housing communities.

Another successful example of this model was the Solar Ambassador program, a part of Arizona SmartPower’s solar challenge. This model uses solar adopters as advocates for solar power in the community. These advocates volunteered their time to promote solar installation in the community and to educate other citizen’ regarding the program. Arizona SmartPower implemented a solar challenge that set a goal of 5% of residences installing solar in 13 Arizona communities and used Solar Ambassadors to spread the word of this goal. Once these communities reach their goal they were designated an Arizona Solar Community, which allowed for publicity and recognition for residents. Along with the Solar Ambassadors promoting the program, the initiative offered solar coaches to provide technical help on installation and design. This program was successful in 6 of the communities reaching the 5% goal, and other communities coming in around 3-4% [12]. This program is currently being repeated in Massachusetts and Connecticut with similar success.

**Recognize Success**

Successes of government or solar champions to increase solar installation need to be celebrated with members of the community and politicians. Mayors and city council members can be invited to ribbon cuttings for new solar installations and can promote the benefit of solar job creation in the local area. Designations and ceremonies can be offered to local businesses if they meet a certain percentage of total energy use from renewable energy. Residents could be recognized on the city website for installing solar. This recognition was a large motivator for residents in the Solarize movement in Portland [4], which will be discussed later in this paper.

**Communicate on Social Media**

Another part of the outreach for solar involves communication over social media. Social media can refer to any content on the city website, pamphlets distributed at local events, or message sent out on social media platforms such as Facebook and Twitter. Any content over social media needs to identify a specific objective for communication and then needs to identify the target audience [13]. As per the social behaviors appendix of the Energize Phoenix report, residential communication needs to focus first on utility bill savings and then on conservation. Communication toward businesses needs to focus also on utility bill savings, but instead of stressing conservation, needs to focus on recruiting trusted contractors and members of the business community to share benefits of solar [14].

A diverse use of social media platforms should be used for the goal in mind to ensure that the message is effective in reaching a wide market. Facebook is good for sending out broad solar market messages and providing access to multimedia content. Twitter can be used for short bursts of information regarding the day to day information of solar. An example of this can be found from Vote Solar, which uses Twitter to host monthly chats regarding solar. The more visual the content, generally, the more likely the content is likely to be shared, according to solar industry media analysts [13]. Social media can also be a venue to start policy discussion among citizens. The local government can take a moderator role in the discussion and ask for feedback from the community [13]. The management of this feedback needs to be assigned to the social media representative of the community or included in another governmental employee’s job task. This information should be shared with energy managers in the city and also with city council members to make sure the public opinion is represented in decisions.

Social media can be used to achieve these goals, but any message needs to be approved through the proper department within government. This department can also be used as a valuable resource for shaping messages to citizens. In order for social media to be effective, someone in local government needs to be responsible for responding to requests from this media as well as in charge of distributing this message. In the end though, social media should be a way to interact with citizens of the community and provide them a feedback mechanism for local policies and programs.

**Involve Local Universities**

A final piece of solar outreach can be achieved through local universities. Universities can provide a third party view and be mediators in policy discussions. They can also be used to bring together sustainability employees, similar to the Sustainable Cities Network at Arizona State University [15]. This network has succeeded in promoting best practice sharing amongst Maricopa County cities regarding renewable energy by organizing meetings to discuss the local energy market. Universities can also offer education regarding solar, potential volunteers through student networks, and research regarding policies that affect solar.
EDUCATION

Education regarding solar energy has been a barrier in solar adoption. There is so much data and information available to citizens through the internet and media that making an educated decision regarding solar installation is difficult. Local government can be used to provide trusted information to its citizens through websites, emails, or pamphlets. The city website can be a venue for providing information regarding solar. This can be through a solar FAQ, a “How to Go Solar” guide, or links to trusted websites and contractors. This information can be provided for businesses, residents, and local installers.

Create a Local Solar FAQ

A solar FAQ is important in providing basic information regarding solar information and also providing information regarding the different policies for that region. It can be a way to provide independent and trusted information to citizens through either the city’s sustainability department or passed on to a local university to manage. An example of a solar FAQ can be found in Annex C and is geared towards residents in Tempe, AZ. This FAQ provides a guide for solar installation, solar financing options, the incentives for solar in the region, and information regarding highly publicized solar debates in the region. All this information can be found on the internet, but the simplicity of having all the information in one area provides a “one stop shop” for citizens. This FAQ could be publicized through the city website or shared on Facebook with citizens. Also, a third party source can compile a solar FAQ for their solar program similar to the one developed during Arizona SmartPower’s Solar Challenge [12].

