



U.S. DEPARTMENT OF ENERGY
SOLAR DECATHLON



SOLAR TEXAS

Texas A&M University

Solar Texas

Project Report

March 28, 2023

Project Narrative

Solar Texas | Texas A&M University (TAMU)



Figure 1: Solar Texas bird's eye view of the solar house (Rendering by Jaechang Ko)

Public Project Summary

SOLAR TEXAS is an interdisciplinary team of students and faculty from all of the Departments in the College of Architecture at Texas A&M in partnership with the Brazos County non-profit Habitat for Humanity that brings resources to the working poor, provides hands-on, interprofessional experiential learning for the students, and skill development to the workers. The TAMU goal is to design/build a safe, attainable, high-performance, carbon-neutral, net-zero, energy-generating workforce house while fostering community development, lifelong learning, health, wellness, and financial stability for "economically vulnerable" classes that break their cycle of poverty and amplifies the quality of life, health, and well-being.

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Design Philosophy of House

With the mounting threats from a changing climate, there is a need to build affordable homes that are also equipped for passive survivability. The strategy of the Solar Texas team has been to address the ten categories of the Solar Decathlon competition while also incorporating twelve elements that can enhance passive survivability:

- 1) Solar Texas
- 2) Solar Integration
- 3) Rainwater Harvesting
- 4) Affordable + Attainable housing
- 5) Butterfly Roof
- 6) Carbon Footprint Reduction
- 7) Passive Survivability
- 8) Drought Tolerant Landscaping
- 9) Aging-in-Place
- 10) Texas Vernacular
- 11) Circadian Rhythms
- 12) User Experience

These twelve categories are described in detail throughout our submission. We acknowledge that while the above twelve elements (inspired by Texas A&M's 12th-man rallying cry) can often be attained at a relatively high first cost, the challenge is to realize them at a price point affordable to households earning a median income. Working with Habitat for Humanity to build homes for underserved communities has spotlighted the complexity of the challenge. The intensity of the Solar Decathlon competition has revealed to participants that, rather than a "one-off" effort, the Solar Texas team needs to engage in long-term continuous improvement to incorporate innovative design, equipment, and material strategies to make passive survivability a realistic possibility for all.

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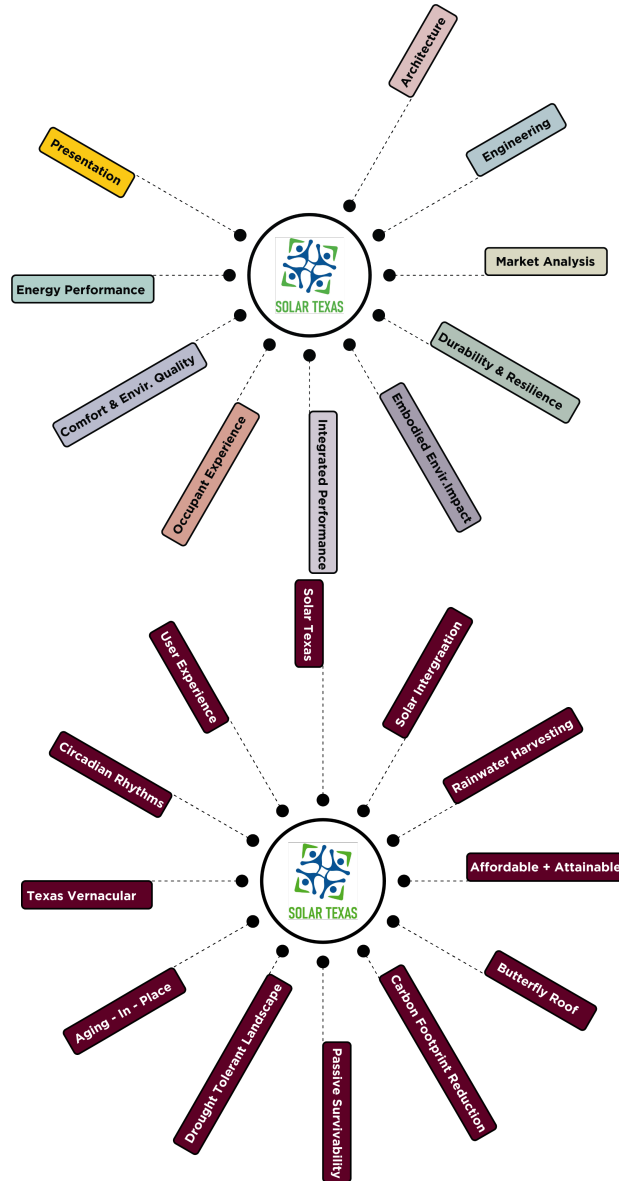


