



U.S. DEPARTMENT OF ENERGY  
**SOLAR DECATHLON**

**Build Challenge Rules  
2019–2020**

July 2019

## List of Acronyms

ADA	Americans with Disabilities Act
ANSI	American National Standards Institute
cfm	cubic feet per minute
CO <sub>2</sub>	carbon dioxide
dB	decibel
dBa	A-weighted decibels
DOE	U.S. Department of Energy
EHS	Environmental, Health, and Safety
HERS	Home Energy Rating System
HVAC	heating, ventilating, and air conditioning
ISO	International Organization for Standardization
kWh	kilowatt-hours
Leq	level equivalents
lx	lux
NAHB	National Association of Home Builders
NREL	National Renewable Energy Laboratory
OSHA	Occupational Safety and Health Administration
PPM	parts per million
PV	photovoltaic
Wh	watt-hours

## Foreword—Why Solar Decathlon Build Challenge?

High-performance building design includes comprehensive building science, energy efficiency, optimized mechanical systems, indoor air quality, resilience, and water conservation. These attributes will ultimately determine whether buildings succeed or fail in terms of the human experience: affordability, comfort, health, durability, safety, and adequate resources. Yet, professional curricula across the United States and around the globe do not consistently provide students the skills needed to effectively integrate high-performance measures into their design, engineering, and construction management careers moving forward. Moreover, emerging crises related to affordability, health, disaster risks, and water shortages are making these skills an imperative at the same time that degree programs are working to effectively integrate them into their curricula. Enter the U.S. Department of Energy (DOE) Solar Decathlon® Build Challenge.

Starting in 2002, the focus was on two critical goals. First, to integrate high-performance design and construction education into degree programs; and second, to inspire the public and industry through innovations implemented by student teams. The Solar Decathlon has grown to encompass an international footprint with events occurring around the globe and tens of thousands of alumni worldwide. The Solar Decathlon Build Challenge is helping to create the next generation of workforce with the skills and passion to build or retrofit future-ready buildings.

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## Solar Decathlon Build Challenge Rules

The Solar Decathlon is a collegiate competition, comprising 10 Contests, that challenges student teams to design and build highly efficient and innovative buildings powered by renewable energy. For more information on the competition as a whole, read the [Solar Decathlon Competition Guide](#).

The Build Challenge encourages student participation during a 2-year period to prepare creative solutions for real-world issues in the building industry. Qualifying teams design and build complete, functional houses that are displayed locally in their communities and/or during the 2020 Smithsonian Folklife Festival on the National Mall in Washington, D.C.

During the Solar Decathlon Build Challenge Event in summer 2020, all competing teams will present to the public and exhibit their solutions before panels of expert jurors. More than 500,000 visitors are expected to visit. Select top-performing teams will also be invited to exhibit at the National Association of Home Builders (NAHB) International Builder's Show<sup>1</sup> in February 2021 in Orlando, Florida.

Build Challenge teams present to industry leaders for evaluation and feedback, meet with event organizers, learn from presentations by thought leaders and collegiate peers, and compare team projects and engage with buildings-related organizations to learn about energy careers at Solar Decathlon 2019 Design Challenge Weekend. Through local and national exhibitions, teams are recognized publicly, and the winning houses are published on the [Solar Decathlon website](#). The competition and winners are 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, young 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.

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<sup>1</sup> NAHB International Builder's Show Website: <https://www.buildersshow.com/Home/>

# 1 Summary of Important Dates

Please note the following key milestones for the 2020 Build Challenge:

- **August 2018:** The initial 2020 Build Challenge Rules are released; the team application is available on the [Solar Decathlon website](#).
  - 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 [Groups.io Project Site](#) is an online forum for participating students to receive timely information from organizers and access necessary resources.
- **December 10, 2018, 5 p.m. Eastern Standard Time (EST):** This is the deadline by which all teams must submit their team application online, including indicating which Division the team wants to enter and submitting a Build Challenge Proposal.
  - DOE accepts up to six teams for each Division, 12 in total for the Build Challenge. Dependent on funding availability and quality of applications, more or fewer teams may be accepted into either or both Divisions.
  - The application site can be accessed from the [Solar Decathlon website](#).
  - 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.
  - Each team pays a nonrefundable \$100 fee, identifies a faculty lead or student team lead, and submits a preliminary roster of student team members.
    - Within 21 days, entries are evaluated against criteria indicated in the [Build Challenge Proposal attachment](#). Based on the Build Challenge Proposal evaluation, up to six teams per Division category are invited to participate in the competition.
  - If a team is not accepted into its desired Division, the organizers may optionally offer a spot in the other Build Challenge Division based on the quality of the team's Proposal and other team Proposals received.
  - If a team is not accepted into either Build Challenge Divisions, the team is provided an opportunity to 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 school may only have one team per Division in the Design Challenge, so if the school already has one or more teams participating in the Design Challenge, the nonselected 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.

- **January 31, 2019:** Updated Solar Decathlon Competition Guide is released. Minimal revisions expected, primarily focused on clarifying intent or adding definition to dates or schedules.
- **February 19, 2019, 5 p.m. EST:** This is the deadline by which all teams must complete the Project Introduction.
  - The Project Introduction, as detailed in Section 6.1, must be submitted via the file submission link posted to the [Groups.io Project Site](#).
- **March 26, 2019, 5 p.m. Eastern Daylight Time (EDT):** Teams must submit the Design Development deliverable by this deadline.
  - The Design Development deliverable, as detailed in Section 6.2, must be submitted via the file submission link posted to the [Groups.io Project Site](#).
- **April 9, 2019, 5 p.m. EDT:** This is the deadline by which teams must submit their Design Presentation deliverable, including presentation files and optional posters, as detailed in Section 6.3. Presentations will not be accepted after this date.
- **April 12–14, 2019: Solar Decathlon Design Challenge Weekend:** Participating teams come to the National Renewable Energy Laboratory (NREL) main campus in Golden, Colorado, and present to industry leaders who evaluate each team’s Design Development Documentation deliverable and Design Presentation deliverable to determine which teams will receive an Approval to Proceed to the next phase and receive the first distribution of prize funding. The funding distribution and process for evaluation of team progress for determining an Approval to Proceed is documented in the Approval-to-Proceed Procedures, which are available on the [Solar Decathlon website](#).
  - At least one student team member, but no more than five students total, from each team must attend in person. One faculty lead is recommended to attend; up to two are allowed to attend for each team. A maximum of seven team members may attend.
- **July 31, 2019:** An updated 2020 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.
- **November 5, 2019, 5 p.m. EST:** This is the deadline by which teams must submit their Construction Documentation deliverable, including complete construction drawings, Public Project Renderings, and an interim project report, as detailed in Section 6.4, and must indicate where they would like their house measurements collected.
  - The Construction Documentation deliverable, as detailed in Section 6.4, must be submitted via the file submission link posted to the [Groups.io Project Site](#).
  - Teams are provided feedback on their Construction Documentation deliverable regarding their project code and rules compliance. The requirements for the Construction Documentation deliverable are detailed in Section 6.4.
  - Within 21 days, entries are evaluated by industry leaders to determine which teams will receive Approval to Proceed to the next phase and receive the second distribution of prize funding. The funding distribution and process for evaluation

of team progress for determining an Approval to Proceed is documented in the Approval-to-Proceed Procedures, which are available on the [Solar Decathlon website](#).

- **January 31, 2020:** An updated 2020 Solar Decathlon Competition Guide is released. Minimal revisions expected, primarily focused on clarifying intent or adding definition to dates or schedules.
- **February 18, 2020, 5 p.m. EST:** This is the deadline by which teams must complete the As-Built Documentation deliverable, including their updated Public Project Renderings, 100% Construction Documentation, and Construction Progress Photos.
  - The As-Built Documentation deliverable, as detailed in Section 6.5, must be submitted via the file submission link posted to the [Groups.io Project Site](#).
- **March 31, 2020, 5 p.m. EDT:** This is the deadline by which teams must submit their Project Summary deliverable, including their final project report, Public Project Summary, and Public Exhibit Materials. This is also the deadline by which all teams must indicate which team members have completed the building science training online or have received an equivalency waiver from their faculty lead.
  - The Project Summary, as detailed in Section 6.6, must be submitted via the file submission link posted to the [Groups.io Project Site](#).
- **May 12, 2020, 5 p.m. EDT:** This is the deadline by which teams must have received a Certificate of Occupancy from their local Authority Having Jurisdiction, to have installed all Organizer Instrumentation Equipment, and to have demonstrated an accessible tour route through their house locally to organizers. This is also the deadline by which teams must submit their Jury Documentation deliverables, including their narratives to each jury, architectural photography of their as-built house, photographs of the as-built house, and Public Construction Documentation.
  - The Jury Documentation deliverable, as detailed in Section 6.7, must be submitted via the file submission link posted to the [Groups.io Project Site](#).
- **Spring 2020 (target dates in May and June): Solar Decathlon Build Challenge Local Build Exhibition Period:** This is the period during which all competing teams exhibit their as-built houses to their local communities, offering tours of the house and hosting educational activities. This is when the organizers will complete verifying functionality as part of the measured contest activities. To ensure equal testing and demonstration without dependency on local utility interconnections, all teams must be able to be operated off-grid for the required contest activities.
  - Note: for teams who need to ship their house or elements prior to the conclusion of this period or are subject to other constraints that limit exhibition schedules, alternative exhibition strategies will be accommodated, and alternative outreach will be considered. Teams may choose whether they would like their measurements collected locally or following arrival of their house on the National Mall in Washington, D.C.



