U.S. DEPARTMENT OF ENERGY
SOLAR DECATHLON

2023 Build Challenge
Explanation of Intent

March 2021

This document is intended to convey the expected approach and structure for the U.S. Department of Energy Solar Decathlon® 2023 Build Challenge to enable interested collegiate institutions to plan, but all elements are subject to refinement. The complete 2023 Build Challenge Rules are expected to be released by July 2021.

If you have questions along the way or to express your interest in the 2023 Build Challenge, please reach out to the organizers directly at sdbuild@nrel.gov.

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Two Challenges, Ten Contests

Overall, the Solar Decathlon gives teams the option to participate in either the ***Design Challenge*** or the ***Build Challenge***. Teams entering the Build Challenge design *and build* a residential unit in their local community. All teams are evaluated across 10 Contests. Just like athletic decathlons, teams must perform well across all 10 Contests to be victorious. Figure 1 provides a graphic depiction of the various competition options. For more information on the competition as a whole, read the Solar Decathlon Competition Guide.

Figure 1. Structure of the Solar Decathlon

Solar Decathlon Build Challenge

The Solar Decathlon 2023 Build Challenge will be a collegiate competition, comprising 10 Contests, that challenges student teams to design and build highly efficient and innovative buildings powered by renewable energy.

Understand the Planned Structure

Participating teams will be tasked with designing and building innovative building solutions. Participating students get hands-on experience and unique training that prepares them to enter the clean energy workforce and influence others to pursue energy efficiency and renewable energy technologies. Faculty and students have the option to showcase their Solar Decathlon-related research before peers.

The competition is expected to reward projects that pursue thoughtful and influential innovation, and teams are expected to demonstrate how the techniques, products, and solutions integrated into their competition entries can be scaled to significantly impact the buildings market in their community and beyond.

Successful teams are multidisciplinary, often including students with majors including construction management, engineering, architecture, interior design, communications, and business. Students are provided the opportunity to learn not only about building science but also

about financial analysis, teamwork, oral and visual presentation, and other skills key to ensuring the viability of building projects in the competition and beyond.

The Build Challenge tasks students to prepare creative solutions for real-world issues in the building industry over a 2-year period. Qualifying teams design and build complete, functional houses that are displayed and measured locally in their communities.

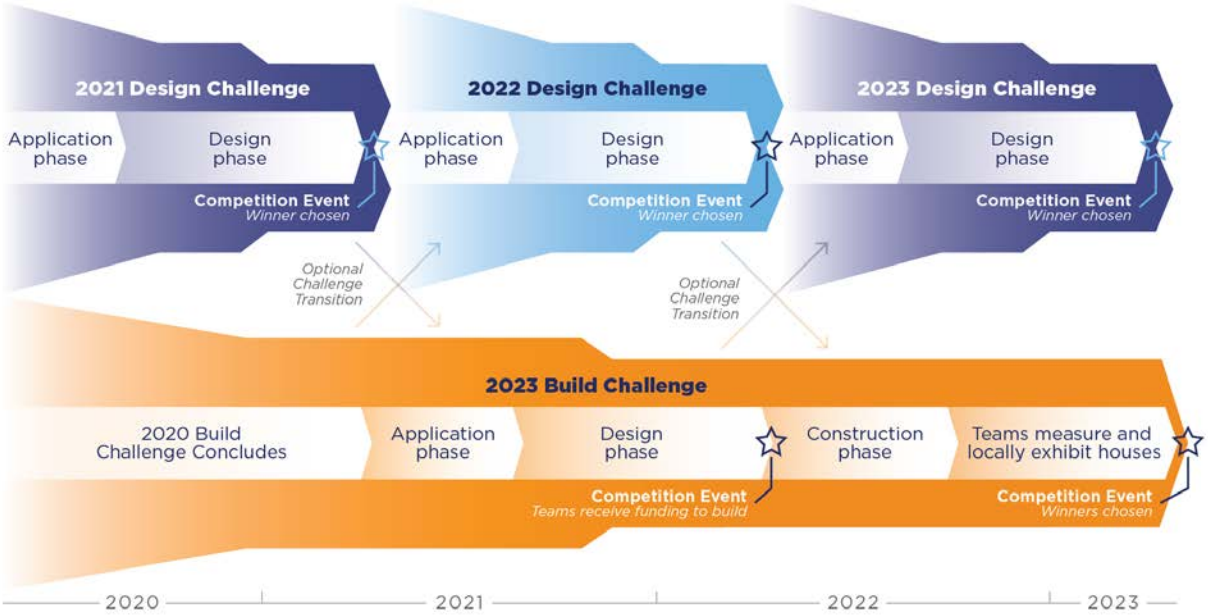

Figure 2. Timeline for the Solar Decathlon

During the Solar Decathlon 2022 Competition Event (to be held April 2022 at the National Renewable Energy Laboratory [NREL] in Golden, Colorado), all competing 2023 Build Challenge teams will present initial residential designs to their peers and panels of expert jurors for feedback. Students will also meet with event organizers, learn from presentations by thought leaders and collegiate peers, compare team projects and engage with buildings-related organizations to learn about energy careers. Up to 20 qualified Build Challenge teams will receive initial prize funding and an approval-to-proceed to the construction phase of the competition.