Educational Resources

A “How to Go Solar” guide can also be provided through the city website [10]. This guide can list specific requirements for solar in the area along with trusted contractors. Ease of access to this information will be beneficial to citizens who are debating solar installation. A source for solar education and prices can be found at Energy Sage [16]. This website was founded through a SunShot grant sponsored by the DOE. It provides third party information regarding the economics and cost of solar. All users need to have is their last month’s utility bill, an average of electricity usage over the year, and their address. Within five minutes a citizen can have information regarding cost and payback time for a solar array. An easy to read layout of this is shown below in Figure 1 [16].

After creating a profile online, this website provides information regarding solar contractors in the area to users. Afterwards, users can contact these installers to get a quote and start the process of designing a system. It also provides examples of past solar installations in different applications and areas of the country. Other links are available online, but cities should take care in choosing the sources for information. Third party websites and government sponsored websites will provide clear and accurate information. A similar website is available at findthesolar.com [17]. This site allows users to calculate their solar resource and system size, provides information regarding local incentives, and provides links to educational websites. Find Solar also provides a network for users to contact local solar installers similar to Energy Sage.

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**Figure 1**: Simple read out of Energy Sage resident example
Educational programs will allow citizens to make informed decisions regarding their solar options. This can be accomplished through a city maintained solar FAQ or a guide for “How to Go Solar” in that region. Online content should be shared through the city website, but a focus on independent third party information, such as Energy Sage, should be encouraged. Once a city has decided to promote solar and followed the previous items, the next step is to begin large scale installation through collaborative purchasing and financing programs.

COLLABORATIVE PURCHASING AND FINANCING

Solar financing has changed over the last twenty years to make solar more accessible to a wider market. Creative financing mechanisms have been needed as subsidies for solar have decreased in recent years along with the 2008 economic crisis limiting the amount of funds available through loans. Collaborative purchasing models were created to promote large volume solar projects that will lead to project efficiencies and money savings for local governments and citizens. These programs will continue to become more popular as financing options for solar become more difficult as subsidies and loan programs for solar expire.

Collaborative purchasing and financing refers to any program that brings together many people or entities to install solar. These programs work on economies of scale that allows installers to provide deals to the customers. Installers also receive a guaranteed amount of business and are able to purchase materials in bulk to receive further savings. The marketing for these programs is often done by the participants of the program or a third party non-profit agency. Three such programs will be discussed in this section: the Solarize program, the EPA’s Clean Energy Collaborative Purchasing Initiative, and financing initiatives.

Solarize

The Solarize Portland program started in 2009 and it increased the solar installation in the area 400% over the previous year. After three years of Solarize programs, Portland has added 1.7 MW to the grid along with fifty jobs in the area. The results from this program were published in collaboration with the National Renewable Energy Laboratory (NREL) in 2011 [4]. This program was led by the City of Portland’s Bureau of Planning and Sustainability in partnership with Solar Oregon and the Energy Trust of Oregon, but started with grass roots interest from local citizens about their options for going solar.

The program attempted to break down three barriers that were identified at the beginning of the project. These barriers were high up-front costs, complexity, and inertia. High up-front cost was solved by a competitive bidding process that allowed installers to bid on projects and provided savings to consumers. These bids were set up for local residential home projects. For example, after tax credits and contractor savings, the price for solar installation for a three kW system dropped from $27,000 to $2,000, with 30-35% of this reduction coming from the bidding process [4]. Also, high up-front costs can be reduced by offering solar leases that reduce the overall savings of the project, but eliminate starting costs. Complexity of the bidding process was solved by third party non-profit guidance and input from the community and installers. Inertia to get people involved was solved by community outreach and offering a limited time offer to consumers, which has been key in many of these programs [4]. The program proceeded in six steps:

1. Awareness
2. Education
3. Enrollment
4. Site Assessments
5. Decision Making
6. Installation

The needed partners identified for this project were a trusted non-profit agency in the community, a technical adviser for the project, a project organizer, and solar industry members to achieve the savings required for program adoption. The trusted non-profit provided credibility and was able to organize volunteer efforts. The technical adviser was needed to inspect contractors and determine the feasibility of solar projects. The project coordinator was useful in being the organizer for the project to make sure everything was completed in a timely manner. The solar industry was able to provide information regarding the local solar market while offering volunteers and expertise [4].

