Building a Solar-Powered Home in a Historic Neighborhood

A Case Study with CVF Homes, the City of San Antonio Office of Historic Preservation, and the Lavaca Neighborhood Association

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Background

The City of San Antonio has made tremendous progress in recent years in the area of solar energy installations on residences. These projects have been great successes, though not without the usual challenges associated with solar energy installations. The City has also seen an increased interest in solar energy systems in official "historic" neighborhoods. These installations have a potential for added challenges, as neighborhoods designated "historic" have additional restrictions, aside from standard building codes, about what changes and upgrades can be done to the exterior. This is in an effort to maintain the historic qualities of the homes and preserve the historical nature of the neighborhoods in which they are present. The purpose of this case study was to examine the construction of a new, single family home, with an included solar energy system, in an official historic neighborhood in San Antonio. Build San Antonio Green hoped to uncover what specific additional challenges the builder faced when working in a historic neighborhood and how those challenges were overcome, to serve as a model for other builders wishing to install solar energy systems in historic neighborhoods. This is of particular importance, as the City of San Antonio has more than 20 officially designated historic neighborhoods, and without proper knowledge of how to comply with the additional regulations, contractors, builders, and solar installers could potentially miss out on tremendous opportunities.

For this study, Build San Antonio Green looked at the home constructed by CVF Homes in the Lavaca Neighborhood. CVF Homes had previous experience with retrofit projects in the Lavaca neighborhood, but this home was the first new construction project they undertook in this area. The home is 1700 square feet of conditioned space and includes a 6 kilowatt solar photovoltaic array. The home was submitted for certification in June of 2011, before construction began. Construction was completed in late March 2012, and the home officially earned certification through Build San Antonio Green's Level 3 Solar Home program on May 10, 2012. After final energy testing was completed, the home achieved a HERS Index of 17, and is estimated to save more than 24,000 kilowatt-hours of energy per year.
This home was chosen for the case study as it was a new construction project with a solar energy system in addition to being built in a designated historic area. The Lavaca neighborhood, located immediately south of downtown San Antonio, is the oldest existing neighborhood in San Antonio and is an officially designated "historic district." Historic areas and districts, in most cases, have restrictions about the type of work that can be done to the buildings beyond the standard code and permitting process put in place by the City. The purpose of these additional regulations is to ensure the historical charm and character of the older neighborhood is not eliminated.

The Project Team consisted for this house consisted of:
Builder/Contractor: CVF Homes
Architects: Alberto Isunza and Juan Fernandez
Plumber: Hernandez Plumbing
Structural Engineer: Louis Faraklas, Jr.
Solar Installer: Lighthouse Solar

The construction and permitting process was examined for the purposes of this study. Interviews were conducted with the builder, the case manager from the City of San Antonio's Office of Historic Preservation, and with the President of the Lavaca Neighborhood Association. The home has several features that were examined to determine challenges and obstacles. These features are

- Location in an officially designated "historic area"
- Installation of a 6 kilowatt solar photovoltaic system
- Greywater recycling system

Builders Perspective:

CVF Homes project at 107 Leigh Street
The solar PV system is on the roof above the second-story outdoor living area

The home at 107 Leigh Street was constructed by CVF Homes, owned by Juan M. Fernandez. Because the home has a significantly different overall design aesthetic from a majority of the surrounding homes, the builder made sure to involve the Office of Historic Preservation from the very beginning. In conjunction with OHP, the builder studied the neighboring properties to ensure the design would be approved. The architect purposefully incorporated features that mirrored features of homes in the neighborhood. For example, the columns on the home were designed to match the columns found on other homes nearby. The front porch and driveway were also designed to be similar to the surrounding area.

After gaining approval from the Office of Historic Preservation, the remainder of the permitting process was the same as constructing a house in a non-historic neighborhood, with one exception. This home was designed to have a combination of metal and timber for the framing. Because of this unique feature, the permitting process did take longer than a more traditional construction job as it required a more in depth structural review and study process. However, this additional time was due to the unique features of this specific home, not because of its location in a historic area.