During the 2022–23 academic year, the houses will be constructed on a permanent site, often with either a long-term resident or research/public-facing use identified prior to construction. While all construction need not be completed by students, as a student-led competition, reasonable access to the build site is an important component of team success. At the 2023 Solar Decathlon Competition Event (to be held April 2023 at NREL in Golden, Colorado), Build Challenge teams will deliver presentations on their completed homes to industry leaders, where winners will be determined.

Through local events at each competition house and national communications, teams will be recognized publicly. The competition and winners will be published on the Solar Decathlon website and promoted through a variety of media outreach efforts, which provide participants and their collegiate institutions an opportunity for national exposure. Collegiate institutions that

participate in the Build Challenge are recognized as leaders in cultivating career-ready, professionals with cutting-edge skills. Industry partners that collaborate with teams gain national and local recognition and have the opportunity to interact with knowledgeable future design and construction professionals.

Summary of Important Dates

Please note the following expected key milestones for the 2023 Build Challenge to help plan for successful collegiate participation:

- **October 2020:** A summary document (this document) indicating the expected approach for the 2023 Build Challenge Rules is released. Teams can begin developing institutional support, proposing coursework integration, and identifying industry partners.
- **Early 2021:** A formal invitation will be extended to collegiate institutions who are considering applying for the 2023 Build Challenge to attend the 2021 Solar Decathlon Competition Event to observe the 2020 Build Challenge team presentations and attend an informational session.
- **April 15–18, 2021:** Collegiate institutions considering applying for the 2023 Build Challenge are invited to attend the Competition Event. 2021 Design Challenge teams in relevant residential Divisions are encouraged to continue to the 2023 Build Challenge.
- **June 29, 2021:** Initial 2023 Build Challenge Rules are released; the team application is available on the Solar Decathlon website. Teams can begin work as early as the release of the rules.
    - After a team completes its application, the team is provided access to Build Challenge communications and resources, including Building Science Training, topical webinars, and energy modeling software. The Project Site is an online forum for participating students to receive timely information from organizers and access necessary resources.
- **October 19, 2021, 5 p.m. Eastern Daylight Time (EDT):** Deadline by which all teams must submit their team application online.
    - The application site can be accessed from the Solar Decathlon website.
    - Each team pays a nonrefundable $100 fee, identifies a Faculty Lead and a Student Team Lead and provides the name, email, and phone number for each of those individuals, and submits a preliminary roster of student team members.
        - Within 21 days, entries are evaluated against criteria indicated in the Build Challenge Proposal requirements. Based on the Build Challenge Proposal evaluation, all teams who complete the minimum stated requirements will be accepted.

    - In addition to providing the required information in the application, teams are required to submit a Build Challenge Proposal. The requirements for the Build Challenge Proposal are available on the Solar Decathlon website. Teams are provided feedback on their Build Challenge Proposal regarding their project compliance and design.
    - If a team is not accepted into the Build Challenge, the team may still participate in the Design Challenge by informing the organizers of its intent to continue and its intended Design Challenge Division within 14 days of notification of nonacceptance. A collegiate institution may only have one team per Division in the Design Challenge. If the institution already has one or more teams participating in the Design Challenge, the non-selected Build Challenge team must choose an available Division or merge with an existing team. An additional $100 registration fee will not be collected for this transference of team application to the Design Challenge.
- **November 30, 2021, 5 p.m. Eastern Standard Time (EST):** Deadline by which all teams must complete the Project Introduction, including Schematic Design.
    - The Project Introduction must be submitted via the file submission link posted to the Project Site.
- **February 15, 2022, 5 p.m. EST:** Deadline by which all teams must complete the Project Management Plan deliverable, including project construction partner and site.
    - The Project Management Plan deliverable must be submitted via the file submission link posted to the Project Site.
- **March 29, 2022, 5 p.m. EDT:** Deadline by which teams must submit the Construction Documentation deliverable.
    - The Construction Documentation deliverable must be submitted via the file submission link posted to the Project Site.
- **April 12, 2022, 5 p.m. EDT:** Deadline by which teams must submit their Design Presentation deliverable, including presentation files and optional posters. Presentations will not be accepted after this date.
- **April 22–24, 2022:** 2023 Build Challenge teams attend 2022 Solar Decathlon Competition Event and present to industry leaders who evaluate each team's Construction Documentation deliverable and Design Presentation deliverable to determine which teams will receive prize funding from DOE. Up to 20 teams may receive DOE prize funding. Additional teams may also receive an Approval to Proceed to the next phase, but not receive any prize funding from DOE. The funding distribution and process for evaluation of team progress for determining an Approval to Proceed will be documented in the Approval-to-Proceed Procedures, which are available in the Build Challenge Prize Award Summary document on the Solar Decathlon website.
- **July 12, 2022:** An updated 2023 Build Challenge Rules document, complemented by the overall Solar Decathlon Competition Guide, is released. Minimal revisions expected, primarily focused on clarifying intent or adding definition to dates or schedules.