The bidding process can be tailored for a community depending on the needs and demographics of the area. Homeowners could choose if they wanted to own the system or go through leasing options. A multiplier for local businesses could be given to promote the local solar industry in the area. Also, a tiered savings structure could be implemented to increase participation in the program.

At the end of this program in 2011 solar was installed on 560 homes (a 400% increase from the previous year) and 50 local jobs were created [4]. This program model has been copied in other states such as Massachusetts, Washington, Colorado, Vermont, and California. Special care should be made in any new program with regard to demographics of the area. A majority of the participants in the Solarize program were households with medium income ($50-125,000 per year) and leaned toward the older generation (35+) [18]. Programs should be crafted to bring solar to low income members of the community for full penetration into the city’s demographic. An example of a program for low income members was the Northeast Denver Housing Center project performed in 2007. This program featured grants to install solar on low income housing, a green jobs training program for on the job solar installation experience, and financing models similar to power purchase agreements. This project is expected to save over $158,000 for the residents over the life of the system [19].
Clean Energy Collaborative Purchasing Initiative

The Clean Energy Collaborative Purchasing Initiative (CECPI) is a similar program to Solarize Portland, but it instead focuses on public sector buildings and is supported by the EPA. This program was successful in Santa Clara County in that it reduced solar prices by 10-15% and reduced administrative cost by 75% over the project. The aim of this program is to avoid high up-front costs to local jurisdictions, many of which have to consider budget priorities in the scope of the project. This program allows for the optimization of solar design and aligns cities of a region in the same direction regarding solar. The benefits to the community are better prices for solar and lower project risks. This program also reduces transaction and administrative costs for the city and installers [20].

The CECPI process is similar to Solarize, but with some differences. The process is broken up in five steps:

1. Identify project sites and establish size Megawatt (MW).
2. Develop purchasing strategies and project bundles.
3. Issue an Request for Proposal (RFP) and award per bundle
4. Tailor the final contract for each entity.
5. Implement and install projects.

The EPA offers guidance and documentation for each of these steps online and through consultations. They issued numerous podcasts that outline a case study for a program in Santa Clara County that took place in 2009 [21]. This program was initiated through a network of government sustainability employees and energy managers. Seventy sites located over nine jurisdictions for solar installation were eventually chosen and broken up into bundles based on site characteristics, project size (large, medium, small), and financing type. The bids eventually resulted in an average cost savings of 10-15% over past projects. This project was expected to generate $70 million economic activity and resulted in roughly 300 local jobs [21].

The Santa Clara case study found that early regional education for solar in the form of workshops was needed to make sure the program included as many projects as possible. Early engagement from legal and public works departments along with city managers was shown to promote more installation. It was identified that a clear project lead was needed to provide regional leadership and make sure the project continued on track. The bid process was successful due to input from the regional solar industry and including the national solar market in the bidding process resulted in cost savings. The bid groups were organized into roughly five and fifteen projects, which allowed for enough incentives while not overly complicating the process. Because most jurisdictions do not have the budget to purchase systems outright, a focus on alternative financing methods (SSAs, leasing, etc.) was beneficial for projects.

Financing

Local governments can also incentivize solar installation by making more favorable financing option available. A local government can partner with financial institutions to provide low interest loans. One such program was Solar Phoenix 1 in 2009. This program partnered the City of Phoenix with the National Bank of Arizona to offer $25 million in low interest loans. This program sold out within a year and promoted over 3 MW of solar installation within the community. Also, over the life of the program no installers have defaulted on their loan, leading to a low risk rating during financing [22]. The popularity of this first program lead to Solar Phoenix 2 in 2010. The difference in this program was that it offered financing through leases to further spur installation to low and medium income households. Through this lease there was no up-front cost to the installer and the expected savings to adopters were 10-15% on electricity bills over the life of the system [22]. This program was not as successful as the first project reaching only 20% of its original goal due to market changes, lowering incentives, and a decrease in demand [23].