- **June 21–24, 2020: Solar Decathlon Build Challenge National Showcase Setup:** This is the period during which all competing teams will prepare for exhibition and competition as part of the Build Challenge Events.
- **June 25–July 5, 2020: Solar Decathlon Build Challenge Events:** Competing teams exhibit and compete at the Build Challenge Events, existing as part of the Smithsonian Folklife Festival in Washington, D.C. National Showcase Division teams bring a complete, tourable house module. Local Build Division teams bring their compelling exhibit and associated signage. All teams will present to juries in Washington, D.C. Upon completion of setup activities on the National Mall, teams will receive the final distribution of prize funding, as documented in the Approval-to-Proceed Procedures, which are available on the [Solar Decathlon website](#). All competing teams will earn points according to these rules and the team with the most points overall will win.
- **July 6–9, 2020: Solar Decathlon Build Challenge Events Teardown:** This is the period during which all competing teams will clear the site following the Build Challenge Events.
- **September 1, 2020, 5 p.m. EDT: Final Report:** Deadline by which teams must submit their Final Report deliverable, including a summary of successes and challenges, to the organizers.
  - The Final Report deliverable, as detailed in Section 0, must be submitted via the file submission link posted to the [Groups.io Project Site](#).
- **February 2021: Team Showcase at National Association of Home Builders (NAHB) International Builder’s Show<sup>2</sup>:** Select top teams may be invited to exhibit their designs—and for National Showcase teams, their tourable house module—to tens of thousands of professionals at the NAHB International Builder’s Show. DOE may make some funding available to offset transportation and attendance costs. Additional information on this optional opportunity will become available.

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<sup>2</sup> NAHB International Builder’s Show Website: <https://www.buildersshow.com/Home/>

## 2 Build Challenge Description

### 2.1 Task Overview

- Read this Build Challenge Rules document and form a team.
- Review the past team entries on the [Solar Decathlon website](#) to inform efforts.
- Submit a team application with a team roster and Build Challenge Proposal using the instructions in the team application site.
- Receive notification of acceptance as a participant in the Build Challenge, or an invitation to join the Design Challenge.
- Ensure all team members have access to the [Groups.io Project Site](#), where competition updates are posted regularly. Within the Groups.io Project Site, there is a subgroup specifically for the Build Challenge.
- 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.
  - The building science training coursework from world-renowned experts is provided at no cost to every team member.
  - Access instructions are available on the [Groups.io Project Site](#).
  - The curriculum includes topics such as enclosure fundamentals; rain control; airflow control; heat flow control; vapor and condensation control; roofs; ventilation and air pressure management; windows; durable, healthy, efficient housing; unique solutions (optional); and multifamily/multiunit housing (optional).
- Identify areas in which industry partnership is needed or wanted.
- Study the resources provided in the Resources document on the [Groups.io Project Site](#).
- Consult the [Solar Decathlon website](#) and [Groups.io Project Site](#) for updates and announcements.
- Attend optional webinars as advertised on the [Groups.io Project Site](#) for technical, design, and competition guidance. These webinars will also be available as recordings posted to the Groups.io Project Site if attendance is not possible as scheduled.
- Attend monthly all-team conference calls for project updates and important information from the organizers about Build Challenge requirements, as outlined in Section 3.
- Design and document a project compliant with the requirements listed in the latest version of the Build Challenge Rules.
- Build a house compliant with the requirements listed in the latest version of the Build Challenge Rules.
- Exhibit the project locally, compliant with the requirements listed in the latest version of the Build Challenge Rules.

- Exhibit the project, compliant with the requirements listed in the latest version of the Build Challenge Rules, to public and professional visitors in May and June 2020.
- Exhibit the project, compliant with the requirements listed in the latest version of the Build Challenge Rules, nationally at the Smithsonian Folklife Festival in June and July 2020 in Washington, D.C.
  - Local Build teams will bring an exhibit—up to 10 feet (ft) wide x 20 ft long x 12 ft tall—and tour juries through their exhibit on the National Mall in Washington, D.C.
  - National Showcase teams will bring a tourable house module, and tour juries through their house module on the National Mall in Washington, D.C.
- 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](mailto:SDbuild@nrel.gov).

## 2.2 Developing a Team

Each team must be associated with a collegiate institution and include a faculty lead. The competition is open to all collegiate and degree-issuing institutions, including community colleges. International institutions are welcome to participate. Each team must have at least four students, with one student designated as the student team lead and others filling in team officer roles, as outlined in Table 1. 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). A team may choose to have several internal groups of students complete designs and then submit only one design when the submission deadlines occur. The team application costs \$100 per team and is nonrefundable. If a school 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. A faculty advisor may advise multiple teams.

If a team member who is not a U.S. citizen wants to participate in person at 2019 Design Challenge Weekend held at the NREL campus, each affected person must submit a Foreign National Data Card. Additional information and requirements are provided in the online team application site and the [Groups.io Project Site](#).

## 2.3 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, 2020.

## 2.4 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 in the Build Challenge Event, including exhibition, participation in Divisions, and 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 in person.
- Ensure the team successfully builds the house as designed and exhibits successfully to the public.

## 2.5 Build Challenge Divisions

The Solar Decathlon Build Challenge comprises two Divisions: National Showcase Division and Local Build Division. Each collegiate institution applies to only one Division. Collegiate institutions may choose to have multiple internal groups of students complete designs, but only one design project may be submitted. The organizers accept up to six teams per Division, based on the review criteria described in the Approval-to-Proceed Procedures, which are available on the [Solar Decathlon website](#).

Each team selects and defines 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. All teams must have a specific target site and location for consideration by the juries, though the team will retain the option to locate the house elsewhere after the Challenge.

A dwelling unit, as defined by the [2018 International Energy Conservation Code](#), is 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.

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. The Contests and Rules apply equally to all teams, regardless of Division, unless noted otherwise. The same jurors judge each Division.

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.

Renewable energy must be evaluated and integrated into the project and built house. All houses, in both Build Challenge Divisions, must be designed and built to be able to be operated off-grid for competition evaluation purposes, including appropriate energy storage and safety systems for operation.

### *National Showcase Division*

Teams shall design and build an energy-positive house that can be effectively transported long distances and rapidly installed. The design should respond to a unique, team-specified target market that would benefit from collegiate institution innovation and engagement. Teams will need to build a transportable design that can be set up in three days or less for exhibit on the National Mall. For example, target markets for the National Showcase Division could include, but are not limited to, disaster response, indigenous-focus, rural solutions, urban accessory dwelling units, multifamily urban infill housing, or many other possible choices where a single-module design would be attractive and appropriate. Additionally, teams may develop and demonstrate possible sites where the design is installed as part of a multifamily building. The National Showcase house built must be a complete dwelling unit for part of its exhibition, whether locally or on the National Mall, defined as a single unit providing complete, independent living facilities for one or more people, including permanent provisions for living, sleeping, eating, cooking, and sanitation. The team's house cannot depend on future expansion to be fully functional, and the team may exhibit only one module on the National Mall, assuming the fully functional home is exhibited at their home site for the collection of measurements.

Teams are expected to exhibit and operate their house in their region in May and June of 2020. Teams are required to exhibit and operate one module of their house at the Smithsonian Folklife Festival on the National Mall in late June and early July 2020. Select top-performing teams may be invited to exhibit their house at the NAHB International Builders' Show in Florida in February 2021. To comply with National Park Service rules and requirements, the exhibit must be designed for effective transportation and rapid setup, shipping entirely constructed with limited work to do on-site to prepare the house for operation and touring. The organizers will provide equipment, such as a telehandler, and associated operators to unload elements from the transporting vehicle.

The National Showcase house module is limited to maximum dimensions of 15 ft wide, 14 ft tall while in transportation mode, and 60 ft long. The build area available to each team is 20 ft wide, 15 ft tall, and 80 ft long. Each house module must have a minimum finished area of 400 square feet (ft<sup>2</sup>), as measured according to [ANSI Z765](#). Potential unfurling of elements such as panels, shading devices, or overhangs are evaluated on a case-by-case basis. The house must have separate entry and exit doors with an accessible

route through the home for tour groups, further detailed in the Solar Decathlon Building Code. The remainder of the house does not need to be accessible. The organizers will rent and install Americans with Disabilities Act (ADA)-accessible ramps to enable the public to tour the house while on exhibit at the Smithsonian Folklife Festival and, if applicable, the NAHB International Builders' Show. The National Showcase house is expected to remain on its trailer for the duration of the exhibit, with tie-downs or weights added as necessary to meet Solar Decathlon Build Challenge Building Code requirements. The finished floor level of the tourable module should be 27" (68.58 cm) above grade or less when in the exhibited configuration. Any plumbing or mechanical element not necessary for measurement or life safety on the National Mall does not need to be functional for the exhibit, however, the team must provide a conditioned envelope and basic electrical functionality, including battery storage, while on site. International teams participating in the National Showcase Division must clearly demonstrate how their home will be transported and exhibited within these constraints.

### *Local Build Division*

Teams shall design and build an energy-positive house in their region that can be effectively exhibited and operated in spring 2020. The design should respond to a unique, team-specified target market that would benefit from collegiate institution innovation and engagement. For example, target markets for the Local Showcase Division 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 may build multifamily housing where the design is part of a townhome or row home development. However, the house presented must represent a complete dwelling unit, and only one dwelling unit will be evaluated as part of the contests.

Teams are required to exhibit and operate their house in their region in May and June 2020. All teams are expected to bring a compelling exhibit—up to 20 ft long, by 10 ft wide, by 12 ft tall—to the Smithsonian Folklife Festival on the National Mall in late June and early July of 2020. To comply with National Park Service rules and requirements, the exhibit must be designed for efficient transportation and unpackaging, shipping entirely constructed with minimal work to do on-site to prepare the exhibit. The organizers will provide equipment, such as a telehandler, and associated operators to unload an exhibit from its transporting vehicle.

The Local Build house must be between 600 ft<sup>2</sup> and 3,000 ft<sup>2</sup>. 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.

## 2.6 Build Challenge Expectations

The Build Challenge Event 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, whether they compete at 2019 Design Challenge Weekend or the 2020 Build Challenge Event. Often, teams partner with industry to guide and support both their design and construction.

The organizers do not plan to provide financial assistance for lodging or travel expenses.

### *Application and Proposal*

Teams interested in participating in the Build Challenge are required to complete a team application, including a Build Challenge Proposal. After evaluating the Build Challenge Proposals, up to six teams are invited to compete in each Division, with up to 12 teams total.