- **July 29, 2022:** This is the deadline by which teams must submit their Permit Documentation deliverable, including an updated project management plan, construction drawings, and construction specifications.
- **October 18, 2022, 5 p.m. EDT:** Deadline by which teams must submit their Construction Progress deliverable, including final construction documentation, construction photography, and an updated project management report.
- **January 30, 2023:** Updated Build Challenge Rules are released. Minimal revisions expected, primarily focused on clarifying intent or adding definition to dates or schedules.
- **February 14, 2023, 5 p.m. EST:** Deadline by which teams must complete construction.
    - Teams must have: (1) received a Certificate of Occupancy from their local Authority Having Jurisdiction, (2) installed all Organizer Instrumentation Equipment, and (3) demonstrated an accessible tour route through their house to organizers.
    - Within 21 days, entries are evaluated by industry leaders to determine which 20 teams will receive Approval to Compete. The funding distribution and process for evaluation of team progress for determining an Approval to Compete is documented in the Approval-to-Compete Procedures, which are available in the Build Challenge Prize Award Summary document on the Solar Decathlon website.
- **February 17–March 17, 2023:** This is the targeted period for Measured Contest Activities. All homes are to be evaluated independently of each other.
- **March 28, 2023, 5 p.m. EST:** Deadline by which teams must submit Project Story deliverable, including Jury Documentation, As-Built Documentation, House Photography and Videography, and summary of public exhibit success and ongoing social media engagement by this deadline.
    - The Project Story deliverable must be submitted via the file submission link posted to the Project Site.
- **February 17–April 14, 2023:** Targeted Period during which all competing teams exhibit their as-built houses to their local communities, offering tours of the house and hosting educational activities.
- **April 19, 2023, 5 p.m. EDT:** Deadline by which teams must submit their Final Presentation deliverable, including presentation files and optional posters. Presentations will not be accepted after this date.
- **April 21–24, 2023:** Solar Decathlon Competition Event on the NREL main campus in Golden, Colorado.
    - All teams will present to juries at Competition Event
    - All teams will receive scores calculated as part of the Measured Contest Activities
    - All competing teams will earn points according to the Build Challenge Rules, and the team with the most points overall will win

    - All competing teams will be provided an opportunity to present their projects to Design Challenge competitors, industry professionals, and related guests.

- **May 10, 2023, 5 p.m. EDT:** Deadline by which teams must submit their Final Report deliverable, including a summary of successes and challenges, to the organizers.
    - The Final Report deliverable must be submitted via the file submission link posted to the Project Site.

1 Build Challenge Expected Structure and Activities

The Solar Decathlon Build Challenge competition cycle involves approximately two academic years of continuous participation, often with students who are involved for only a portion of the cycle. It is important that each competing team has consistent faculty and student leadership who can keep the project moving forward, ultimately concluding with the successful construction, operation, and presentation of a fully functional, zero energy house. The following elements are meant to convey the basic activities required for success in the 2023 Build Challenge.

1.1 Task Overview

- ☐ Read this Explanation of Intent document and start developing institutional and industry support for your project.
- ☐ Review the past team entries on the Solar Decathlon website to inform efforts.
- ☐ Submit a team application and register team members on the Project Site, including the Build Challenge Proposal using the instructions in the Project Site.
- ☐ Receive notification of acceptance as a participant in the Build Challenge.
- ☐ Ensure all team members have access to the Project Site where competition updates will be posted regularly.
- ☐ Ensure all student team members complete the Building Science Training course online or receive a confirmation from the team's Faculty Lead that equivalent training is provided as part of the student's curriculum.
- ☐ Study the resources provided by the organizers on the Project Site.
- ☐ Attend optional webinars for technical, design, and competition guidance.
- ☐ Attend monthly all-team conference calls for project updates and important information from the organizers about Build Challenge requirements.
- ☐ Design and document a house project compliant with the requirements listed.
- ☐ Secure funds necessary from the final owner of the house, sponsors, and/or collegiate institution to enable construction of house and in-person student and faculty participation in Competition events.
- ☐ Build a house compliant with the requirements listed.
- ☐ Exhibit the house, compliant with the requirements listed, to public and professional visitors in Spring 2023.
- ☐ Operate the house and allow measurements to be collected, in accordance with the Rules, in Spring 2023.
- ☐ Present the project to juries at the Competition Event at NREL in Golden, Colorado, in April 2023.
- ☐ Submit all materials by the deadlines. Note that all deadlines are 5 p.m. Eastern Time (EDT from March to November each year, and EST from November to March).
- ☐ Submit questions to SDbuild@nrel.gov.