The other necessary permit was for the solar photovoltaic system. This is relatively simple in San Antonio, as it is included in the electrical permit. There was no additional or separate permit specifically for the PV system. The system did have to be approved by the Office of Historic Preservation. While the Office of Historic Preservation has significantly fewer regulations concerning new construction in historic neighborhoods, one that applies to both new and retrofit is the placement of a solar energy system on the house. These systems are not prohibited per se, but they are not allowed to be installed in such a way that they are visible from the street. Fortunately, in this case, because of the roof pitch and the design of the house, this was not a concern. The builder and architect had

Installation of the 6 kW PV system. The system is completely hidden from view from the right-of-way. This allowed the project to comply with historic designation regulations and ensured optimal exposure for the panels.

intended from the very beginning to place the PV System on the roof over the second floor outdoor living area. This was a two-fold victory for the builder. Placing the solar PV system in that location not only ensured that the project complied with Office of Historic Preservation regulations, but also ensured the efficacy of the system. The orientation of the lot and the design of the house dictated that the system be placed there for maximum exposure to the sun.

CVF Homes, prior to the construction of this project, had previous experience in historic neighborhoods through several retrofit projects also in the Lavaca neighborhood. The builder reported that, when compared to retrofit projects, this new construction projects was actually much simpler than retrofit projects. This was due mostly to the fact when retrofitting existing homes, there are often problems or issues the builder is not aware of until work actually begins on the project. With a new construction project, there are fewer, if any surprises during the construction process, as everything is done from the ground up. The only additional challenge faced was the longer permitting time which was due to the combination of steel and lumber for the framing of the house. Again, this longer permitting time was due to the unique characteristics of this particular project, not because of its location in a historic area. CVF Homes reported that this was an easily overcome challenge. It required several meetings with the framer and engineer during the course of the project so that all parties involved could be sure of what was required. The builder reported that for others facing a similar challenge, the key is to make sure that all parties are involved in the process as early as possible to that each knows what is expected.

The builder also made sure to mention the project to the Lavaca Neighborhood Association. While the Office of Historic Preservation does have guidelines and restrictions for solar PV installations, they do not have any clear rules about new construction projects in general. In the case of new construction, though, OHP does confer with the residents of the neighborhood to make sure they have signed off on the project. If the Lavaca Neighborhood Association had told Office of Historic Preservation they did not want the project, then they would have been able to prohibit the construction. While the Neighborhood Association does not have a legal means of prohibiting the project, they could have made it very difficult.

While there were additional costs associated with this project, they had more to do with the unique features of the lot rather than the fact it is in a historic area. Originally, the lot containing the home at 107 Leigh Street had an old garage and was part of the same lot as the adjacent property. When CVF Homes purchased the property, they decided to re-plat it into two separate lots and demolish the old garage that was there. The re-platting added an extra cost because of the associated engineering and impact fees that happen with any re-platting. San Antonio Water System and CPS Energy had to do some minor work re-routing the utilities to bring them to where the new home was to be built, but there was no cost associated with this as they were simply altering existing utility connections rather than installing new ones. San Antonio Water System did not charge impact fees or sewer connection fees for this project, again because it was an existing lot that had been subdivided into two lots, with sewer connection already in place that only needing a minor rerouting.

The greywater recycling system required a special permit, as do any such systems in the City of San Antonio, regardless of historic designation

The only other special consideration and additional permit that was necessary for this project was associated with the greywater recycling system. It required a permit for

reclaimed water and another for backflow preventer. The system installed at 107 Leigh Street takes water from the upstairs shower, upstairs sink and AC condensation line and uses that water to fill the toilets. The water recycling is not for potable water. There are also connections in place if the homeowner opts to use the greywater for landscaping purposes. This system required the plumber to pull a special permit from the City of San Antonio, but did not pose any serious challenge. This permit cost was less than $100. As per regulations, the pipes carrying the non-potable water are purple and required a backflow preventer , so that clean water will never mix with grey water.

The builder reported the only serious challenge was obtaining no-VOC primer and paints for the interior of the home. While Build San Antonio Green requirements allow for low-VOC paint, the builder chose to go further and opted for paint with no VOC's. They reported that this type of paint is somewhat difficult to find and is more expensive than low VOC paint, but he was willing to pay the extra price for the improved indoor air quality.