### *Schematic and Design Development Activities*

Following notification of acceptance into the Build Challenge as a finalist, each team is expected to promptly begin work on its design solution. Most schools will integrate the design and team formation process into a course (or more) in the spring semester or first quarter of 2019. During this phase, teams will refine their concept, recruit industry partners, confirm the location for the construction of the house, and prepare deliverables. The organizers expect each team to send at least one student, or up to five students total, to attend 2019 Design Challenge Weekend in-person, April 12–14, at NREL in Golden, Colorado, to present their design progress for determination of the first Approval to Proceed. One faculty lead is recommended to attend; up to two are allowed 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.

Teams are expected to indicate when registering for 2019 Design Challenge Weekend if they are interested in bringing an architectural-scale model. The models may be on display during the team's presentation and the Poster Session. These models are optional; all shipping and transportation costs are the responsibility of the teams.

As part of 2019 Design Challenge Weekend, team progress are evaluated by experts for an Approval to Proceed to the next phase and for receipt of a portion of prize funds, as outlined in the Approval-to-Proceed Procedures, which are available on the [Solar Decathlon website](#).

These activities run from acceptance into the Build Challenge through April 2019.

### *Construction Documentation Activities*

Following receipt of an Approval to Proceed in April 2019, teams are expected to complete their designs; Construction Documentation deliverable; and include all appropriate construction drawings, details, energy models, specifications, site plans, transportation logistics, and project plans per the schedule of deliverables outlined in Section 6. Teams will complete recruitment of industry partners/sponsors and fundraising and identify a final location for their as-built house. 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. The Construction Documentation will not be released publicly. It is expected that most teams will utilize some summer coursework or internship activities to make progress in the summer of 2019, and then integrate Construction Documentation, fundraising, and final project planning into the fall and winter of 2019.

Following the completion of each teams' Construction Documentation deliverable, team progress is evaluated by experts for Approval to Proceed in the Challenge, as outlined in the Approval-to-Proceed Procedures, which are available on the [Solar Decathlon website](#).

These activities run from April 2019 through November 2019.

### *Build Activities*

Following the successful completion of their Construction Documentation, teams begin the process of building their house. For Local Build teams, the house will likely be built on a permanent foundation. For National Showcase teams, the house will be built on, or integrated with, a trailer frame that allows the unit to be easily transported as a single module to the Build Challenge Event Site as part of the Smithsonian Folklife Festival on the National Mall in Washington, D.C. Teams may choose to also have a permanent foundation created for eventual placement of the house following the competition. Teams will work with industry partners and sponsors to raise sufficient funds and receive sufficient materials to build the house as designed. Throughout the process, teams are expected to follow safe construction practices and document activities that may be relevant to the juries.

These activities run from November 2019 through the completion of the house in May 2020.

### *Competition*

Following the successful construction of the house, each team will compete in the Solar Decathlon 2020 Build Challenge. Organizers will work with each team to verify functionality and collect measurements necessary for scoring at a location to be coordinated with each team, and teams will present their solutions to juries at the Smithsonian Folklife Festival on the National Mall in Washington, D.C. The teams will present to juries using photographs, videos, models, and/or other mediums to demonstrate their design and as-built house. All teams may optionally use photographs, videos, models, and or/other mediums to demonstrate aspects or elements of their design not present on the Event Site. The organizers will have each house photographed and documented using interactive 3D photography with walkthroughs to provide to the juries for review in advance of deliberation. Simultaneous to the competition phase, teams are expected to exhibit their as-built houses to members of the general public, educating them about opportunities for energy efficiency and energy production in their own homes. Teams may also be asked to participate in related program activities as part of the Folklife Festival.

These activities run from June to July 2020.



## 2.7 Industry Partners

Industry partnerships are encouraged to provide a market-ready perspective for proposed solutions and to help select and integrate building systems into the built 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.

## 3 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, including electric vehicle charging. 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, resiliency, 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 Building Official. The Solar Decathlon Build Challenge Building Code applies to both the Local Build and National Showcase Divisions, though additional restrictions may exist for homes or exhibits that will be occupied by visitors on the National Mall as part of the 2020 Smithsonian Folklife Festival.

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](#).

### 3.1 Authority

#### *U.S. Department of Energy*

DOE is the sponsoring organization, and the Solar Decathlon Build Challenge Director has the final decision-making authority in all aspects of the project.

#### *Build Challenge Manager*

The Build Challenge Manager is the only rules official authorized to write and modify these rules.

#### *Rules Officials*

The rules officials are the only organizers authorized to interpret the rules, revise the project schedule, change a team's score, or enforce the rules as required for the fair and efficient operation or safety of the competition.

- a) The official version of the rules shall be the rules on the [Groups.io Project Site](#). Other printed, electronic, and verbal communications covering the rules shall have the effect of the rules unless such communications are in conflict with the official version on the Groups.io Project Site. In the case of a conflict, the official version shall govern. If there is a dispute, DOE and the organizers shall resolve the dispute in accordance with the dispute procedures contained in the official version.
- b) Printed, electronic, and verbal communications from the rules officials shall be considered part of, and shall have the same validity as, these rules.

## 3.2 Administration

### *Precedence*

If there is a conflict between two or more versions of the rules, the version having the later date takes precedence. If a conflict exists between two or more rules in this document, the Build Challenge Manager will determine which rule has precedence and will inform all teams of the decision on the rules. If a conflict exists between the Competition Guide and the Build Challenge Rules document, the Build Challenge Rules document takes precedence.

### *Violations of Intent*

A violation of a rule's intent is considered to be a violation of a rule itself. The organizers, in consultation with DOE, have the ultimate authority in interpretation of rules. All decisions made by DOE are final, and there is no process for appeal. Attempting to exploit a perceived loophole in the rules that incentivizes behavior that does not align with the goal of the competition will not be viewed favorably. DOE reserves the right to change the rules of the competition at any time.

### *Official Communications*

It is each team's responsibility to stay current with official project communications. Official communications between the teams and the organizers occur through, but are not limited to, one or more of the following:

- a) **Project Site:** Official communications suitable for viewing by all teams and organizers are posted on the Groups.io Project Site. The group will host messages and files for the teams. The Project Site is: <https://solardecathlon.groups.io>. Within the Project Site, there is a subgroup specifically for the Build Challenge.
- b) **Organizer Email:** For confidential communications, teams may email the organizers. The content of communications sent to this email address remains confidential unless the team grants permission to the Build Challenge Manager to divulge the content of these communications to the other teams. If a question has general applicability to all teams, organizers—at their sole discretion—will post the answer to the [Groups.io Project Site](#). The Build Challenge email address is [SDbuild@nrel.gov](mailto:SDbuild@nrel.gov). The overall Solar Decathlon Competition email is [solardecathlon@nrel.gov](mailto:solardecathlon@nrel.gov). Should a team need to contact DOE's Solar Decathlon Director directly, the email is [solar.decathlon@ee.doe.gov](mailto:solar.decathlon@ee.doe.gov).
- c) **Conference Calls:** At least one member from each team is expected to participate in regularly scheduled conference calls with the organizers. Invitations and instructions for participation in conference calls are provided via the [Groups.io Project Site](#).
- d) **Building Science Training:** All student team members are required to complete the free, organizer-provided building science training course or receive an equivalency waiver from their faculty adviser indicating that students receive equivalent training as part of their curriculum. Invitations and instructions for participation in training are provided via the [Groups.io Project Site](#).
- e) **Webinars:** Teams are expected to participate in regularly scheduled webinars intended to educate and prepare the teams for successful participation in the Challenge. Invitations and instructions for participation in webinars are provided via the Project Site.

- f) **Meetings:** Before the Build Challenge Event, the teams and organizers may have one or more in-person meetings. Notification of the date(s) and agenda(s) for these meetings is made via the [Groups.io Project Site](#). Meetings will also be held on a daily basis throughout the Build Challenge Event. Attendance is expected unless prior notice is given to the Build Challenge Manager.
- g) **Individual Email:** For expediency and to protect design confidentiality amongst teams, teams and organizers may communicate directly via email. Organizer and team lead email addresses will be listed in the [Groups.io Project Site](#). Organizers will not share team information discussed via email publicly unless appropriate for all teams or the public.

### *Prize Structure*

To help increase the likelihood of success for Build Challenge teams, DOE will offer prize funding to successful 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. The winner of the Build Challenge is the team that earns the most points at the end of the competition from the 10 Contests.

- a) Depending on the Division chosen, teams that successfully complete their house and compete in the Challenge will earn a financial award based on their Division.
- b) Prize disbursements are expected to be distributed in three phases, following the process outlined in the Approval-to-Proceed Procedures, which are available on the [Solar Decathlon website](#).
- c) 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.
- d) 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.
- e) 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.

### *Effective Date*

The latest released version of the rules posted to the [Groups.io Project Site](#) represents the rules in effect.

### *Decisions on the Rules*

The [Groups.io Project Site](#) will contain a Decisions on the Rules database that provides interpretations of the rules contained in this document. Should a rules official make a decision

that may affect the strategies of all teams, the rules officials will add the decision to the Decisions on the Rules database and notify the teams of the addition.

### *Self-Reporting*

Teams shall self-report obvious or suspected rules infractions that have occurred or may occur.

- a) The rules are not expected to address every possible scenario that may arise during the competition. A team considering an action that is not explicitly permitted by the rules should ask the rules officials for a decision before proceeding with the action. If the team does not ask for an official decision, the team is putting itself at risk of incurring a penalty.

### *Penalties*

Teams committing rules infractions are subject to one or more of the following penalties, depending on the severity of the infraction: (1) point penalty applied to one or more of the 10 Contests; (2) disqualification from part, or all, of one or more of the 10 Contests; or (3) disqualification from the competition.

- a) The rules officials are authorized to apply point penalties and disqualify a team from part, or all, of one or more contests as a consequence of rules infractions.
- b) The rules officials shall report to the director any significant rules infractions. The Build Challenge Manager determines whether a rules infraction is significant. The Build Challenge Director is solely authorized to disqualify a team from the competition. Disqualification from the competition requires prior notice to the team and an opportunity for the team to make an oral or written statement on its behalf.
- c) The Build Challenge Manager shall notify all teams via the [Groups.io Project Site](#) and update the competition scoring when a penalty has been assessed against any team. The notification shall include the identity of the team receiving the penalty, an indication of the specific rule violated, a brief description of the infraction, and the penalty to be applied.