1.2 Developing a Team

Each team must be associated with at least one collegiate institution and include a Faculty Lead. The competition is open to all collegiate and degree-issuing institutions, including technical and community colleges.

- International institutions are welcome to participate.
- Each team often has more than 60 students participate (though not necessarily simultaneously), whether supporting design, fundraising, marketing, construction, or presentation, with several students designated as student team leaders.
- Teams are encouraged to be multidisciplinary.
- Multiple collegiate institutions may combine to form a team.
- A collegiate institution may submit only one team application to the Build Challenge (see Section 3, Project Requirements).
- The team application costs $100 per team and is nonrefundable.
- If a collegiate institution has multiple teams competing in the Solar Decathlon, across the Design and Build Challenges, each team must have distinct designs and must have unique team leads and team members.
- Team members who are not a U.S. citizens and would like to participate in person at the Competition Event activities held on the NREL campus, must submit a Foreign National Data Card. Additional information and requirements are provided upon registering on the Project Site. These requirements are subject to change, and NREL will follow the latest federal guidance.

1.3 Student Decathlete Qualifications

Great teams are cross-functional. Student team members can be from any discipline and any level of collegiate schooling. Past teams have included students who majored in fields such as architecture, engineering, building science, construction management, interior design, marketing, management, and landscape architecture. Often, students who receive some benefit for team participation—whether course credit, internship hours, a stipend, or a scholarship—are able to achieve greater success. Each student must be pursuing a degree and enrolled in at least one class at a participating collegiate institution or have graduated within 12 months of April 1, 2023.

1.4 Faculty Lead Role

The Faculty Lead, along with Student Team Leads, is responsible for communicating competition details from the organizers to the team members. A team may have more than one Faculty Advisor; however, one Faculty Lead must be designated to serve as a primary contact and oversee the team. Among other responsibilities, the Faculty Lead will maintain responsibility for verifying that participating students complete the Building Science Training or equivalent curriculum, ensure safety for all people participating in construction, and help guide participation throughout the Community Exhibition and Competition Event, including overall project budgets. The Faculty Lead is encouraged to closely engage with the students on the project. The Faculty Lead provides support in many areas, including the following:

- Ensure familiarity with the Competition Guide and Challenge-specific guidance, as appropriate.
- Make sure all student team members complete the Building Science Training. The Faculty Lead must ensure the team meets this requirement or indicate that building science is part of the core curriculum. Also, by understanding the strengths of the students, the Faculty Lead can encourage the students to view additional webinars and access training materials that are most relevant to the team.
- Guarantee the necessary information is provided to team members who will be on-site at the competition events. The Faculty Lead is expected to attend the Competition Event.
- Ensure the team successfully builds the house as designed and exhibits to the public.

1.5 Project Partners

Project partners act as a specific client for a competing team, often helping by providing funding for the long-term use of the project, development of project constraints, and constructive reviews during the design process. Design partners work directly with a student team to develop a zero energy design for a new or existing building in their portfolio. Through the design and construction of their houses, project partners receive a zero energy design and support throughout construction. The structure of the relationship between the organizations is entirely negotiable between the competing team and the partner, including the exchange of funds for design and construction activity.

1.6 Industry Partners

Industry partnerships are encouraged to provide a market-ready perspective for proposed solutions, to support construction, and to enable the long-term use of the house.

For the design and construction of their houses, teams are encouraged to engage with industry professionals such as builders, architects, city officials, contractors, developers, energy auditors, engineers, or tradespeople in areas such as site development, codes, construction, building materials, mechanical systems, lighting systems, financing, and sales. These partners can help inform the students' decision-making processes and review the project. It is expected that industry partners can provide support, donations, and guidance to students while the students remain responsible for design, detailing, documentation, construction, operation, and competition activities.

1.7 Build Challenge Projects

The Solar Decathlon Build Challenge tasks each team to select and define a specific location, building lot or site, and neighborhood characteristics as context for the building design and its relationship to surrounding structures and the community. Each team is also expected to build their house design permanently in their own community. The organizers accept all qualified applicants for the design phase of the competition and, based on the review criteria, will choose up to 20 teams to receive Prize Funding and an Approval to Proceed to the construction phase of the competition.

The Solar Decathlon Build Challenge is meant to provide flexibility to collegiate institutions to compete in a way that resonates with their goals and fits within their cost, schedule, and technical constraints.