In summary, the builder reported very few challenges associated with building this solar powered home in a historic area. The builder made sure to meet with the Neighborhood Association so they would not raise any objections with the Office of Historic Preservation. The solar PV array was originally planned to be out of sight from the street view, so there was no challenge to its installation. The only additional fees, permitting and challenges came about because of the unique features of this particular home, namely the combination steel and wood framing, the re-platting of the original lot, and the installation of the greywater recycling system. Overall, the builder reported that it was easier to construct a new home in a historic area than the retrofit projects he had previously worked on, due mainly to the lack of surprises and hidden problems that are often uncovered in retrofit projects.

City of San Antonio Office of Historic Preservation Perspective:

The City of San Antonio Office of Historic Preservation's perspective was provided by Anna Glover, the caseworker assigned to the project at 107 Leigh Street.

OFFICE OF HISTORIC PRESERVATION san antonio

The Office of Historic Preservation is a department of the City of San Antonio that "protects the historical, cultural, architectural, and archaeological resources that make San Antonio unique."

The Office of Historic Preservation reported that while there are no clear-cut rules or regulations governing the construction of new projects in historic areas, they do evaluate them and, if approved, issue a "Certificate of Appropriateness." The Office of Historic Preservation (OHP) uses national standards when evaluating preservation and new construction in historic districts. The Secretary of the Interior Standards for Rehabilitation consist of 10 guidelines that help OHP staff and the Historic and Design Review Commission (HDRC) evaluate the appropriateness of new projects. Guidelines number nine and ten speak to new construction:

> ***9.*** *New additions, exterior alterations, or related new construction will not destroy historic materials, features, and spatial relationships that characterize the property. The new work shall be differentiated from the old and will be compatible with the historic*

materials, features, size, scale and proportion, and massing to protect the integrity of the property and its environment.

10. *New additions and adjacent or related new construction will be undertaken in a such a manner that, if removed in the future, the essential form and integrity of the historic property and its environment would be unimpaired.*

OHP staff uses these guidelines along with the FRESH Test as developed by Pratt Cassity:

- **Footprint** – new projects that have similar footprints to existing structures in the neighborhood are encouraged. Radically different footprints can dramatically change the feel of the neighborhood, or that particular part of the neighborhood. New footprints that are very large can easily dwarf existing structures and compromise the historic feel
- **Roof shape** – roof shape should be similar to other roofs in the neighborhood. A different roof shape, particularly when combined with a different footprint, can easily create a house that does not fit in with the historic homes in the neighborhood. Contrastingly, a roof on a new structure similar to existing ones can easily blend in with the neighborhood.
- **Envelope** – the outside shape of the building should match surrounding structures in size, shape, projections, and height-to-width ratio
- **Skin** – the exterior surface and cladding of the new structure should have similar physical and visual appearance to existing structures in the neighborhood. New construction projects can be uniquely styled and yet still have a skin and cladding that is harmonious with the other structures
- **Holes** – doors, windows and other openings ("voids") in the new construction project should visually match as well as follow the historic solid-to-void ratio of existing structures. For example, in a historic residential neighborhood, guidelines would not allow for a home clad entirely in glass.

See Appendix II, a presentation that the Office of Historic Preservation uses to train Commissioners in determing appropriateness of proposed designs for more information about the "FRESH Test"

These guidelines are subjective and not very prescriptive. As a result, the Office of Historic Preservation evaluates projects on a case-by-case basis to determine appropriateness of design for the historic neighborhood. In addition, while the above serves as guidelines, they are not necessarily code or regulatory, and in many cases substitutions can be made. The Office of Historic Preservation looks at the overall design of the home, and failure to meet one of the above guidelines is not necessarily cause for prohibiting the structure. For example, this home at 107 Leigh Street has a flat roof, while the other residences in the neighborhood have gabled roofs. The project was still approved because other criteria were met. The home has a similar-sized footprint to other homes in the neighborhood. While this home is two-stories and this could be a concern in some cases, Ms. Glover reported that it was not with this particular home as the home right next door is also two-stories. Had the adjacent home been one story, there could have been concern about the new structure overshadowing it or seeming out of place.