Another financial program is the Solar Forward initiative that was introduced in tandem with Solarize Portland. This initiative was a crowd funding program to install solar on local buildings. Citizens would donate money to the program, which would in turn fund solar installations. This money was matched by a seed grant, with all of the profits of this project being placed into a revolving solar fund to provide financing for more installations in the community. This program is still being pursued, but has not seen the same success as the Solarize Portland program [4].

Other crowd funding solar options are available through Solar Mosaic [24]. This website allows for qualified investors to invest money into solar projects. This network connects borrowers with investors to finance solar projects. The borrower gets savings through the installed solar array and the investors get paid back with interest. This financing has been popular in California and New York where state legislation has allowed for out of state investment in these projects. Currently, efforts are being made to localize the solar projects to prevent federal trade regulations from impacting this model [24]. This program could be promoted through local governments to citizens to provide another financing model and to allow people to invest in solar projects throughout their community.

A final program available is Property Assessed Clean Energy (PACE). PACE allows for financing that is tied to the property assessment of a building and is repaid through yearly property tax increases. A lien that is placed on the house provides collateral and this lien is transferred with the sale of the house as it is tied to the property [25]. This program is popular in states where state legislation has allowed for this financing method because it allows for a low cost loan and reduces the up-front cost of solar financing. However, as current legislation lies, the Arizona state legislature would need to pass a law to make it legal.

This program first encountered resistance from Fannie Mae and Freddie Mac regarding a dispute over the right of first lien on the house. They worried that the solar installers would get paid before the bank and this is an issue that needs to be addressed with legislation or contract going forward. Without state legislation and support from the banking industry, PACE will be very difficult to implement on an independent city basis, but similar financing methods could be considered. These large scale programs are pivotal in
increasing the visibility of solar, but every program needs to identify and manage the demographics of the region.

**SOCIAL, POLITICAL AND ECONOMIC CONSIDERATIONS**

Community demographics need to be considered in order to design the programs that will work best within communities. A growing concern with solar energy is that it favors people with higher incomes and does not include low income residents, often people who would greatly benefit from fixed prices. These demographic considerations need to place a heavy emphasis on the income levels of the community. A strong emphasis on the low income households will promote greater support amongst the entire community and in the media.

Any new solar program needs to be vetted through the city council to ensure that the program is in the best interest of the community. Politicians can also use their leadership position to advocate for solar programs and set the goals for a community. Because these actions are being taken by city employees, an open process for the creation of these programs needs to be implemented to ensure that citizens have the right to comment and shape policies that are in the interest of the community. For example, in Tempe, AZ the city council, environmental groups, and citizens were included in the creation of the energy goals up-front to align the program with local politics.

Regulations and laws of the state and county have to be addressed to ensure no legal challenges will be encountered from these programs. For example, future Arizona Corporation Commission decisions regarding the future of net metering and other solar subsidies can have an impact on the economics of solar market. Future political legislation or rulings need to be considered and discussed with members of the community to get their opinion.

The solar market, incentives, and cost of electricity (COE) of an area need to be considered in order to provide programs that match the need of a community. A robust solar market can provide input into the programs to endure that all the up-front complexity of solar installation can be removed and the largest savings for adopters of these programs can occur. Incentives can change the economics of solar by reducing the cost of solar. Expiring installations can cause increased solar installation just before expiration, which is then followed by a market downturn. COE can affect the overall payback time of solar, with higher utility electricity prices leading towards more favorable solar economics.

Most of these programs will be run or maintained by city officials so available personnel resources need to be examined to make sure enough time is allocated. Solar energy outreach needs to be included in job tasks or one person needs to be designated as a lead at the start of these programs. Also, time and resources need to be allocated in measuring the success and areas of improvement for these programs to ensure these resources are efficiently spent. An employee or third-party group should be assigned to see these programs through to completion.

**CONCLUSION**

Solar adoption can be achieve through local governments by setting a renewable goal, streamlining the solar permitting process, participating in solar outreach, educating their citizens, and participating in collaborative purchasing and financing options. Roof-top solar adoption can lead to benefits in the community that include lower electricity prices, delayed investment in large power plants, job creation, lowered water use, and land savings. A community needs to identify their needs for solar and present these benefits in a way that will entice the citizens to install solar.