Maximizing energy performance of the designed house is critical to the success of the Solar Decathlon Build Challenge. Energy efficiency decisions significantly impact virtually all design decisions and submissions associated with the project. Teams will be tasked to build one dwelling unit, as defined by the 2018 International Energy Conservation Code, as a single unit that provides complete independent living facilities for one or more people, including permanent provisions for living, sleeping, eating, cooking, and sanitation. Total area compliance should be verified using Square Footage—Method for Calculating: ANSI Z765-2003 (R2013), which states that the finished area is the sum of the finished and conditioned areas measured at the floor level to the exterior finished surface of the outside walls. While teams may build more than one unit, only one unit will be measured by organizers and evaluated as part of the competition.

Renewable energy must be evaluated and integrated into the project and built house. Each design should respond to a unique, team-specified target market that would benefit from collegiate institution innovation and engagement.

Teams shall design and build an energy-positive house in their region that can be effectively exhibited and operated in spring 2023. The design should respond to a unique, team-specified target market that would benefit from collegiate institution innovation and engagement. For example, target markets could include, but are not limited to, improved production housing, custom housing, housing for aging in place, low-income housing, existing-home renovation, attached housing, or disaster-resilient housing.

Teams are required to exhibit and operate their house in their region in spring 2023. Each dwelling must be between 400 ft^2 and 3,000 ft^2. The house must have separate entry and exit doors with an accessible route through the house for tour groups. Not all levels must be accessible, but the visitor should have a comprehensive and compelling tour experience. The team must integrate into the design or otherwise provide ADA-accessible ramps to enable the public to tour the house while on exhibit. The organizers will have a third-party inspector verify the ADA tour route through each house prior to providing an approval to compete, though teams may use prize funding awarded to the team for this purpose, if desired.

1.8 Build Challenge Expectations

The Build Challenge provides a rich experience for students and on-site participants through networking opportunities, building a house, and attending other team and professional presentations. All students benefit from participation, regardless of event attended or role played. Students can benefit supporting design, project management, construction, or presentation. Teams often partner with industry to guide and support both their design and construction.

Figure 3. Timeline for the Solar Decathlon

Application and Proposal

Teams interested in participating in the Build Challenge are required to complete a team application, including a Build Challenge Proposal. All teams that successfully complete the application will be accepted into the design phase of the competition.

Design Activities

Prior to acceptance into the Build Challenge, each team is expected to begin work on its design solution. Most collegiate institutions will integrate the design and team formation process into a course (or more) in the fall semester or first quarter of the 2021–2022 academic year. During this phase, teams will develop their concept, confirm industry partners, confirm the location for the construction of the house, and prepare deliverables. The organizers expect each team to have at least one student—up to five students total—participate in the 2022 Competition Event in-person (to be held April 2022 at NREL in Golden, Colorado) to present their design progress for determination of the first Approval to Proceed. One Faculty Lead is strongly recommended to attend; up to two faculty may to attend for each team. In total, a team may have a maximum of seven team members present if they bring five students and two Faculty Leads.

As part of 2022 Competition Event, Building Challenge team progress is evaluated by experts for an Approval to Proceed to the construction phase, and up to 20 teams will be eligible for a cash prize. The organizers do not plan to provide financial assistance for lodging or travel expenses to any competition events. However, the prize funding provided to up to 20 teams who receive an Approval to Proceed to the construction phase of the competition may use the funds for this purpose if desired. All funds will be distributed as prizes, and it will be the responsibility of the recipient to pay any associated taxes with the distribution. International institutions may be subject to a 30% withholding depending on tax-treaty status with the United States.

Overall, design activities run from Summer 2021 through April 2022.

Construction Activities

Following receipt of an Approval to Proceed in April 2022, teams are expected to move forward with construction, completing all construction drawings, details, energy models, specifications, site plans, transportation logistics, and project plans. The Construction Documentation should be completed to such a level that a general contractor could build the house as the team intends with minimal additional questions or follow-up. It is expected that most teams will utilize the summer of 2022 to finalize funding, secure permits, and confirm partners to enable successful construction of the house during the 2022–2023 academic year.

Construction activities run from April 2022 through February 2023.

Community Exhibition

Teams are expected to exhibit their as-built houses over at least two weekends to members of the general public, educating them about opportunities for energy efficiency and energy production in their own homes.

Community Exhibition activities typically run from March to April 2023.

Competition

Following the successful construction of the house, each team will compete to determine the winners of the Solar Decathlon 2023 Build Challenge. The organizers will work with each team to verify functionality and collect measurements necessary for scoring of the measured Contests, and teams will present their solutions to juries at the 2023 Competition Event. The organizers will have each house photographed and documented using interactive 3D photography with walk-throughs to provide to the juries for review in advance of deliberation. The teams will present to juries using photographs, videos, models, and/or other media to demonstrate their design and as-built house. *Houses will not be transported to the Competition Event.*

Competition activities run from February to April 2023.