### *Protests*

- a) Official written protests may be filed by a team for any reason during the Build Challenge Event. A filing fee of up to 10 points is assessed to the team if the protest is deemed by the Protest Resolution Committee to be frivolous.
- b) Teams are expected to communicate with the rules officials to resolve issues and complaints before resorting to the protest process. Protests should be filed only if the team and the rules officials are unable to resolve the dispute themselves, or if the team or the rules officials are too busy to engage in discussions that may result in resolution of the dispute without a protest.
- c) Protests shall be submitted between 8 a.m. and 6 p.m. EST/EDT, and within 24 hours of the action being protested. The final opportunity to file a protest is 5 p.m. EDT on July 4, 2020.

**Exception:** The results of the contests are announced during the final awards ceremony. The results of contests announced during the final awards ceremony may not be protested.

- d) The protest shall be submitted to a rules official in a sealed envelope or emailed to the Build Challenge Manager at [SDbuild@nrel.gov](mailto:SDbuild@nrel.gov). If submitted electronically, the protest shall be attached as a PDF to the email, and the email subject should include “Solar Decathlon 2020 Build Challenge Protest” and the name of the team submitting the protest. The protest shall include the name of a decathlete representing the team filing the protest, the date of the protest submission, an acknowledgment that a 10-point filing fee may be assessed, and a clear description of the protest.
- e) Juried contests are inherently subjective, and the opinions of a jury cannot be protested. Only factual errors or mistakes may be protested.
- f) The Protest Resolution Committee will consist of at least three individuals with relevant expertise and knowledge of the Solar Decathlon Build Challenge rules.
- g) Following the receipt of a protest, the protest resolution procedure will occur as follows:
- The Build Challenge Manager convenes the Protest Resolution Committee.
  - The Build Challenge Manager submits the team’s protest to the committee. Unless the Build Challenge Manager is called by the committee to testify, the Build Challenge Manager is not permitted to read the protest until after the Protest Resolution Committee has submitted its written decision.
  - The committee reads the protest in private. No appearance by the Build Challenge Manager, rules officials, or team members is authorized during the committee’s private deliberations. No right to counsel by organizers or team members is authorized.
  - The committee members shall individually call the decathlete who submitted the protest and the Build Challenge Manager for testimony to fully understand the protest. The committee may choose to call additional individuals for testimony.
  - The committee considers the protest and notifies the director and Build Challenge Manager of its recommendation in writing. The committee shall indicate the reason for the decision, any adjustment to a team’s measurement or score, and how many points shall be assessed as a filing fee, if any.
  - Following acceptance by DOE, if the recommendation involves changes to a team’s measurement or score, the Build Challenge Manager will ensure that the appropriate changes are applied to the scoring server.
  - The Build Challenge Manager posts a copy of the protest and decision on the [Groups.io Project Site](#).

### 3.3 Participation

#### Contact Information

Each team shall provide contact information via the [Groups.io Project Site](#) for the team officers listed in Table 1 and shall keep the contact information current for the duration of the project. In addition, all team members are encouraged to join the official [Solar Decathlon LinkedIn group](#) to better enable future engagement and networking.

- a) If a team’s internal officer titles do not exactly match those listed in Table 1, each team shall still provide the contact information for the person fulfilling each of the areas of responsibility described in the second column.
- b) Teams shall provide the contact information for only one person in each officer position.
- c) Faculty members are only eligible to fill the faculty advisor team officer position. The collegiate institution health and safety officer position may only be filled by a member of the collegiate institution’s Environmental, Health, and Safety (EHS) department. Decathletes must fill all other team officer positions.

For a period of time, extending 5 years from the end of the Solar Decathlon Build Challenge, each student and faculty member of a collegiate institution team is encouraged to participate in an evaluation of the downstream impacts of the Solar Decathlon. This evaluation is performed by a DOE-selected, third-party evaluation contractor. Participation in this evaluation will involve answering an annual survey of approximately 30 minutes or less in duration. The evaluator will use the collected survey information to assess the impact of the Solar Decathlon. The evaluator is authorized to use the collected information solely for the purpose of developing a DOE-sponsored and DOE-managed evaluation report that presents only results in aggregate. Information collected pertaining to individual students, alumni decathletes, or individual faculty will not be reported.

**Table 1. Team Officers**

<b>Title</b>	<b>Responsibilities</b>
Student team lead	The team lead is responsible for the overall success of the team’s entry to the Challenge. This person ensures that official communications from the organizers are routed to the appropriate team member(s).
Construction officer	The construction officer is responsible for planning and executing the construction, transport, setup, and removal of the house, including providing the necessary oversight on construction activities.
Measured contest officer	The measured contest officer serves as the primary strategist and coordinator of measured contests. This person collaborates with the organizers’ instrumentation team and the team’s construction manager to accommodate the organizers’ equipment.

Title	Responsibilities
Health and safety officer	The health and safety officer is responsible for developing the team's Health and Safety Plan, providing health and safety oversight to the project, and advising the project manager and construction manager, as necessary, on project health and safety issues. This person is also responsible for the team's safety during the Build Challenge Event, including the fire watch, public safety within the team's solar envelope, and evacuation procedures.
Faculty advisor	The faculty advisor serves as the lead faculty member and representative of a participating school in the project. This person also provides guidance to the team throughout the project.
Collegiate institution health and safety manager	The collegiate institution health and safety manager serves in an advisory role as an EHS mentor or consultant, not project oversight. To help ensure the safety of students building houses, it is required that each team engage a collegiate institution expert to help guide the team with regard to EHS activities.

In addition to these required roles, teams often assign student team leads for the following positions listed in Table 2.

**Table 2. Team Leads (Optional)**

Title	Responsibilities
Architectural project lead	The architectural project lead is responsible for the architectural design effort; no license is required.
Engineering project lead	The engineering project lead is responsible for the engineering design effort; no license is required.
Sponsorship lead	The sponsorship lead is responsible for recruiting team sponsors and for team compliance with the Rules for sponsor recognition.
Public relations lead	The public relations lead works in conjunction with DOE's Office of Public Affairs to coordinate the team's interactions with the media.

**Safety**

Each team is responsible for the safety of its operations.

- a) Each team member and team crew member shall work in a safe manner at all times during the project in accordance with the requirements identified in the Rules and team Health and Safety Plan, see Section 6.4.
- b) Each team shall supply all necessary personal protective equipment and safety equipment for all of the team's workers and visitors during the project.
- c) Throughout activities on the National Mall, including any setup of exhibits or houses and regardless of Division, a minimum level of personal protective equipment shall be worn by each team member and team crew member:
  - o Hard hat (ANSI Z89.1 or equivalent, Type I, Class G or better)
  - o Safety glasses with side shields (ANSI Z87.1 or equivalent)
  - o Shirt with sleeves at least 3 inches (7.6 centimeters) long



- Long pants (the bottoms of the pant legs shall, at a minimum, touch the top of the boots when standing)
  - A Class 2 high-visibility reflective vest, shirt, or jacket
  - Safety boots (meeting Class 75 impact/crushing standards of ASTM F2413 or equivalent) with ankle support.
- d) Additional personal protective equipment or safety equipment shall be used if required for the task being performed (e.g., shock/arc protection, hearing protection, face shields, dust mask, and so on).
  - e) Team members who are expecting to work on any electrical work during the project shall meet Occupational Safety and Health Administration (OSHA) 29 CFR Part 1910, Subpart S Electrical 1910.399 requirements, and in doing so will be considered a Qualified Electrical Worker.
  - f) Individuals under the age of 18 are not permitted to be on the competition site during setup and removal.
  - g) Smoking is not permitted on the site of the Build Challenge Event at any time.
  - h) For exhibit or house setup at the Build Challenge Event, organizers may issue a stop work order at any time during the project if a hazardous condition is identified. The duration of the stop work order is at the discretion of the organizers; additional construction time will not be provided.
  - i) Failure to follow the procedures and requirements outlined in each team's Health and Safety Plan on the Build Challenge Event Site is considered a rule violation, and violations are subject to penalty points. All electrical work on the Build Challenge Event Site shall meet electrical lock-out/tag-out requirements indicated in each team's approved Health and Safety Plan. Fall protection systems shall be used in a manner to provide protection against fall exposures 100% of the time.

### *Conduct*

Improper conduct, the use of alcohol or marijuana, and the use of illegal substances are not permitted on the competition site. Improper conduct may include, but is not limited to, improper language, unsportsmanlike conduct, unsafe behavior, distribution of inappropriate media, and cheating.

### *Use of Likeness, Content, and Images*

Team members agree to the use of their names, likenesses, content, graphics, and photos in any communications materials issued by the organizers and event sponsors.

- a) Content and images (graphics and photos), and any publications in which the content and images appear, may be viewable and made available to the general public via DOE's and the Solar Decathlon sponsors' websites with unrestricted use.
- b) The organizers and event sponsors will make all reasonable efforts to credit the sources of content and images, although they may be published without credit.

### *Competition Withdrawals*

Any team wishing to withdraw from the Challenge must notify the Solar Decathlon Director and Build Challenge Manager in writing. Teams considering withdrawal are encouraged to communicate early and frequently with the Build Challenge Manager. All written withdrawals signed by the listed faculty advisor are final.

### *Deliverables*

Teams are required to submit all deliverables associated with the project. All deliverables are due by 5 p.m. EST/EDT on the dates indicated in this document. Late or incomplete submission of deliverables may be subject to penalty points. Following receipt, organizers will review the deliverables and provide comments to teams. Teams shall correct all issues noted to be eligible for participation in the competition. Eligibility for earning points in the competition is determined separately from evaluation for an Approval to Proceed, as outlined in the Approval-to-Proceed Procedures, which are available on the [Solar Decathlon website](#).