A local government should start by identifying their renewable energy goal for the city in order to set an example for its citizens and identifying the benefits of solar. This goal should first be agreed upon by the community and politicians with an implementation plan in place. Other organizations can be useful in providing expertise and experience in creating these programs, such as the EPA or Optony.

Improving the permitting process will reduce the time of installation for a project and reduce the cost of installation. The permitting process can be simplified by sharing best practices locally and following guides, such as the Project Permit guidelines. Once the process has been streamlined, then the community should work on sharing successes of solar installation and offering reward programs for solar designs.

Outreach and education for increase the visibility and educate consumers of solar energy. Outreach can be through volunteer local solar champions or solar adopters, similar to solar ambassadors in the SmartPower Model. Solar outreach can occur over social media networks, with an emphasis on focusing the message and using a variety of sources. Local universities can provide outreach through sustainability networks and by offering volunteers from local student organizations. Education resources can be shared on the city website and can include a local solar FAQ or links to other independent websites.

Collaborative financing and purchasing can in reduce the cost of solar and increase the amount of solar installed in a region. Collaborative purchasing models include the Solarize Portland program and the EPA’s Clean Energy Collaborative Purchasing Initiative. Both of these programs sought to take advantage of economies of scale by grouping together large volumes of projects and bidding them out to the solar industry. Solar financing models should be implemented to reduce the complexity and increase the availability for solar installation funds. This process will continue until the goals of the community have been met and then the process can begin again with new goals.

Through this process the social, political, and economic considerations of an area need to be addressed to ensure that programs are designed to succeed in a community. These considerations should not be viewed as barriers, but opportunities to take advantage of. Every community has different demographics and these programs need to change to reflect this. If all of these issues are addressed then a community can be empowered to go solar and start taking advantage of all the benefits solar energy has to offer.
REFERENCES


ANNEX A

ONE PAGE GUIDE FOR SOLAR PROGRAMS

1. Set Solar Goals
   a. Create solar plan for community
      i. Example: 20% electricity from solar by 2025
   b. Consider demographics of region
   c. Create and communicate an implementation plan
   d. Use tools
      i. [EPA Green Power Communities](http://www.epa.gov/greenpower/communities/
      ii. [Optony’s Solar Roadmap](http://www.solarroadmap.com/)

2. Improve Solar Permitting Process
   a. [Project Permit Best Practices](http://www.epa.gov/greenpower/communities/permitting/
   b. [Residential Solar Permitting Best Practices Explained](http://www.epa.gov/greenpower/communities/permitting/
   c. Expedite solar permitting
      i. [Scottsdale, AZ process](http://www.scottsdaleaz.gov/details.aspx?aid=2769)
   d. Celebrate solar designs
      i. [Santa Barbara, CA design rewards](http://www.sustainablecities.asu.edu/)

3. Implement Solar Outreach Programs
   a. Appoint a solar champion
   b. Utilize [Arizona SmartPower’s](http://www.sustainablecities.asu.edu/) model of solar ambassadors
   c. Recognize success with citizens and politicians
   d. Communicate over social media
   e. Involve Local University
      i. Example: [ASU Sustainable Cities Network](http://www.epa.gov/greenpower/communities/

4. Educate Citizens About Solar
   a. Create a local [Solar FAQ](http://www.epa.gov/greenpower/events/4aug10_webinar.htm)
   b. Share information regarding solar economics and contractors
      i. [Energy Sage](http://www.epa.gov/greenpower/initiatives/cecp/)
      ii. [FindSolar](http://www.epa.gov/greenpower/events/4aug10_webinar.htm)

5. Participate in Collaborative Purchasing and Financing Programs
   a. Community oriented programs
      i. [Solarize Guide](http://www.epa.gov/greenpower/events/4aug10_webinar.htm) – NREL
b. Government oriented programs
   i. **EPA Clean Energy Collaborative**
      Procurement Initiative

c. Financing Options
   i. **Loan Partnerships**
   ii. **PACE Financing**
   iii. **Solar Forward**
   iv. **Solar Mosaic**

6. Consider Local Demographics
   a. Get buy in of city council and energy managers
   b. Aim programs at low income residents
   c. Consider city resources available for programs
   d. Keep educated on local solar laws and regulations