2 Build Challenge Project Requirements

A Solar Decathlon house is a high-performance building so energy efficient that a renewable energy system will offset all of the building's annual energy consumption. Along with achieving this level of performance, teams demonstrate the effective integration of building science principles and best-practice guidelines for the building envelope and mechanical systems into a compelling architectural design.

Homes are subject to local, state, and national codes or standards governing topics such as minimum bedroom size, fire protection requirements, resilience, or other requirements. If there are conflicts between the Solar Decathlon Build Challenge Building Code and local regulations where both conditions cannot be met, teams must discuss the discrepancy with the Solar Decathlon Build Challenge organizers.

English units of measurement are preferred; however, a submission with metric units is acceptable. If metric units are used, state metric units first, followed by English equivalents in parentheses. For example, 38.1 meters (125 feet). For quick online conversions of English units of measurement to metric units, see the Digital Dutch Unit Converter or the French Investment Property Metric and Imperial Conversion Charts and Tables.

Prize Structure

To help increase the likelihood of success for Build Challenge teams, DOE will offer prize funding for up to 20 teams. Teams are selected for prize funds via the process outlined in the Approval-to-Proceed Procedures, which are available on the Solar Decathlon website. Evaluators determining whether or not a team receives Approval to Proceed and a prize disbursement are separate from NREL staff, DOE staff, contest jurors, and the adjudication of these rules. Overall, the winner of the Build Challenge is the team that earns the most points at the end of the competition from the 10 Contests.

1. Up to 20 teams that successfully complete their house design and complete construction will earn a financial award, likely $50,000 per team.
2. Prizes are expected to be distributed in two disbursements, one following the completion of design and one following the completion of construction.
3. Prizes are distributed by the organizers to a single entity and account, as directed by the team Faculty Advisor on official collegiate institution letterhead and signed by collegiate institution leadership. The official team Faculty Advisor must be identified prior to any award. Multiple recipients will not be accommodated.
4. For U.S. teams, it is the sole responsibility of the team to determine any taxes or associated payments required as a result of this award. Foreign teams are subject to nonresident alien withholding of 30% under Chapter 3 of the Internal Revenue Code (26 U.S.C. Chapter 3). Tax withholding requirements are determined by the W8BEN-E submitted by the foreign entity that was certified by their authorized signer. Any distribution beyond the initial recipient is the sole responsibility of the team.
5. Through participation in the competition, the team agrees to accept the decisions of the organizers. The results are final. No right to counsel is authorized.

2.1 Build Challenge House Restrictions

The teams must meet their local Authority Having Jurisdiction requirements for residential construction. Renovation of an existing structure is permissible. Teams may compete using one unit of a multifamily building, duplex, row home, or townhouse development. The teams must provide accessible tour-route access to and from the house.

The finished square footage, as defined by Square Footage—Method for Calculating: ANSI Z765-2003 (R2013), shall be at least 400 ft^2 but shall not exceed 3,000 ft^2.

1. If the building has convertible or moveable components, the maximum and minimum square footages observed during live demonstrations or shown in printed or electronic media presented by the team during jury visits, public exhibit hours, or Contests count as the maximum and minimum square footages of record, respectively.
2. For the purposes of the Solar Decathlon, all finished square footage is included in the finished square footage calculation, regardless of whether or not the finished square footage is contiguous (i.e., attached to the main dwelling unit). Both maximum and minimum square footages must be within the limits set above.

3 Build Challenge Contests

Projects submitted to the Solar Decathlon Build Challenge demonstrate competency by applying principles of building science and best practice solutions to an as-built, functional house. The teams are assessed on a variety of deliverables, their as-built house and its measured performance, and the quality and content of their presentations to the public and to juries. These submissions should demonstrate the team's ability to design, analyze, plan, build, operate, exhibit, and showcase a complete house design.

The Solar Decathlon Build Challenge consists of 10 separately scored Contests, and some Contests contain one or more Subcontests. Each Contest is worth 100 points. The team with the highest total points at the end of the competition wins. Points are earned through jury evaluation and measured performance. Measured Contests are evaluated based on the criteria indicated in the Contest details. The scoring of the juried Contests is more subjective than the scoring of the measured Contests. However, for the sake of fairness, the jurors will use the evaluation method described in Section 5.

This competition values innovation and creative approaches in the design for increasing the likelihood of scaled adoption of prefabricated design, energy efficiency, energy production, grid integration, and building operations, as well as overall functionality and appeal. Effective designs incorporate innovations that are likely to be embraced by the construction industry and consumers on a large scale. Enabling the construction and building design industries to adopt modern technology, manufacturing techniques, automation, or mass customization may allow innovation to have a greater impact on building energy consumption. Teams are encouraged to find solutions that make use of new or existing technologies as well as other creative features to improve building operations and desirability.