Figure 2: Solar Texas presentation and twelve categories of passive survivability

Short Summary of the Team House

The lack of affordable housing is one of our nation's most pressing crises. The National Low-Income Housing Coalition [<https://nlihc.org/news/nlihc-released-today-gap-shortage-affordable-homes>] reports that the shortage of affordable homes (for rent or purchase) can cause low-income families to become severely cost-burdened, spending more than half of their incomes on housing at the expense of other necessities such as healthy food and health care, and putting themselves at risk of unstable housing situations such as eviction. This instability undermines their efforts to educate their children, maintain stable employment, and build wealth. Solving this requires a multi-pronged approach that disrupts current design, supply, delivery, and policy systems, breaks down silos within the design, social, and engineering sciences, and leads to research and practice resulting in sustainable and equitable development.

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Texas A&M University, the School of Architecture (SOA), and the College of Engineering (COE) - Architectural Engineering (AREN) have unique positioning to address affordable housing design, evaluation, testing, and fabrication. The SOA faculty (comprising three departments: Architecture, Construction Science, and Landscape Architecture and Urban Planning) and COE AREN faculty from Multidisciplinary Engineering are leading experts in their fields, which will serve as the foundation of emerging scientific and creative design solutions that are economical, energy-efficient, resilient, and architecturally attractive. The courses taught by these faculty enable hands-on, project-based educational opportunities that narrow the gap between the classroom and the profession and blend new sustainable concepts, technologies, and aesthetics.

The SOA and COE each have a range of research centers and institutes that enable faculty collaboration and applied real-world research to facilitate dialogue. In addition, many of these centers include scholars and researchers from other colleges, thus expanding the sphere of influence and impact of this shared common goal. Many of SOA's and COE's former students are in leadership positions extending collaborative opportunities further by facilitating mass customization, building optimization, and hybrid construction techniques. When considering the larger scope of Texas A&M University, the Mays School of Business and the Bush School of Government and Public Service are available for additional partnership areas, including Predictive Financial Modeling and Public Policy. These programs can further pair with other Texas A&M University System programs and across the Aggie Network to tackle these issues and achieve success.

Solar Texas is a team comprising TAMU faculty and students from the Department of Architecture, the Department of Construction Science, and the Department of Architectural Engineering in partnership with the Brazos County (TX) Chapter of Habitat for Humanity. The *Solar Texas* team developed a Life Cycle Analysis (LCA) of the area's most recently constructed Habitat for Humanity projects. It used this data as a baseline for comparison. The team aims to deliver a scalable prototype for the organization to offer the highest possible quality product optimized for energy efficiency and resource sustainability.

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Construction Site Details

Initial site selection of a single residential lot in Bryan/College Station Habitat for Humanity's Wyatt Place Subdivision began in January 2022. The original master plan and construction drawings for Wyatt Place Subdivision were approved by the City of College Station on February 04, 2022. Unfortunately, the engineering cost estimates for infrastructure development in March 2022 were impractical for B/CS Habitat to continue with the current subdivision design. With the initial construction site unavailable due to the time required to redesign the subdivision and generate jurisdictional approval, the opportunity to research the feasibility of a new construction site began.

B/CS Habitat for Humanity was able to offer up four properties for evaluation. Research started immediately to identify which site held the optimum conditions to maximize the project's potential. Two out of the four sites did not have an ideal pathway for sunlight due to the orientation of the site and the surrounding environment. Another site had harmful air quality and potential health issues from a nearby concrete manufacturing facility. One site out of the four earned the ability to be the new construction site for the project - 1613 Conlee Street, Bryan, TX, in Brazos County. The site area is 4,500 square feet and is located on lot 9 in the Conlee Addition No. 3 Subdivision. This site introduced unique challenges due to the dilapidated structure that needed demolishing. Additionally, the double right-of-way easements located on the front and rear property boundaries presented challenging obstacles. The initial survey showed a 7.5' side and rear build lines, which were later determined to be 5' side build lines and a 25' rear build line after the initial City of Bryan Planning & Development permit reviews. The project's floor plan had to be redesigned once again to fit the new construction site's buildable area. A total buildable footprint of 40' x 40' was one of the many constraints the City of Bryan placed. Interestingly enough, the City of Bryan is using this project to formulate their future inspection methods and protocols for solar connectivity in Residential New Construction.