Penalty points for late submissions still received on the due date are scaled linearly, based on the time received after 5 p.m. EST/EDT up until 11:59 p.m. EST/EDT on the due date. The maximum penalty associated with same-day late submission of each deliverable is two points; additional penalty points may be assigned for failure to meet submission requirements beyond the scenarios indicated in this document, including incomplete but on-time deliverables and deliverables received after the due date.

Refer to Table 7 for a summary listing deliverables and due dates.

## **3.4 Build Challenge House Restrictions**

### *National Showcase Size Restrictions*

The organizers and teams must meet National Park Service requirements for access throughout the National Mall at all times during setup and operation. At all times, the house module must remain on the gravel pathway of the mall, in the area designated on the site map. Each team's maximum dimensions from 0 ft to 7 ft above grade shall be no more than 15 ft wide in the north-south direction and no more than 60 ft long in the east-west direction. The maximum height of the house module, while in transportation mode, shall be 14 ft including any height of the trailer used to move the house. The finished floor level of the tourable module should be 27" (68.58 cm) above grade or less when in the exhibited configuration. The finished and conditioned space of the National Showcase house shall be at least 400 ft<sup>2</sup> as measured according to [ANSI Z765](#). The build area available to each team is 20 ft wide, 15 ft tall, and 80 ft long.

Teams may compete using one unit of a multifamily property, where additional dwelling units are placed adjacent to or otherwise surrounding the competition prototype. Teams may compete using a house that consists of more than one module; however, the module exhibited on the National Mall must meet the minimum size requirements of the National Showcase.

- a) The official height of a site component or set of contiguous site components is the vertical distance from the point of highest grade along the outside perimeter of the site component(s) to the highest point of the site component(s).

- b) Shading devices, solar panels, weather stations, antennas, air vents, and other similar components may be specifically exempted from the constraints listed above if all of the following conditions are met:
  - o The team makes a request to the Build Challenge Manager for an exemption prior to the start of setup.
  - o The element can be rapidly deployed, erected, or unfurled upon arrival on the competition site. Construction of any element newly existing is not permissible on-site.
  - o The Build Challenge Manager determines that the component is sufficiently unique in function to warrant an exemption.
- c) Moveable or convertible house or site components extending beyond the dimensions stated previously shall not restrict pedestrians at any time during jury visits, public exhibit hours, or contests.
- d) The organizers will rent and install ADA-compliant ramps for access to and from the house on the competition site. The ramps may protrude beyond the dimensions stated above, but orientation and placement must be coordinated with the organizers so as to minimize impact on the National Mall's existing infrastructure, such as park benches, light poles, and trash cans.

The finished square footage, as defined by [Square Footage—Method for Calculating: ANSI Z765-2003 \(R2013\)](#), shall be at least 400 ft<sup>2</sup> (55.742 square meters [m<sup>2</sup>]). The maximum is limited only by the maximum dimensions listed previously.

- a) 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.
- b) 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.

### *Local Build Size 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 duplex, row home, or townhouse development where units are placed side by side from each other.

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 600 ft<sup>2</sup> but shall not exceed 3,000 ft<sup>2</sup>.

- a) 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.

- b) 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.

### **3.5 House Design Requirements**

#### *Structural Design Approval*

Each team shall submit structural drawings and calculations that have been stamped by a qualified, licensed design professional for the complete house design and the exhibit on the National Mall. The professional must be registered in the state associated with the final target location of the house.

- a) By stamping the structural drawings and calculations, the licensed professional certifies that the structural provisions of the Solar Decathlon Build Challenge Building Code have been met by the design and that house is safe for the public to enter if it has been built as designed.
- b) The licensed professional shall stamp the structural drawings and calculations of the house and all site components that might pose a threat to public safety if they fail.
- c) The licensed professional shall stamp the structural drawings for any relevant element to be exhibited on the National Mall.

#### *Entrance and Exit Routes*

Each house must have a distinct entrance and exit doorway, each of which shall be at least 36 inches (in.) wide.

- a) The main house entrance may be placed on any side of the house. However, an accessible route leading from a public access point to the main entrance of the house shall be provided.
- b) The house exit route shall be accessible to the public and lead from the main house exit to a publicly accessible street or path.

#### *Competition Prototype Alternates*

The juries may consider alternate installations of the competition prototype; however, each team must build a single complete dwelling unit for consideration by the juries. Additional dwelling units may be proposed to be adjacent to, or otherwise surrounding, the competition prototype, but additions to the dwelling unit itself is not allowed. Only the competition prototype house with its included components and functionality, as built, is evaluated by juries. It is permissible to show the competition prototype house in context in renderings, photographs, or other media. National Showcase teams may bring a single module of a larger house, but the module must be presented as it would exist as part of the larger design.

- a) Juries shall consider how the design addresses local building code provisions and site restrictions at the target client's site.
- b) Public exhibit communications materials are not considered part of the competition prototype and do not need to be shown in renderings, drawings, or other materials.

## 3.6 Energy

### *Photovoltaic Technology Limitations*

- a) Bare photovoltaic (PV) cells and encapsulated PV modules must be commercially available by May 14, 2020, which is the beginning of the Solar Decathlon Local Build Division exhibit period, or approved by the organizers prior to the beginning of the Solar Decathlon Local Build Division exhibit period.
- b) Substantial modification of the crystal structure, junction, or metallization constitutes the manufacture of a new cell and is not allowed unless approved by the organizers prior to arrival at the competition site.

### *Energy Monitoring*

Teams shall install full branch-circuit level monitoring equipment within their competition prototype. Teams may be asked to provide the collected data at the conclusion of the competition, and the data may be shared among teams. For the benefit of teams and DOE, some energy monitoring equipment used for the competition may be left with each team following the completion of the competition for long-term research and monitoring.

### *Energy Sources*

Teams are expected to design their house to operate as part of an established electric grid and utility but must design their house to be able to operate off-grid. However, approval to operate on an electric grid is *not* a requirement of participation in the Build Challenge, for either the National Showcase or Local Build Challenges. After a team has become grid-tied, the organizers will not require grid isolation for testing should the local utility not allow islanding.

To participate successfully in the Build Challenge, each house must have the capability of operating independently of an electric utility grid. After the conclusion of construction and until the conclusion of the Build Challenge Event, global solar radiation incident on the lot is the only source of energy that may be consumed in the operation of the house without the requirement of subsequent energy offsets.

- a) Fireplaces, firepits, candles, and other devices using nonsolar fuels are not permitted in the designs.
- b) The use of batteries is permitted as detailed below in the Energy Storage Inspections section of these rules.

### *Energy Storage*

Batteries include most commercially available energy storage devices, such as electrochemical batteries and capacitors. Additional energy storage may also be permissible, following discussion and approval by the Build Challenge Manager.

- a) The use of energy storage as part of the competition prototype design is required to enable the off-grid operation previously discussed. The storage, such as batteries, and associated enclosure(s) must be compliant with the Solar Decathlon Build Challenge Building Code.
- b) The use of primary (nonrechargeable) batteries (no larger than 9-volt) is limited to smoke detectors, remote controls, thermostats, alarm clock backups, and other small devices that

typically use small primary batteries. These batteries do not need to end the competition with a full charge.

- c) The use of the factory-installed battery within a team's electric vehicle is permitted. Vehicle-to-grid power flow capabilities within the competition prototype is only permitted if vehicle-to-grid power flow and associated equipment are approved by the vehicle's manufacturer.
- d) Plug-in (nonhardwired) devices with small secondary (rechargeable) batteries that are designed to be recharged by the house's electrical system (e.g., a laptop computer) shall be connected, or plugged into, the house's electrical system whenever the devices are present at the competition house.

**Exception:** If not used in the operation of the house at any time during the Build Challenge Event, portable electronic devices used for mobile communications, such as cell phones and tablets, are permitted within the solar envelope without having to be plugged into the house's electrical system.

- e) Stand-alone, PV-powered devices with small secondary batteries are permitted, but the aggregate battery capacity of these devices may not exceed 100 watt-hours (Wh).

### *Desiccant Systems*

If a desiccant system is used, it must be regenerative.

- a) To ensure that the desiccant has been fully regenerated by the conclusion of the Energy Performance Contest, the desiccant material or device must be easily measurable.
- b) In most cases, the material or device is measured prior to, and at the conclusion of, the Energy Performance Contest. In some cases, a measurement at the conclusion of the Energy Performance Contest may not be necessary.
- c) At the conclusion of the Energy Balance Contest, the weight of the desiccant material or device shall be less than or equal to its initial weight.
- d) Some desiccant systems with very low moisture storage capacities may be exempt from this requirement. Exemptions are granted on a case-by-case basis by the Build Challenge Manager.

### *Gray Water Reuse*

A team may reuse gray water as permitted in the Solar Decathlon Build Challenge Building Code or approved by the Solar Decathlon Build Challenge Building Official on a case-by-case basis. Any gray water reuse must be approved by the Build Challenge Building Official before the start of construction.

### *Rainwater Collection*

A team may collect rainwater that falls on its site and use it in, or as, any of the following as permitted by their local Authority Having Jurisdiction:

- a) Irrigation source
- b) Water feature
- c) Heat sink or heat source

d) Other purposes as approved by the Solar Decathlon Building Official on a case-by-case basis.

### *Evaporation*

Water may be used for evaporation purposes.

### *Thermal Mass*

Teams may use liquids as thermal mass. The thermal storage containers shall be isolated, i.e., the contained liquid shall not circulate to other containers or systems.

### *Gray Water Heat Recovery*

Heat may be recovered from gray water as it flows from the drain to the waste tank. “Batch”-type gray water heat recovery is prohibited.

## **3.6.1 Build Challenge Events**

Build Challenge Events include Design Challenge Weekend occurring April 12–14, 2019 at NREL in Golden, Colorado, the Local Build Division exhibit, which runs May 14–June 14, 2020, and the National Showcase Event at the 2020 Smithsonian Folklife Festival in Washington, D.C. Optionally, select top-performing teams may be invited to participate in the 2021 NAHB’s International Builders’ Show.