Table 1. Contests and Subcontests

Contest No.	Contest Name	Contest Type	Points	Subcontest Name
1	Architecture	Juried	100	None
2	Engineering	Juried	100	None
3	Market Analysis	Juried	100	None
4	Durability and Resilience	Juried	100	None
5	Embodied Environmental Impact	Juried	100	None
6	Integrated Performance	Measured	100	Hot Water
				Interior Light Levels
				Laundry
				Internally Generated Noise
				Airtightness
				Passive Performance
7	Occupant Experience	Measured	100	Kitchen Appliances
				Laundry
				Home Electronics
				House Occupancy
				Electric Vehicle Charging
				Grid Responsive Electronics
8	Comfort and Environmental Quality	Measured	100	Temperature Control
				Humidity Control
				Indoor Air Quality
				Comfort Gradient
				Exterior Noise Infiltration
9	Energy Performance	Measured	100	Energy Efficiency
				Energy Production
				Energy Balance
				Demand Response
				Energy Value
10	Presentation	Juried	100	None

3.1 Architecture

This Contest evaluates the building's architecture for creativity, overall integration of systems, and ability to deliver outstanding aesthetics and functionality.

Architecture marries aesthetics with sound building science, energy efficiency, natural comfort, energy production, and resilience. Cutting-edge energy-efficient buildings are better positioned to achieve meaningful market acceptance if integrated into architectural designs that creatively meet or exceed aesthetic and functional expectations of both industry and consumers.

The Evaluation Criteria are likely to focus on:

- Architectural Concept and Design Approach
- Architectural Implementation
- Architectural Documentation
- Architectural Innovation.

3.2 Engineering

This Contest evaluates the effective design of high-performance engineering systems, technologies, and techniques through the use of energy efficiency and renewable energy.

Effective designs for buildings systems incorporate careful considerations of structural performance, occupant comfort, environmental conditions, and regulatory constraints. Heating, cooling, water, and ventilation system types and design should reflect different technology and integration options, including analysis of implications for energy and environmental performance, up-front and long-term costs, and reliability. Opportunities for water efficiency should be reflected in smart engineering solutions for domestic hot water delivery and landscaping irrigation as well as plumbing fixture and landscaping choices. Energy consumption and production is evaluated against specific site constraints and designed accordingly.

The Evaluation Criteria are likely to focus on:

- Approach
- System and Component Design
- Efficiency and Performance
- Documentation
- Innovation.

3.3 Market Analysis (includes Financial Feasibility and Affordability)

This Contest evaluates the building's appeal, affordability, scalability and attainability by its stated target market; this includes the likelihood of adoption by intended occupants and the construction industry for impactful, cost-effective design.

To ensure uptake in the market and drive both demand and supply, effective energy-efficient designs take into account the interests of intended building occupants and owners as well as the construction industry. On the consumer side, designs should reflect how occupants can best use and enjoy the built environment and accommodate potentially changing preferences of occupants over time. On the supply side, a successful design will consider how to reduce construction cycle

time, ensure outstanding quality, and improve productivity of building industries so that the ideas developed by the team can be replicated across the market successfully. A successful design should also include high-quality construction documentation.

Financial analysis should include estimated costs of construction, monthly utilities, and maintenance to determine an overall cost of ownership and provide a basis for comparison to the financial capabilities of target market and overall affordability. The cost of construction, as well as the extent to which the design would cost more than a code-compliant building, should be carefully considered and justified.

The Evaluation Criteria are likely to focus on:

- Affordability and Cost-Effectiveness
- Market Analysis
- Livability
- Buildability
- Scalability
- Innovation.

3.4 Durability and Resilience

This Contest evaluates the building's long-term ability to endure local environmental conditions and anticipate, withstand, respond to, and recover from disruptions.

Durability reflects the ability of the building envelope to maintain long-term performance despite routine environmental conditions. Resilient design enables the building to maintain critical operations during disruptions and quickly restore normal operations. The benefits of investing in highly efficient buildings are compounded by also investing in resilient design. Teams must demonstrate how their buildings effectively address all of these challenges.

The Evaluation Criteria are likely to focus on:

- Durability
- Performance
- Resource Management
- Resilience
- Innovation.

3.5 Embodied Environmental Impact

This Contest evaluates the full life cycle of a building, from cradle to grave.

"Circular economy" for a building refers to an economic system in which buildings are designed with a focus on minimizing environmental impact from material extraction and manufacturing to transportation, construction, and use, while also considering "Re-X"—reclamation, refurbishment, repair, reuse, recycle, etc.—of materials throughout its life cycle.

Within the sphere of a circular economy, various measurements and calculations are used to quantify the environmental impacts that are embodied into the building at each life cycle stage.

As buildings become more resource efficient during occupancy, the environmental impact during this stage decreases. Consequently, the other life cycle stages—such as material production, manufacturing, construction processes, and end of life—become larger contributors to a building's total environmental impact and, therefore, become more important to address. The building industry must go beyond the occupancy stage to address these impacts in all life cycle stages.