ANNEX B

PROJECT PERMIT BEST PRACTICES SCORECARD

<table>
<thead>
<tr>
<th>#</th>
<th>Solar Permit.org Question</th>
<th>Matched Scorecard Field</th>
<th>Score = Best Practice</th>
<th>Score = Not Best Practice</th>
<th>Weighting Final Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Is there a solar permitting checklist?</td>
<td>Posts requirements online?</td>
<td>yes = best practice</td>
<td>no = not best practice</td>
<td>0.05 0.5</td>
</tr>
<tr>
<td>2</td>
<td>Online permit applications</td>
<td>Allows online processing?</td>
<td>available = best practice</td>
<td>no = not best practice</td>
<td>0.05 0.5</td>
</tr>
<tr>
<td>3</td>
<td>Is there an over-the-counter permit option</td>
<td>Fast Turn Around Time?</td>
<td>Yes = best practice</td>
<td>no = not best practice</td>
<td>0.25 2.5</td>
</tr>
<tr>
<td>4</td>
<td>Ave. turn around time for residential permit</td>
<td>Fast Turn Around Time?</td>
<td>under 3 days turn around time = best practice</td>
<td>over 3 days = not best practice</td>
<td>0.15 1.5</td>
</tr>
<tr>
<td>5</td>
<td>Permit Fee = “Flat Rate” PLUS $400 or less</td>
<td>Reasonable Permitting Fees?</td>
<td>$400 or less = best practice</td>
<td>no = not best practice</td>
<td>0.25 2.5</td>
</tr>
<tr>
<td>6</td>
<td>Licensing for solar contractors</td>
<td>No community specific licenses needed?</td>
<td>Additional licensing beyond a business license is not required= best practice</td>
<td>no = not best practice</td>
<td>0.05 0.5</td>
</tr>
<tr>
<td>7</td>
<td>Time window for a scheduled inspection</td>
<td>Offers a narrow inspection appointment window?</td>
<td>2 hours or under = best practice</td>
<td>more than 2 hours = not best practice</td>
<td>0.1 1</td>
</tr>
<tr>
<td>8</td>
<td>Number of inspections required</td>
<td>Eliminates excessive inspections?</td>
<td>1 inspection = best practice</td>
<td>more than 1 inspection = not best practice</td>
<td>0.1 1</td>
</tr>
</tbody>
</table>

Total Points: 10
ANNEX C

SOLAR FAQ FOR TEMPE, AZ

How many solar modules are needed to power a house?
This depends on the amount of electricity that the house uses, the type of solar modules, and the amount of sun received by the modules on your roof. A typical system size for Arizona homes is between 3 and 7 kW and these systems will produce roughly 4800-11200 kWh per year. These produced kWh will be used to offset kWh from your electric bill. Commercial solar modules are generally rated for 200-220 W per module so a 3 kW system would require roughly 15 modules.

Weather patterns, amount of sun received, shading, and orientation of the solar panels can all affect the total output from the solar modules. The angle of the sun also affects the amount of sunlight and power production from a solar module, with the maximum power production occurring around noon. Tempe receives, on average, the equivalent of 6.8 sun hours per day. This number is greater in the summer and smaller in the winter.

What is the average cost of installation and what is the average payback?
Installation costs are generally referred to on a per Watt basis. These costs change with the size of the system, the solar market, and contractor availability. Recently, installed system costs have been roughly $3-4 per watt. This means a 5 kW system will cost $15,000-$20,000. This number can be offset by incentives from the utility, tax credits from the government, or rebates.

Payback is an economic term that defines the time period where you have paid back the original amount of installation and are now starting to make money off of your system. This number is highly dependent on solar output, cost of the system, and the loan rate. With current incentives and costs, the payback period is between 7 and 10 years. The average life of a solar system is between 20 and 25 years allowing for an investor to make profit in the later years of the system.

If you are interested in estimating your savings and total cost for a solar system you can go to www.energysage.com. All you need is your previous month’s electricity bill and an understanding of your average monthly energy usage.

What are the purchasing options for solar?
In the state of Arizona there are currently three purchasing options for residents and businesses: direct ownership, solar leases, and solar service agreements (SSA). Direct ownership is when the home owner owns the system. The home owner can either pay for the system up front in cash or go through a bank for a loan to install the system. This option requires up front capital, but offers more savings to the home owner over the life of the system.