The Office of Historic Preservation uses the guidelines from the Secretary of the Interior when it comes to new construction in historic neighborhoods, but they are more a set of guidelines that set in stone rules. Most of the regulations OHP has in place govern the retrofit of existing structures. OHP also has a "repair rather than replace" standard. If at all possible, the existing structure and its components should be repaired – for example, windows can be re-glazed instead of installing new ones. If something is to be replaced, OHP requires "in kind materials" be used – materials that are as close to the original

historic materials as possible. The design aesthetic of material to be replaced should also match the original as closely as possible.

All exterior changes in historic districts are subject to OHP regulations, including certain renewable energy systems such as solar panels. They should, whenever possible, be hidden from view on the right-of-way. This can be accomplished in many different ways. In the case of this home at 107 Leigh Street, the design of the home itself allowed the system to be installed completely out of view from the street. Homeowner and builders might also try ground-mounted systems if a roof mounting will result in the system being visible. If none of these are viable options, then the approval of the system must go to the Historic and Design Review Commission. They are reviewed on a case-by-case basis.

The Office of Historic Preservation's main concerns with this project, being new construction rather than a renovation or retrofit, concerned the impact it would have on the surrounding area. Because of the "repair rather than replace" rule, if projects require demolition, even if the project is new construction, OHP is reluctant to approve the project. However, in this particular case, the lot contained two outbuildings in bad repair, one of which was a garage. The structures were determined to not be contributing to the historic district allowing for the removal of the structures. When it comes to empty lots, OHP is an enthusiastic supporter of in-fill development as it helps promote the continued viability of inner city neighborhoods and helps slow the push to develop green space in the suburbs. However, if something is present the lot, depending on the circumstances and what the structure is, they prefer to follow the "repair rather than replace" rule.

While these guidelines are general requirements for all historic areas, as is the "FRESH Test," each neighborhood has its own unique set of design criteria, based on the historic features, architecture, and materials found in that particular neighborhood. See Appendix III, the Lavaca Design Guidelines, for more detailed information about the specific regulations and requirements for the Lavaca Neighborhood.

Other concerns were related to the FRESH Test, but when the builder presented their plans OHP was happy to approve them. As mentioned previously, the height of the structure was initially a concern, but when determined that it would be a similar height as nearby structures, it became no problem. The square footage of the house (Footprint) was also a temporary concern, but the house is the same size square footage as many of the other houses in the neighborhood. Thus, in terms of its scale, it does not seem out of place by being either much larger or smaller than other structures. The materials to be used (skin) were the other primary concern, but the builder and architect opted to use similar materials to other houses and structures in the neighborhood. OHP found the design acceptable because the home uses similar materials, just in a more contemporary way. The builder was able to alleviate any possible concerns by involving OHP early on the process, submitting plans and drawings to the Design Review Committee, which is comprised of several architects, at the very beginning of the process. The Commission, after reviewing the drawings and meeting with the builder and architect, found the project to be appropriate for its site and setting.

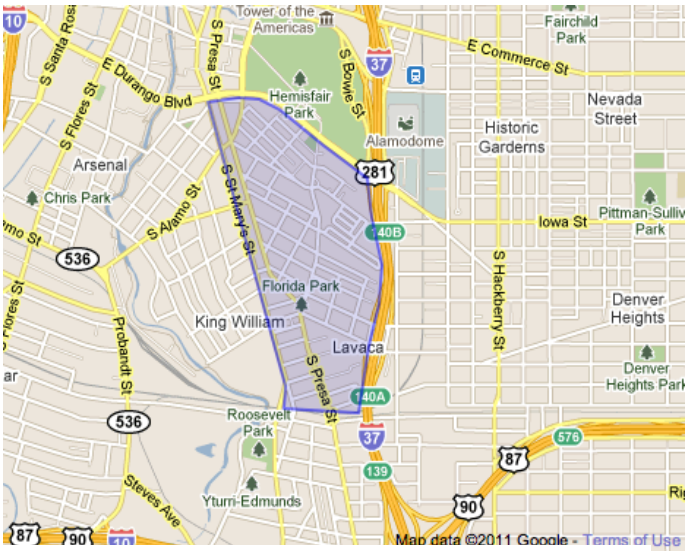
Two existing historic home in Lavaca (left) showing historic "skin" and the case study home (right) showing similar materials used in a more contemporary manner.