### *Registration*

All Solar Decathlon Build Challenge Event participants must register.

- a) The following rules apply to **all participants**:
  - Each event participant must register individually. Group registrations are not allowed.
  - When registering, event participants must complete all required information and forms before access to the competition site is allowed.
- b) **Organizers, team members, and staff** should use the online registration site to submit completed forms, information, and Foreign National Data Cards prior to the Build Challenge Event. Once all information, forms, and Foreign National Data Cards are received, the organizers will issue an event security ID that must be visible at all times while on the competition site.
- c) **Visiting media** are not considered participants and will not be required to register but must check in at registration headquarters. For safety, site access for visiting media may be restricted.

### *Event Sponsor Recognition*

All communications materials produced by the teams concerning or referring to the project (including team websites) shall refer prominently to the competition as the “U.S. Department of Energy Solar Decathlon” and the Challenge as the “2020 Build Challenge.”

- a) Teams are required to use the Solar Decathlon logo, the DOE word mark, and the NREL logo on all communication materials used on the competition site. The Solar Decathlon logo must be at least three times the size of all other logos, as outlined in the Solar Decathlon identity

guidelines.<sup>3</sup> As appropriate, the team may be asked to recognize the Smithsonian Folklife Festival as part of their elements on the national mall site.

- b) The Solar Decathlon logo, the DOE word mark, and the NREL logo are the only required graphic elements teams must use.
- c) Team uniforms are exempt.

### *Team Sponsor Recognition*

Team sponsors may be recognized with text, logos, or both, but the text and logos must appear in conjunction with the Solar Decathlon text and logo and meet the Smithsonian Folklife Festival branding requirements.

- a) The information in the Construction Equipment at the Build Challenge Event Site section applies, but is not limited, to all communications materials that will be on display or distributed on the Build Challenge Event Site.
- b) Communications materials or other products that exist largely for the recognition of sponsors are limited to 20 ft<sup>2</sup> (1.858 m<sup>2</sup>), on the National Mall at the Build Challenge Event. “Other products” include, but are not limited to, signs, exhibits, posters, plaques, photos, wall art, and furnishings.
- c) For multimedia or audio presentations a team chooses to play on the National Mall, no more than 20% of the total time, 1 minute, or whichever is less may be dedicated to the recognition of team sponsors.
- d) Off-the-shelf components that feature a built-in manufacturer’s logo are acceptable and do not need to be accompanied by the Solar Decathlon text and logo.
- e) Team uniforms are exempt.

### *Logistics at the Build Challenge Event*

- a) Each team is responsible for the transport of its house or its exhibit, including the house’s contents, and all necessary tools and equipment to the Build Challenge Event Site. Each team is responsible for any damage to or loss of such items.
- b) The organizers will provide a telehandler and operator for unloading exhibits or elements. The specifications of the equipment available are provided on the [Groups.io Project Site](#) so teams can design their exhibits accordingly.
- c) Each team is responsible for procuring all necessary equipment, tools, and supplies to build its house and to exhibit at the Build Challenge Event.
- d) Each team is responsible for transportation, accommodations, lodging, food, and beverages. The organizers will make drinking water available on the competition site to all team members for the duration of the Build Challenge Event.
- e) Each team is responsible for making its own reservations and arrangements, and for covering all necessary costs.

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<sup>3</sup> Solar Decathlon identity guidelines are expected to be made available by fall 2018.



## *Inspections*

Each team entry is required to comply with the Solar Decathlon Build Challenge Rules and Building Code.

- a) All teams must provide an inspection record from their local Authority Having Jurisdiction or an approved third-party inspector that demonstrates compliance with the Solar Decathlon Building Code and, as applicable, locally adopted codes. Inspections are expected to occur throughout the construction process and must be completed for a team to be eligible to compete in the Build Challenge Event.
- b) Each team shall be required to provide an ADA-compliant accessible tour-route through its house, inspected by a qualified professional prior to public exhibit. The entire home does not need to be accessible.
- c) Additional random inspections for compliance may take place throughout the Build Challenge Event.
- d) The Build Challenge Manager shall check each team's inspection status, as indicated on the team's official inspection card, to determine which houses are eligible to participate in the contests. All final inspections shall be passed by the deadline indicated on the Build Challenge calendar, which is available on the [Groups.io Project Site](#). Failure to pass inspections by the required deadline may disqualify a team for participation in the Build Challenge Event and is considered a rules violation. A team must have passed inspections by the conclusion of the inspector's workday for a team to be eligible to participate in the following day's contests, which officially start at midnight.

**Exception:** Jury visits or presentations will proceed as scheduled regardless of a team's inspection status. However, jurors will be made aware of the team's inspection status and may consider it in their evaluations.

- e) Because open, partially functioning houses and exhibits are preferable to closed, fully functioning houses, the organizers may direct the inspectors to require that an unsafe condition be corrected so public visits can occur—even if, as a consequence, the house is ineligible for participation in one or more contests.

## **3.7 Site Operations at the Build Challenge Event Site**

The following sections apply only to activities on the Build Challenge Event Site on the National Mall in Washington, D.C., as part of the 2020 Smithsonian Folklife Festival. For any construction done off-site, either in preparation for exhibition on the Event Site or as part of the Local Build Division, teams are expected to follow local rules and regulations.

### *Damage Liability*

Each team is financially responsible for any damage it causes to the Build Challenge Event Site.

### *Construction Equipment at the Build Challenge Event Site*

- a) Trailers, semitrailer trucks, and related vehicles are limited to the approved surfaces of the Build Challenge Event Site.
- b) Heavy construction equipment, including cranes, are prohibited at all times for use by teams on the Build Challenge Event Site without prior approval from the Build Challenge Manager.

A team may use a scissor lift or similar equipment for safe movement of personnel during the unfurling of the National Showcase houses. An exception may be made with prior approval from the Build Challenge Manager.

- c) Teams shall not permit the use of any equipment or tools at the Build Challenge Event that are not safe and/or do not comply with applicable requirements of OSHA and/or other related regulatory standards. Teams are expected to follow safe and applicable practices at their own Local Build sites.

### *Ground Penetration at the Build Challenge Event Site*

Ground penetration on the Build Challenge Event Site on the National Mall is not permissible at any time.

### *Impact on the Build Challenge Event Site*

Footings, or the use of appropriate trailer wheels and stabilizing elements, shall be used to support all house and site components. All footings shall comply with the bearing pressure criteria specified in the Solar Decathlon Building Code.

### *Generators*

Teams are not allowed to use generators at the Build Challenge Event Site. Minimal power will be available from the organizers for teams use to power tools and lights.

### *Spill Containment*

The release of water or other liquids onto the Build Challenge Event Site or into nearby storm drains is prohibited.

### *Lot Conditions*

A vertical elevation change of up to 6 in. (15.24 centimeters [cm]) may exist across any 50 linear feet of area designated for team use at the Build Challenge Event. Teams must plan for adjusting the levelness of their finished floor and plan accordingly to meet the specific conditions. While each National Showcase house is expected to remain on its transportation trailer, some teams may choose to use adjustable jacks or footings to level the floor and provide additional stability. For National Showcase teams, the organizers will provide and install ramps with handrails as necessary for an accessible route from each team's ingress and egress doors to the Event Site. The maximum height above grade of the finished floor for National Showcase house modules shall be 28 inches when installed. Any height greater than this requires approval and coordination in advance.

### *Vegetation Placement*

The use of vegetation is permitted. All vegetation shall comply with the Impact on the Build Challenge Event Site rules and the Spill Containment rules. Vegetation may be moved until the beginning of the Build Challenge Event, after which time it shall remain stationary until the conclusion of the Build Challenge Event, unless the drawings clearly show how some or all vegetation is designed to be moved as part of an integrated system.

## Gray Water Storage

The organizers will provide water to National Showcase teams for use in their houses to assist with the completion of measured contest activities, if required; however, teams are required to store any water used in storage tanks under the house until it is removed by a suction-pump truck at the conclusion of the Build Challenge Event.

- a) Primary gray water containers shall be located outside of the finished square footage. These containers may be located beneath the finished square footage. Juries will be directed to disregard the presence of any temporary tanks in their evaluation.

**Exception:** Teams may utilize one or more small tanks, up to a maximum aggregate volume of 20 gallons (gal) (75.708 liters [L]), to accept wastewater discharge in preparation for delivery to the main wastewater tank(s).

- b) Solar storage, hot water, or other thermal storage containers may be located within the finished square footage.

## Team-Provided Liquids

A team may provide its own liquids for the following purposes:

- a) Personal hydration
- b) Irrigation (one-time delivery before water delivery day, 50 gal [189.271 L] limit, water only]
- c) Thermal mass
- d) Food preparation
- e) Hydronic system pressure testing<sup>4</sup>
- f) Setup (e.g., hydraulic fluid), finishing (e.g., paint), and cleaning (e.g., mineral spirits)
- g) Glycol, deionized water, or other working fluids for thermodynamic systems using working fluids other than nonpotable water if approved by the organizers prior to arrival at the competition site.

## Water Supply

National Showcase Division teams are able to receive water from the organizers.<sup>5</sup>

The procedure and associated requirements for water delivery are as follows:

- a) Team design deliverables shall clearly indicate the connection location(s), quantity of water requested, and clearance for connecting to the fill location(s) (minimum 12 in. [30.48 cm]). All locations shall be easily accessible.
- b) Teams are responsible for distributing water within their houses. This includes all necessary pumps, containers, lines, valves, and so on.

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<sup>4</sup> The water may only fill isolated loops; it shall not enter tanks.

<sup>5</sup> The teams shall include a detailed water budget in the project manual.