Local Jurisdiction: Since 01 January 2022, the City of Bryan adopted and enforced the 2021 International Code Council's guidelines. This includes Fire Code, Building Code, Existing Building Code, Residential Code, Mechanical Code, Plumbing Code, and Fuel Gas Code. In addition to these codes, the city also enforces the 2020 National Electrical Code and the 2018 International Energy Conservation Code.

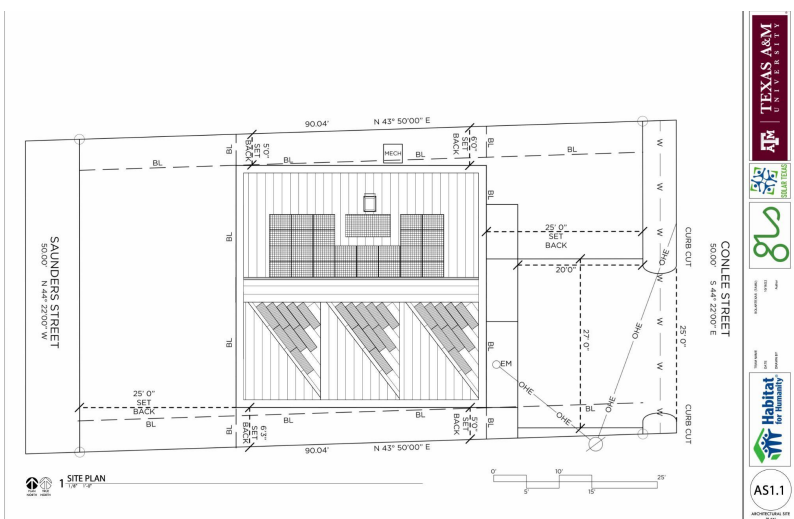


Figure 2: Solar Texas site plan at 1613 Conlee Drive, Bryan, TX

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Construction Partners

Beginning in January of 2022 Texas Solar began networking with local non-profits that could potentially fit the model of a sustained partnership between the Texas A&M solar build team. Ultimately, the decision was made to collaborate with Bryan/College Station Habitat for Humanity. Their pipeline network of partner families, established business model, and community presence was an optimal fit.

A cross-section of local, state, and national partnerships were fostered to offset the cost of the initial construction. Early stages of development had the majority of labor being done by volunteers through B/CS Habitat for Humanity. Unfortunately, due to the site limitations early in the project, the decision was made to consult with various contractors to streamline the construction process. When the site was finally selected for 1613 Conlee Street, B/CS Habitat for Humanity staff submitted the building permits and reviewed the comments with the City of Bryan Planning and Development staff in October of 2022. The back and forth between the City of Bryan and Habitat for Humanity took over 45 days to complete. Working with the Department of Public Works to upgrade the existing sewer and water infrastructure to accommodate 3 new dwellings prevented work from commencing earlier. B/CS Habitat for Humanity would assist in coordinating the materials and staging while the contractors completed their work. Two contractors would be enlisted to share quotes and help steer the on-site project management. Brazos Construction Services submitted a bid in early September 2022 that was considerably higher than budgeted and ultimately was denied. In December 2022 another contractor from Tomball, Texas submitted a bid slightly higher than the expected budget costs, but within acceptable margins due to time constraints for deliverables. T&V Custom Homes was selected as the primary on-site construction contractor. T&V began preliminary site preparations while the Texas Solar team and B/CS Habitat for Humanity began soliciting Gift-In-Kind and monetary donations from critical vendors and stakeholders. To date the project has received numerous donations in materials from various suppliers from across the nation.

National partners such as SunPower, Red River Brick, and LP Corp have donated a range of materials to B/CS Habitat for Humanity for the purposes of this project. We are constantly enlisting other project partners to ensure the cost range falls within an acceptable range for B/CS Habitat for Humanity. Recently, team leaders met with an industry pioneer in the large-scale construction and prefabrication of total home solutions. This includes foundations, complete exterior envelope systems, and interior finishings. GroundFORCE is located in Bryan, Texas and as a private company, has shown great promise as a project partner.