Solar leasing is where a third party company installs solar on your home and this third party owns the system. The third party pays for all the up-front costs and takes advantage of the tax credits of the system. The homeowner receives the power produced from the system and pays the leasing company a flat rate every month. The leasing company designs the lease amount to allow the homeowner to save money. There is generally a buy-out clause in the lease in which the user can purchase the system.

Solar Service Agreements (SSA) are currently available for non-profit and governmental organizations, but not available for businesses or residences. This allows the installer to take advantage of the tax incentives and does not burden these organizations with up-front costs. The installer owns the system and sells power at a pre-determined rate to the user according to the agreement. An SSA allows for a guaranteed power rate over a 15-25 year period and can lead to savings for these institutions. According to ACC rules, only non-profits, schools, and governments can purchase solar through an SSA.

Why are most houses with solar still tied to a utility?
Solar modules only produce power during daylight hours. A connection to the utility grid is needed in order to provide power to the house at night. The only way for your house to not be connected to the utility grid is to install a solar and storage system (generally batteries) that will provide enough power at all times of the day.

Why does solar not provide power to a home or businesses during power outages?
During a power outage your solar system disconnects from the electrical grid. This is a safety mechanism that is provided at the time of installation and a requirement from your utility in order to be connected to the electrical grid. The purpose of this is to maintain safety for electrical workers. If your system still produced power onto the grid during an outage it could potentially shock line workers working on the power lines.

Without a safety in place, the utility would have to check every solar system in their area to ensure it was not producing power onto the grid. This process would be very difficult and would increase the length of outages. Recent power outages in New Jersey and New York have caused a change in electrical codes that allow for another switch to be installed with the inverter. This allows the system to “island” itself in case of emergencies and solar to still provide electricity to the house. If a home owner would like this option they need to consult the PV designer up-front in the process.

If Arizona has the best solar resource in the country why are more solar panels not being installed?
Arizona has one of the best resources of solar energy in the country due to the high sun intensity and favorable weather patterns. We have, on average, one of the highest amounts of sun hours per day. However, Arizona is currently not the leader in solar installation in the country. There are numerous reasons for this which include cost of electricity and solar policies.

Cost of electricity affects the economics of solar. If a homeowner has to purchase electricity at a higher price, then they will save more money by installing solar. Arizona has some of the lowest cost of electricity in the country which causes the break even period on the solar investment to be longer. In order for solar to compete with traditional electricity generation it has to be available at the same price as the electricity provided, which is called grid parity. Some of the Northeastern states are already at grid parity due to a high cost.
of electricity in the region, even though they have less sun hours per year.

Policies heavily affect the economics of solar as well. Incentives cause the price of solar installation to be lower. For example, New Jersey has less sun hours than Arizona, but the incentives for solar were high for many years. New Jersey, until last year, was the number two solar installer behind California. State policies also affect the funding options that allow money to be freed up for solar installation. California set up a fund for solar installations which lead to an increase in solar. States can also set what is called a Renewable Portfolio Standard. This is a law or regulation that requires utilities to purchase a certain amount of renewable energy. Some states have passed provisions that benefit solar as well as part of this regulation.

What are current incentives for solar?

The incentives for solar change over time as certain laws and incentives expire. An up to date list of incentives for Arizona solar can be found here.

Incentives can come from different sources which include federal and state policies and utility rebates. Current federal incentives comes in the form of the Investment Tax Credit (ITC) which allows the installer to write-off 30% of the cost of the installed solar system in the year it was put into production. State incentives are currently in the form of the Residential Solar Tax Credit which allows the installer to write of 25% of the installed cost up to $1000 per residence. Also, state sales tax is waived on equipment that can be used to install solar systems.

Utilities can offer incentives in the form of rebates. These rebates are funded by a renewable energy surcharge that can be found on your electric bill from your utility. Also, the utility can offer a Production Rebate which pays a certain amount per kWh produced by the system. Both of these incentives are set by the ACC and are currently set to expire soon.

Who controls the incentives for solar?