The Office of Historic Preservation is currently developing a set of Historic Design Guidelines that will apply to existing buildings and new construction in historic neighborhoods, and is specifically considering adding something about renewable energy to the regulations. As this is currently in development, no final decisions have yet been made. However, the rules preventing the system from being visible from the street still apply. OHP feels confident that as technology advances, it will facilitate the installation of solar energy on historic projects. Ms. Glover specifically cited technologies like building integrated photovoltaics as a technology that would be more in compliance with the FRESH test. As technologies advance and the footprint/silhouette of solar energy systems is further reduced, they are more apt to be incorporated in to the aesthetic design of the buildings and thus preserving historic character.

In summary, the Office of Historic Preservation had initial concerns over the design of this new construction project, but their concerns were alleviated by the builder and architect when presented with plans and drawings. The home was designed to not overshadow or dwarf surrounding and nearby structures, its footprint was similar in size to other homes in the neighborhood, and while the look of the home is much different, it uses materials similar in appearance and visual aesthetics to other homes in the neighborhood, but in a more contemporary fashion. OHP had very few major concerns about this project, and it proved relatively simple to receive the approval of the Office for the house at 107 Leigh Street.

Lavaca Neighborhood Association Perspective

The Lavaca Neighborhood Association was the third group that was surveyed for the purposes of this case study. We spoke with Curtis Bowers, the current President of the Neighborhood Association, about their experience with this project and with CVF Homes. The Neighborhood Association had absolutely no problem with CVF Homes' proposed project before construction began. In fact, Juan Fernandez of CVF Homes, lives in the neighborhood and has been active in the Neighborhood Association for some time. As reported by Mr. Fernandez, he



The Lavaca Neighborhood, located just south of downtown San Antonio, is the oldest existing neighborhood in the City

involved the Neighborhood Association early on in the process, to keep them informed of what his plans were and to make sure that the neighbors were accepting of the design and construction of the home at 107 Leigh Street.

As CVF Homes had already been active in the neighborhood through the purchase and renovation of several existing projects, the Neighborhood Association enthusiastically supported his efforts to build the home at 107 Leigh Street. Mr. Bowers stated that the previous renovation projects have all been very well received by the Neighborhood Association, as each renovated home completed and new family that moves into these houses strengthens and improves the neighborhood and community. The Neighborhood Association saw the home at 107 Leigh Street as a continuation of CVF Homes' efforts to revitalize the neighborhood, and thus offered no objections to the project.

As stated previously, Mr. Fernandez made sure to involve the Neighborhood Association as early on as possible during the process to keep neighbors apprised of the plans for the lot and home, and to help ensure that when the Historic Design & Review Commission asked the neighbors for their opinion of the project that they would give the go-ahead and not voice any concerns. The key factor was eliminating surprise, and making sure that, as this project could have ramifications on the feel of the neighborhood and community, that the neighborhood was understanding and above all, supportive of the efforts to build the home at 107 Leigh Street.

Conclusions and Findings

The conclusions of this case study are very encouraging. The number of obstacles and challenges present when building a new, solar powered home in an historic area proved to be significantly fewer and much easier to overcome than what was believed at the start.

CVF Homes faced a few extra challenges during the course of this project, but those were due to the unique features of the project itself. These include the framing of the home, consisting of a combination of metal and timber, and the installation of a greywater recycling system. The advanced framing simply necessitated a longer study and review process with the City of San Antonio, resulting in a permit process that took slightly longer than typical. The greywater recycling system caused the plumber to have to pull an extra permit, but that was easily overcome and cost less than $100.