Additional partnerships will be cultivated over the coming months locally through the Greater Brazos Valley Builders Association in an effort to enlist local trades in the completion of the home. The extraordinary fabric of community within Bryan/College Station is tightknit and falls directly inline with the core values of Texas A&M University. Values such as Excellence and Selfless Service will be central to the completion of this project. =

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Summary of public exhibit and community exhibition strategies planned

The Solar Texas team has a proactive communication presence complete with websites, flyers, and door-to-door meetings with neighborhood residents. These items are showcased on other files requested in this submission.

While a public exhibition of the physical project was originally scheduled for this April, challenges associated with reducing the final overall price to a point affordable for a Habitat for Humanity family made it impossible to physically construct the home in time for this phase of the competition. However, the Solar Texas team has been in communication with Solar Decathlon organizers about proactive strategies we are exploring with donors and commercial entities to make the Solar Texas home a reality in time for the April 2024 NREL exhibition.

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Future plans for the house explaining where it will go after the competition

When completed the Texas Solar project house will be used exclusively for the benefit of Bryan/College Station Habitat for Humanity partner families. B/CS Habitat for Humanity recommended that this house be considered “Transitional” housing for the many partner families in their Home Buyer Services Program pipeline. Meaning, no one family will use this as a permanent address. However, continual year-round usage data will still be collected. As future Habitat homeowner houses are being built, partner families who are in need of housing will be able to take advantage of the energy-efficient features and learned practices while occupying this transitional housing. The remarkable characteristics of this house will allow multiple future Habitat homeowners to think proactively when using energy resources. At the same time, offering a truly unique learning experience and home environment for numerous families as opposed to serving just one family. The impact of shared learning across different families will shape the fabric of future neighborhoods they will occupy. Another distinctive aspect of this project is the diverse data collection across different family configurations. Instead of gathering data on just one family unit, this house will allow researchers to adjust data acquisition variables to quantify household size usage. Being able to alter the variables based on needs allows the researchers to modify expectations and create new hypotheses based on different configurations and expected energy usage. This noteworthy characteristic adds depth to the Texas Solar project, generating positive and critical thinking across a broad spectrum of stakeholders.

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Final details for the team's Community Exhibition (dates, times, location, parking, etc.)

The details and tentative* dates for the community exhibition are:

Location: 1613 Conlee Street, Bryan, TX 77803

Dates: April 2024

Times: To be determined

Parking: Street parking - highlighted details

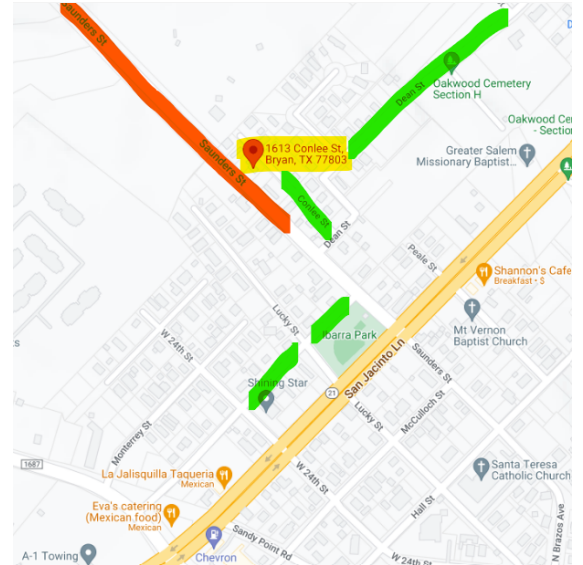
Green Areas

less vehicle activity but limited availability

Orange Areas

moderate/heavy vehicle activity

additional parking



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Summary of Online and Public Exhibition Success

As mentioned previously, while a public exhibition of the physical project was originally scheduled for this April, challenges associated with reducing the final overall price to a point affordable for a Habitat for Humanity family made it impossible to physically construct the home in time for this phase of the competition. However, the Solar Texas team has been in communication with Solar Decathlon organizers about proactive strategies we are exploring with donors and commercial entities to make the Solar Texas home a reality in time for the April 2024 NREL exhibition. We look forward to scheduling tours for local schools as well as for the general public. We will also collect impact statistics related to tours and media engagements at that time.