The Evaluation Criteria are likely to focus on:

- Life Cycle Assessment
- Design Decisions and Conclusions
- Documentation
- Impact Evaluation
- Innovation.

3.6 Integrated Performance [MEASURED]

This Contest evaluates how effectively the whole building performance is optimized through passive and active strategies across multiple building disciplines.

An integrated design utilizes architectural and engineering elements that complement each other to help the building achieve optimal performance. For example, a building that is properly oriented will more effectively capture passive heating, cooling, ventilation, and lighting. Without one design element (e.g., building orientation), additional energy-consuming systems are required to provide the dependent design element for interior conditions (e.g., mechanical HVAC). In a truly integrated design, when any element is altered or removed from the building, energy consumption of the overall building will increase.

The Subcontests are likely to include:

- Hot Water: points are earned for providing hot water that reaches a specified temperature before a specified amount of water has passed through multiple faucets.
- Interior Light Levels: points are earned for providing time-averaged interior light levels that meet a minimum specified level over the measured Contest period.
- Internally Generated Noise: points are earned for a measured internally generated noise from HVAC systems, electronics, appliances, lighting, and other noise-emitting devices below a specified level.
- Airtightness: points are earned for a measured airtightness less than or equal to a specified level.
- Passive Performance: points are earned for demonstrating a house that passively maintains a comfortable interior environment across an extended measurement period.

3.7 Occupant Experience [MEASURED]

This Contest evaluates how the building optimizes occupants' quality of life while also meeting the energy performance goals of the design.

Technologies and appliances should be thoughtfully selected and integrated into the overall design. This includes strategies for efficiency, comfort, health, and safety that address operational expectations of consumers.

The Subcontests are likely to include:

- Appliances: points are earned for operating typical kitchen appliances successfully.
- Laundry: points are earned for successfully washing and drying laundry.
- Home Electronics: points are earned for successfully operating typical household electronic devices such as a television or computer.
- House Occupancy: points are earned for hosting multiple people within the house for an extended period of time.
- Electric Vehicle Charging: points are earned for using infrastructure provided as part of the house
- Grid-Responsive Electronics: points are earned for selectively responding to utility signals to enable a modern grid-interactive efficient building

3.8 Comfort and Environmental Quality [MEASURED]

This Contest evaluates the building's capability to deliver intended comfort and indoor environmental quality.

Well-designed buildings provide both a comfortable and healthy indoor environment. For occupants to be comfortable, the building must be able to control temperature and relative humidity levels, as well as reduce exterior noise infiltration. To provide a healthy indoor environment, the design must include a comprehensive approach to indoor air quality that incorporates ventilation, filtration, dilution, and material selection strategies.

The Subcontests are likely to include:

- Temperature Control: points are earned for maintaining interior temperature within a specified range during the measured Contest period.
- Humidity Control: points are earned for maintaining interior relative humidity within a specified range during the measured Contest period.
- Indoor Air Quality: points are earned for maintaining indoor air quality within a specified range during the measured Contest period.
- Comfort Gradient: points are earned for providing consistent comfort across the entire house during the measured Contest period.
- Exterior Noise Infiltration: points are earned for minimizing the infiltration of exterior noise through the envelope during the measured Contest period.

3.9 Energy Performance [MEASURED]

This Contest evaluates reduction of whole building energy consumption, ability to generate clean energy that is needed on-site, and interaction with local grid operations. Effective whole-building energy analysis and decision-making is the foundation for energy performance. Energy performance incorporates energy consumption, clean energy generation, and the capability of the building to provide grid services.

The Subcontests are likely to include:

- Energy Efficiency: points are earned for a calculated HERS score below a set level.
- Energy Production: points are earned for successfully generating a minimum amount of energy using the house's photovoltaic panels within the time specified.
- Energy Balance: points are earned for a net electrical energy balance of at least 0 kWh, where a positive net electrical energy balance indicates net production and a negative net electrical energy balance indicates net consumption.
- Demand Response: points are earned for successfully responding to a utility-initiated load-shedding request.
- Energy Value Contest: points are earned for successfully prioritizing and evaluating time-of-use and time-of-sale energy to add value to the household and the utility simultaneously.

3.10 Presentation

Successful evaluation of each Contest depends on the team's ability to accurately and effectively convey its design and approach to energy performance to relevant audiences.

In order to inspire future professionals, incumbent industry leaders, and the public at-large to pursue energy efficiency and renewable energy opportunities, the value proposition must be clearly conveyed, both verbally and visually.

A smart design on its own is insufficient. Presentation quality can dramatically affect consumer perception and the likelihood of innovation being adopted. As such, each jury evaluates not just the criteria of the individual Contest but also the team's presentation of the design solution.

The Evaluation Criteria are likely to focus on:

- Strategy
- Implementation
- Documentation.