### *Water Removal*

Teams are required to provide gray water storage tanks for any water they use during the competition. The procedure and associated requirements for water removal follow:

- a) On water removal day, a water truck will service each house. Each truck will be equipped with a pump to aid in water removal.
- b) Teams shall supply a minimum of six people, on command, to help move the water hose to their house from the previously serviced house.
- c) After the two trucks have serviced all houses once, they will visit the village again to service any house needing remaining water removed.
- d) Teams that delay the water removal process may be required to pay for their own water removal. Teams required to pay for their own water removal shall use a company approved by the organizers.
- e) Team design deliverables shall clearly indicate the removal location(s), quantity of water to be removed from each removal location, container dimensions, diameter of the opening(s) (minimum 4 in. [10.16 cm]), and clearance above the container(s) fill location(s) (minimum 12 in. [30.48 cm]). All openings shall be easily accessible.
- f) Teams are responsible for either removing remaining water from the site.

## **3.8 Build Challenge Activities**

### *House Occupancy*

Under normal circumstances, no more than 50 people may be located in the finished square footage of the house at any one time for safety reasons. This applies to both the Local Build and National Showcase teams.

- a) Occupancy will also be limited when temperature and humidity measurements are being taken, though this is expected to occur outside of public exhibit periods. See the Build Challenge calendar on the [Groups.io Project Site](#) for the temperature and humidity measurements schedule.
- b) Jurors, Observers, official organizer-provided competition photographers, media, writers, visiting Observers, and others with authority to enter a house as an organizer are not counted toward the number of house occupants.

### *House Operators*

Only student decathletes, as defined in Section 2.3, are permitted to operate the house and participate in the contests.

- a) All competition-related communications during the Build Challenge Events shall be between the organizers and decathletes. Nondecathlete team members and crew, including faculty, are not permitted to participate in or listen to competition-related communications.
- b) Nondecathlete team members are permitted to give tours to the public and be present on the competition site.

### *Late Design Changes*

The final project assembled on the competition site shall be consistent with the design and specifications presented in the As-Built Documentation.

- a) If there are known inconsistencies between the final project and the as-built drawings and the Project Manual, the team shall document these inconsistencies and submit the documentation to the Build Challenge Manager as soon as possible after the inconsistency is known. The Build Challenge Manager will review the changes against the team's final documentation to assess whether the changes warrant additional or different controls. The Build Challenge Manager will compile a summary of all known inconsistencies discovered during the inspections process and submit the summary to the respective juries.

### *Public Exhibit*

- a) Teams are required to provide an accessible route to all areas of the house or exhibit that are available to the public during exhibit hours.
- b) Teams are permitted to produce and distribute up to one informational brochure or handout at the Build Challenge Event.
- c) Teams shall develop signage that complements public exhibit tours by informing visitors about the team project and engaging visitors waiting in line.
- d) Signage on display at the Build Challenge Events shall be compliant with National Park Service rules and the Smithsonian Folklife Festival Branding Guidelines.
- e) Teams are prohibited from selling items to the general public on at the Build Challenge Event.
- f) Teams are prohibited from providing food and beverages to the general public at the Build Challenge Event Site.
- g) Each house shall be impounded on specified nights as indicated in the Build Challenge calendar under the direct supervision of the organizers or staff. Team members shall not occupy the competition site during impound hours to be indicated in the competition calendar.

### *Team Uniforms*

- a) During the Build Challenge Events and special events specified by the organizers, all team members present on the competition site or the site of a special event shall wear uniforms representing their team.
- b) Team uniforms are exempt from the Event Sponsor Recognition section.
- c) Team sponsor logos are approved to be visible only on the back of the team uniform (e.g., jacket, shirt, hat, or another wearable item).
- d) The only information or graphics that are approved to be visible from the front of the team uniform (jacket, shirt, hat, or other wearable item) shall be the institution(s) and its logo(s), the team name and logo, and the Solar Decathlon logo.

## 4 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, as outlined in Table 3. 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.

**Table 3. Contests and Subcontests**

Contest No.	Contest Name	Points	Subcontest Name	Subcontest Points
1	Energy Performance	100	Energy Efficiency (HERS Score w/o PV)	30
			Energy Production (producing power w/ PV)	20
			Net-Zero Plus Energy (estimated annual energy production – consumption)	20
			Demand Response (capability to shed at least 30% of peak load automatically)	10
			Off-Grid Functionality (ability to maintain critical <u>loads</u> )	20
2	Engineering	100	None	n/a
3	Financial Feasibility & Affordability	100	None	n/a
4	Resilience	100	None	n/a
5	Architecture	100	None	n/a
6	Operations	100	Kitchen Appliances	25
			Hot Water	25
			Laundry	5
			Electric Lighting	15
			Home Electronics	5
			House Occupancy	10
			Electric Vehicle Charging	15
7	Market Potential	100	None	n/a
8	Comfort & Environmental Quality	100	Temperature Control	30
			Humidity Control	20
			Indoor Air Quality	20
			Air Tightness	20
			Exterior Noise Infiltration	5
			Internally Generated Noise	5
9	Innovation	100	None	n/a
10	Presentation	100	None	n/a

## 4.1 Energy Performance

### *Contest Intent*

This Contest evaluates the building's energy use and production, as well as its capability to provide energy services—whether connected to the electricity grid or operating with on-site and/or stored power.

Superior energy performance is at the heart of the Solar Decathlon. Energy modeling can help inform design choices as well as estimate a building's likely energy performance. Once built, energy performance is verified by measuring building loads as well as on-site generation. The capabilities of the building to interact with the grid, and potentially address the needs of a local electric utility, are also part of a building's overall energy performance. Finally, thoughtful selection and operation of lighting, plug loads, appliances, and other components are increasingly important as they commonly represent more than 50% of total energy consumption in high-performance buildings.

### *Energy Efficiency Subcontest*

The residential building industry often uses the Home Energy Rating System (HERS) Index to indicate energy efficiency. A lower score signifies a more energy efficient home. To determine the score, homes are compared to a benchmark based on the [2006 International Energy Conservation Code](#). The HERS score can be calculated by using any accredited HERS software.

HERS rating software calculates heating, cooling, hot water, lighting, and appliance energy loads, consumption, and costs for new and existing single family and multifamily homes. One of the industry accredited programs, REM/Rate™, is provided to teams at no charge after completing the team application; however, using it is not required. The organizers will generate a HERS score of each house as part of measured contest scores following a consistent and to-be-distributed process provided to all teams.

All available points are earned for a HERS score of 35 or below, without any renewable energy being considered. The organizers will hire qualified HERS rater(s) to evaluate all team houses based on as-built features and construction documents.

- a) Reduced points are earned for a HERS score between 35 and 60. Reduced points are scaled linearly. No points are earned for a HERS score above 60.

### *Energy Production Subcontest*

All available points in this Subcontest are earned at the conclusion of the energy period by successfully generating at least 20 kilowatt-hours (kWh) in a 24-hour period, starting at a time agreed upon in advance between the team and the organizers. A positive energy production indicates successful solar installation and operability.

- a) Reduced points are earned for an energy production value between 0 kWh and 20 kWh. Reduced points are scaled linearly. No points are earned for an energy production value of 0 kWh.



### *Net-Zero Plus Energy Subcontest*

Each team's modeled energy production and estimated energy consumption will be evaluated by the organizers for the target site, as well as evaluated for whether or not the house will produce at least as much energy as it will consume over the course of 1 year, including the charging and operation of an electric vehicle estimated to be driven 20 miles per day.

- a) Reduced points are earned for an annual net consumption between 0 kWh and 2,000 kWh. Reduced points are scaled linearly. No points are earned for an estimated annual net-energy consumption more than 2,000 kWh.

### *Demand Response Subcontest*

Each house shall have the capability to respond to a conceptual utility-initiated load-shedding call. To earn full points in this Subcontest, the organizers will verify the house's capability to shed at least 30% of its load in response to a received request from the local utility.

- a) Reduced points are earned for a load-shedding capability between 0% and 30% of its load. Reduced points are scaled linearly. If automated load-shedding is not possible, no points are earned.

### *Off-Grid Functionality Subcontest*

To demonstrate resilience, each house shall have the capability of maintaining critical loads in the house for a period of at least three days (72 hours) within the schedule provided in the Build Challenge calendar, which is available on the [Groups.io Project Site](#). Critical loads shall include, at a minimum, fire protection systems, a refrigerator, a freezer, sufficient lighting circuits to maintain 70 lux (lx) in the living room for at least 4 hours daily, one small appliance circuit, and two plug outlets for critical occupant personal devices. If the photovoltaic system allows operation in an islanded mode, PV generation will be estimated as the average daily production over annual analysis for each of the three days.

- a) Reduced points are earned for an ability to maintain critical loads for between 24 and 72 hours. Reduced points are scaled linearly. No points are earned for an inability to maintain critical loads for at least 24 hours.

## **4.2 Engineering**

### *Contest Intent*

This Contest evaluates the effective integration of high-performance engineering systems in energy-efficient and energy-producing buildings.

Structural and engineering systems should be effectively integrated with natural heating and cooling opportunities, including solar orientation, thermal mass storage, solar shading, and convective cross-ventilation. Heating, cooling, water, and ventilating system types and design should reflect thoughtful consideration of different technology and integration options, including analysis of implications for energy and environmental performance, up-front and long-term costs, and reliability. The space-conditioning system must be designed to maintain comfort with extremely low load conditions via effective temperature control, humidity control, air mixing, and distribution systems. Opportunities for water efficiency should be reflected in smart

engineering solutions for domestic hot water delivery and landscaping irrigation, as well as selection of plumbing fixtures and landscaping.

### *Build Challenge Criteria*

A jury of engineers shall assign an overall score for the house's engineering merit and implementation. The jury will consider the submitted deliverables and perform an extensive evaluation of the as-built house.

The jury shall consider the following specific criteria in its evaluation:

#### **Approach**

- Quality of the overall approach to solving engineering challenges and integrating solutions in design
- Extent to which the design demonstrates research, multidiscipline collaboration, market-leading technologies, and engineering integration.

#### **Design**

- How well will house systems and architectural details function together?
- Sound selection and design of all building envelope components (foundation, wall systems, roof) to address building science control layers
- Natural comfort design (a.k.a., passive solar design) integration including solutions such as solar orientation, effective solar shading, thermal mass storage, and cross-ventilation
- How well will the home's envelope and active comfort systems maintain occupant comfort in the permanent site location year-round, including but not limited to: air temperature, humidity, surface temperatures, temperature asymmetries and stratifications
- Lighting system selection and design for energy efficient ambient, task, and mood lighting fully integrated with natural light
- How appropriately are energy production systems sized for estimated annual performance of the competition prototype house at its target location?
- Plumbing system layout for efficient hot water delivery
- Landscaping system for minimizing water use for irrigation.