Congress currently controls the federal incentives for solar. The Investment Tax Credit is expected to be reduced from 30% to 10% when the bill expires at the end of 2016. The Arizona legislature controls the state incentives and the Arizona Corporation Commission (ACC) has the power to set utility rebates in combination with the utilities themselves.

Why are solar panels not covering more parking lots around the area?

Solar panels are not being installed on municipal parking lots because of regulations from the Arizona Corporation Commission. According to the net-metering rules a solar array cannot produce more than 125% of the total buildings usage for systems over 10 kW. This means that most of the power produced from the solar system needs to be used onsite and over the span of a year only 25% of the total production can be sent back to the grid.

Parking lots generally only use electricity at night for street lamps and these lights do not use a large amount of electricity. Because of this small energy use, a solar system would be too small to cover more than a few parking spots and would not be cost effective. If you could use the power onsite in a building, then the system installed could be larger.

What is “net metering” and what was the outcome of the Arizona Corporation Commission case?

Net metering is the process that allows a user to take advantage of the excess energy produced by solar modules. With the exception of summer months, solar systems generally produce more power during the daytime hours than is used by the home. Net metering counts all of the electricity that is sent back to the electrical grid and provides a credit that is used to offset usage during nighttime hours. At the end of the year any credits that are still left in the consumers are sold back at a wholesale rate, which is generally much lower than electricity prices. Without this process, owners would not be able to take advantage of any excess power produced by the modules.

The debate regarding net metering was started when a case came before the ACC that wanted to attach a fee on solar systems. The supporters of the bill argued that solar customers were not paying their fair share for access to the grid as other non-solar customers. These grid charges are built into the electricity rates and took away revenue from utilities. Deniers of the bill argued that it equated to a tax on solar and would lead to contraction of the solar industry. The outcome that a $0.70 per kW installed fee was placed on solar customers. This is roughly a $3-7 charge on electric bills per month. More information can be found here.

What is the solar access law in Arizona?

The solar access law is a state law that states that a homeowner’s association rule cannot interfere with residents installing solar modules on their roof. However, the HOA can set rules as to where the modules can be installed on the house (example: cannot be visible from street, etc) if they choose.

What ruling did the Arizona Department of Revenue issue recently and how does it affect solar?

As of September 2013, the Arizona Department of Revenue released a ruling on the AZ tax code that will have a big impact on leased solar systems. 80% of the new installations in the past couple of years has been leased systems so this will have an impact on the solar industry in Arizona.

The ruling states that because a third party owns the panels and then provides electricity to a different user (home) it is considered off-site generation and not available for tax breaks. This will equate to roughly a $125 tax a year on the leasing company, which will be passed onto homeowners. This will reduce the payback of solar completely and could halter the growing solar leasing industry in AZ.

What is base load generation and how does solar affect it?

Base load generation is the general term used to describe power plants that cannot ramp output up and down easily. Both coal and nuclear plants fall into this category because it takes a long time to develop the heat to create steam to produce electricity. They tend to have a steady output and are generally considered some of the cheapest electricity rates once the plant has been paid for.

Solar module’s output varies with the time of day and can also be affected by clouds or other weather patterns. This means that the electricity output is variable. This does not interact with base load generation plants because these plants need to be able to ramp up or down depending on output from the solar modules. Natural gas plants have offered a solution to this problem as they can ramp up and down to meet need.
What can citizens do to promote solar?

The biggest thing citizens can do to promote solar is to look into installing panels on their roof. While installation may not be viable for everyone, the more solar on roofs will help the solar market and show politicians that citizens want solar. A solar consumer can be an example to the rest of their neighbors.

The next thing would be to pay attention to energy in politics. Become educated about the Arizona Corporation Commission elections which are little publicized, but affect the rules regarding solar laws.

What are some good websites to consult if you are looking to go solar?

https://www.energysage.com/ - All you need is your address, your last month’s utility, and the average power consumed per month and you can estimate the system size and production. This third party website can also put users in touch with local installers and get a quote online. Provides economic data for owning and leasing a system.

http://pvwatts.nrel.gov/pvwatts.php - More technical website that allows user to estimate power production and annual savings.

http://arizonagoessolar.org/ - Website maintained by ACC and utilities regarding solar in Arizona.

http://www.pveducation.org/pvcdrom - Access to technical information. Site used by colleges for teaching basic science behind solar.