The design of the structure was subject to review by the Historic Design and Review Commission, part of the City's Office of Historic Preservation, but the builder was easily able to alleviate concerns by demonstrating that the footprint, skin, and envelope of the home would be similar to existing homes in the neighborhood. Aside from minor tweaks to the original design, the home was approved "as is" by the Historic Design and Review Commission as well as by the Lavaca Neighborhood Association. While the home does have a much more contemporary design aesthetic, it uses similar materials and techniques to the exisiting homes in a more contemporary fashion. The important lesson learned is to choose an architect who is willing and capable of incorporating identical or similar features and materials of the existing structures in the area, thus making approval of said design a much higher probability.

Perhaps the biggest challenge faced by the builder was the planned solar photovoltaic system. The normal City of San Antonio permit for this solar PV system was not an obstacle. In fact, the solar energy system did not even require a separate permit; it was included in the general electrical permit required for any new construction project. The only challenge was due to the historic designation of the Lavaca neighborhood. The Office of Historic Preservation and Historic Design and Review Commission usually

prohibit the installation of solar energy systems in historic neighborhoods when the system is visible from the right-of-way. CVF Homes was fortunate that the design of the home as well as the location of the lot enabled the system to be installed in compliance with OHP regulations. Since the completion of this project, the Office of Historic Preservation has released official guidelines with regard to the installation of solar energy systems in historic areas. The guidelines offer a variety of options for the installation of solar panels. Details of each option may be found in Appendix I of this document.
In order of preference, the Office of Historic Preservation recommends:

1) **Freestanding or Detached On Site – ground mounted, arbor, trellis or other detached structure**
2) **New Construction On-Site** - a new building in a historic area
3) **Historic Accessory Structures**, such as carriage houses or garages
4) **Primary Historic Resource – the historic home itself**

Each of the options has recommended practices for minimizing the solar panels' visibility from the right-of-way. For freestanding or detached installation, the first preferred method, they should be screened either with material consistent with established historical materials in the neighborhood or appropriate vegetation. For new construction on-site, the panels should be incorporated into the initial design of the structure. View from the right of way should be minimized either through the particular roof surface on which they are installed or installation on the far edge of the roof, or, if possible, behind an architectural feature such as a chimney or parapet. If installing on a historic accessory structure, it is easier to reduce the view of the panels from the right-of-way, as carriage houses, garages and other structures are typically set back from the street and much less prominent and visible. Care should also be undertaken to install on the far side of the structure and if possible, positioning the panels behind architectural features. The primary historic resource installation guidelines are similar to the historic accessory installation guidelines, but because the panels are installed on the primary building itself, it can prove more difficult to shield the panels from view. Again, the Office of Historic Preservation recommends installing on roof surfaces not visible from the right-of-way or on the far edge of the roof. Also recommended is installing the panels behind chimneys, parpets, or dormers to reduce visibility.

For future new construction projects in historic neighborhoods, the best options for builders, in order of preference of the Office of Historic Preservation, are to build a detached structure on which to mount the solar panels and screen from view or to design the home so the solar panels are included and as unobtrusive as possible.

For retrofit projects, the preferred method of installation would be to installed the solar panels on a detached structure and screen from view of the right-of-way. Secondary options and best practices, in order of preference would be use of secondary historic accessories, such as carriage houses, garages, etc. or installation on the primary historic resource itself. In each of these last two cases, the panels should be oriented and installed in such a way as to not change the shape or slope of the roof and to minimize visibility from the right-of-way.

In all cases, regardless of the option employed, original and historic materials are not to be removed for the installation of the system. Existing architectural features such as parapets, chimneys or dormers are to be retained, and in no cases should an installation procedure irreversibly change historic features or materials.

As previously mentioned, the house examined in this case study benefitted from circumstances that allowed the builder to easily comply with recommendations from the Office of Historic Preservation with regard to the installation of solar panels, namely that the lot location was ideal for southern-facing panels. The builder and architect worked diligently to ensure that the panels were incorporated into the

initial design of the structure to ensure compliance with historic regulations. Incorporating panels into the design is a much simpler task when embarking on a new construction project. Retrofitting an existing structure with solar panels could be problematic. A lot might be oriented in such a way, or a roof constructed in a particular manner, that the only way to achieve optimum exposure for the panels is to have them viewable from the right-of-way. Another option is using building-integrated photovoltaics, or other non-traditional solar technologies. However, this could also prove difficult in historic areas, as the recommendations state that if solar shingles, laminates, or glazing are used, they are not to replace any existing historical materials. While these alternative solar technologies could be attractive in other areas, it could prove difficult to install in historic areas with the additional regulations concerning replacement or irreversible change to historic materials and features.

Another crucial factor relating to the solar energy system is the size of the system itself. A smaller system would make it easier to comply with the regulations in place for historic areas, as fewer panels are necessary and thus, easier to install in a less-visible area of the home. Best practices for reducing the size of the solar energy system call for making the home as efficient as possible first, and then sizing a solar energy system appropriate to the home. In the case of the home examined for this case study, it was certified through Build San Antonio Green's Level 3 Solar Home program, the highest performing program in the Build San Antonio Green family of programs. To achieve certification at this level, the home was required to be at least 50% more efficient than San Antonio City Code calls for before the solar energy system is factored in. Because this home met these increased efficiency standards, it only required a 6 kW system to be near net-zero. This is in stark contrast to the average residential solar installation in San Antonio. These are primarily installed on existing homes, average approximately 5 kW per system, and account for approximately 40% of expected energy use. If CVF Homes had opted to build a home to code-minimum standards, or even 15% or 30% above code-minimum, to make the home near net-zero energy would have required a significantly larger solar energy system. A larger solar energy system would have been more difficult to incorporate into the design of the home and thus might not have obtained approval from the Office of Historic Preservation. If it failed to achieve approval, then a smaller system, hidden from view, could conceivably have been installed, but the home would be much further from achieving a near net-zero energy status.

For retrofit projects in historic areas, the same logic applies – increase the efficiency of the home as much as possible and then add the solar energy system. Again, this allows for greater flexibility in installation as the system required will be much smaller and easier to shield from view of the right-of-way. In addition, the homeowner will enjoy a much better return on investment through energy efficiency measures than they would if they had opted for a solar energy installation first. It is true that solar energy is very popular, and many homeowners believe that is their best option for reducing utility bills, but in the case of existing homes, the best option in terms of energy saved per dollar invested is to tighten the building envelope. We would recommend that the homeowner hire a HERS Rater to obtain a detailed examination and report as to the status of their home. The HERS Rater's report provides specific information about specific improvements that should be made, as well as how much of an improvement can be expected from each. The homeowner thus has a scientifically-based report on which to base improvement decisions. This is beneficial because in most cases, the areas that can cause the greatest increase in efficiency are not subject to regulations from the Office of Historic Preservation. OHP's regulations concern only architectural and other exterior features. Anything done to the inside of home, whether it be air-sealing, added insulation, duct repair or replacement, or other efficiency measures does not require approval. If work is to be done to windows, approval must be obtained from OHP. Usually windows are not allowed to be replaced, as they represent a significant aspect of the historical nature of the home, but window repair is allowed with approval. Again, the HERS Rater's

report is a valuable tool, as the cost of repairing windows compared to the increased efficiency may not prove feasible, particularly when compared to other recommended improvements. With a repaired, more energy efficient home, the homeowner can then consider installation of a solar energy system and enjoy a smaller system that is easier to install while complying with historic regulations.

In case where, for whatever reason or reasons it is not feasible to fully comply with the Office of Historic Preservation's recommended practices, the best option is to work with the Office of Historic Preservation to determine a mutually agreeable compromise. The Office of Historic Preservation determines the eligibility of systems that are visible on a case-by-case basis, and there are no flat-out refusals of a "Certificate of Appropriateness" based on this. The important factor, as with the Neighborhood Association, is to foster a good working relationship with the Office of Historic Preservation as early in the process as possible, and have a willingness to compromise and work with them to reach a mutually agreeable arrangement.

The results of this case study are very encouraging. They demonstrate that with the correct design and involvement of all interested parties, a solar energy system can be installed on a project in a historic-designated area with little to no extra work or permitting required for the project. This study should serve as an example to other builders and solar contractors as best practices should they decide to embark on a similar project in an historic area. By utilizing the lessons learned, there should be very few, if any, major obstacles to increasing the number of solar energy installations in older neighborhoods that are subject to the Office of Historic Preservation's regulations.