#### **Efficiency and Performance**

- To what extent is energy efficiency integrated into the house design?
- How complete is the space-conditioning system integration within the building's structural system?
- Extent of the quality of space-conditioning system design to ensure full air mixing in all rooms
- To what extent is water efficiency integrated into the house design?
- To what extent has the team considered maintenance in the design?

- How likely is it that a homeowner will be able to operate the house as the team intends?

### **Documentation**

- How accurate, complete, and clear are the competition drawings and specifications?
- To what extent was the energy model created in a professional and accurate manner?
- How effectively did the reviewed deliverables reflect the constructed project and enable the jury to conduct a preliminary evaluation of the design prior to its arrival at the competition site?

### **Engineering Innovation**

In addition to and separate from the score assigned to each team for the Engineering Contest, the jury shall assign each team a score for innovation, which is scored as one-quarter of the Innovation Contest.

- To what extent did the team use engineering research processes to develop or decide on the solution implemented?
- To what extent does the design solution utilize new, unique, or atypical technologies or engineering solutions that improve on the status quo?

## **4.3 Financial Feasibility & Affordability**

### *Contest Intent*

This Contest evaluates the building's financial costs and ability to address growing affordability challenges in the housing industry.

The purpose of this Contest is to ensure the team's unique solution is affordable and cost-effective for occupants. Financial analysis should include up-front cost to the consumer, monthly utilities, and maintenance to determine an overall cost of ownership, and provide a basis for comparison to the financial capabilities of the target market. The cost of construction, and the extent to which the design would cost more than a minimally code-compliant building, should be carefully considered and justified.

### *Build Challenge Criteria*

A jury of professional builders and cost estimators shall assign an overall score for the house's financial feasibility in the marketplace, including the up-front cost and costs of operation and maintenance. The jury will consider the submitted deliverables and perform an in-depth evaluation of the as-built house.

The jury shall consider the following specific criteria in its evaluation:

### **Affordability**

- How likely is it that the house would be affordable to the team's target market, estimated up-front cost (i.e., cost to consumer), financing, insurance, taxes, monthly utilities, and maintenance?

- How do the energy-related and other innovative features enhance the home's market value?
- To what extent does the estimated competition prototype cost align with market needs and expectations?

#### **Cost-Effectiveness<sup>6</sup>**

- Does the house offer a good value to the target market, considering quality of design, construction, materials, equipment, and other related elements?
- To what extent is the cost-effectiveness supported by reasonable and complete market analysis?

#### **Cost Estimate**

- Quality of construction cost estimate based on built house.
- How successfully does the team construction cost estimate reflect the as-built competition house?
- The quality and magnitude of the team operational cost estimate for the as-built competition house, including forecasted utility, maintenance, insurance, and any monthly operations or subscription fees.

## **4.4 Resilience**

### *Contest Intent*

This Contest evaluates the building's ability to withstand and recover from prevailing disaster risks for its intended location, maintain critical operations during grid disruptions that commonly occur post-disasters, and ensure long-term durability in response to local climatic conditions.

Resilience is the ability to anticipate, withstand, respond to, and recover from disruptions. The benefits of investing in highly efficient buildings are protected by also investing in resilient design. Buildings must demonstrate how they effectively address all of these challenges.

### *Build Challenge Criteria*

A jury of industry professionals shall assign an overall score for the house's durability and resilience. The jury will consider the submitted deliverables and perform an on-site evaluation of the as-built house.

The jury shall consider the following specific criteria in its evaluation:

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<sup>6</sup> Although no points are directly assigned based on the estimated construction cost of the house, the jury will evaluate whether cost-effective decisions were made with respect to the client demographic and expected house performance. A professional cost estimator is included as part of the jury and will review the team-developed estimated construction cost in detail to determine its thoroughness, reasonableness, and accuracy. Teams may provide justification to have the cost of a particular innovative technology included at a cost equal to a market-ready equivalent.

## **Durability**

- To what level do the building design details, materials selection, and construction practices ensure durability of all building science control layers (thermal, air, bulk moisture, and moisture vapor)?
- To what extent is the house, through both design and materials, durable and able to resist extreme environmental conditions?
- How well does the design optimize or address longevity of design, including maintenance, material performance, life cycle costs, and owner operation?

## **Performance**

- To what extent does the building design approach for the specified location enable the building to withstand and recover from potential disasters because of risks posed by weather and other natural or man-made events?
- To what extent does the house provide occupants critical load capabilities, including the ability to operate during an extended power and water outage through energy efficiency designs, on-site generation, on-site storage with islanding capabilities, and critical load considerations?

## **Resource Management**

- To what extent does the team holistically integrate passive strategies, materials selection, life cycle, and local strategies to maximize resilience?
- To what extent does the competition prototype enable the reclamation and reuse of water utilized by the house?
- To what extent is the competition prototype house expected to require less energy than a comparable minimally code-compliant building?

## **Resilience Innovation**

In addition to and separate from the score assigned to each team for the Resilience Contest, the jury shall assign each team a score for innovation, which is scored as one-quarter of the Innovation Contest.

- To what extent did the team take unique or innovative approaches to building resilience and occupant safety throughout the design process and implementation?
- How well does the team use resilient design to improve house performance and occupant health?

## 4.5 Architecture

### *Contest Intent*

This Contest evaluates the building architectural design for its creativity, overall integration of systems, and ability to deliver outstanding aesthetics and functionality along with energy-efficient performance.

Cutting-edge energy-efficient building performance is better positioned to achieve market acceptance if integrated into architectural designs that creatively meet or exceed aesthetic and functional expectations of both industry and consumers. Specifically, good design marries aesthetics with sound building science, energy efficiency, natural comfort (e.g., glare-free views, natural heating, natural fresh air, and natural lighting), energy production, and resilience.

### *Build Challenge Criteria*

A jury of architects shall assign an overall score for the design's architectural conceptual coherence, merit, integration, and implementation. The jury will consider the submitted deliverables and perform an extensive evaluation of the as-built house.

The jury shall consider the following specific criteria in its evaluation:

#### **Architectural Concept and Design Approach**

- How well did the team utilize an overall clear concept, idea, or ideas to guide the development of the house?
- How well does the house demonstrate overall coherence among disciplines and systems?
- How well does the house address unique issues and challenges to respond to its target site?
- What is the design's overall ability to effectively enhance the life of intended occupants?
- How effectively does the overall architectural design offer a sense of inspiration and delight to occupants?
- To what extent does the design consider climatology, including plant palette and water conservation, in the landscaping and site design?
- How effectively does the design address unique issues and challenges given its target site?

#### **Architectural Implementation**

- What is the overall quality of the architectural design and project appearance?
- What is the design's effectiveness in integrating energy efficiency and building science principles?
- To what extent do the floor plan and interior details account for functionality, furnishings, storage, linkages to outdoors, and efficient use of space?

- How well does the house demonstrate quality design through materials, details, and implementation?<sup>7</sup>
- How effectively does the design use natural methods to meet heating, cooling, and lighting needs (also known as passive solar design)?
- How well does the team integrate both natural and electric lighting into the house?
- How well did the team integrate energy efficiency and energy production technologies into the architectural design?
- How optimal is the use and consideration of the specified site, including views, drainage, regionally appropriate materials, and community connection?

### **Documentation**

- How effectively did the deliverables enable the jury to conduct a preliminary evaluation of the design?<sup>8</sup>
- How effectively does the team use digital technology, to represent its as-built competition prototype remotely?
- How accurate, complete, and clear are the competition drawings and specifications?

### **Architectural Innovation**

In addition to and separate from the score assigned to each team for the Architecture Contest, the jury shall assign each team a score for innovation, which is scored as one-quarter of the Innovation Contest.

- How innovative was the team in its use of architectural elements including, but not limited to, scale and proportion, indoor/outdoor connections, composition, and linking of various house elements?
- How innovative was the team’s approach to holistic and integrated design, inclusive of space, structure, and building envelope?

## **4.6 Operations**

### *Contest Intent*

This Contest evaluates how effectively and efficiently the building operates to carry out intended functions while also ensuring persistence of performance.

Building systems, appliances, and features should be thoughtfully selected and integrated into the overall design. Buildings should incorporate creative and technical solutions that work seamlessly with energy efficiency and energy production strategies. This includes strategies for persistence of performance (e.g., efficiency, comfort, health, safety, and durability) that address operation limitations of typical occupants.

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<sup>7</sup> The jury should consider the design, detailing, and implementation from the perspective of a professionally constructed house. Student-built or installed elements should be evaluated as if they were professionally built and installed.

<sup>8</sup> Deliverables are required to accurately reflect the competition prototype as it appears on the competition site.

For all Operations Subcontests, see the Build Challenge Event Schedule to be provided on the [Groups.io Project Site](#) for the agenda and number of available points per scored period, measurement, or task.

### *Kitchen Appliances Subcontest*

All available points are earned for successfully operating each kitchen appliance according to the following constraints.

- a) **Refrigerator:** All available points are earned for maintaining time-averaged interior temperature of a refrigerator between 34°F (1.111°C) and 40°F (4.444°C) during the scored periods.
  - Reduced points are earned if the time-averaged interior refrigerator temperature is between 32°F (0°C) and 34°F (1.111°C) or between 40°F (4.444°C) and 42°F (5.556°C). Reduced point values are scaled linearly. No points are earned for a time-averaged interior refrigerator temperature below 32°F (0°C) or above 42°F (4.444°C).
  - The refrigerator volume published in the manufacturer's specifications shall be a minimum of 4.5 cubic feet (ft<sup>3</sup>) (0.127 cubic meters [m<sup>3</sup>]).
  - The refrigerator may only be used to store food and beverages.
- b) **Freezer:** All available points are earned for maintaining a time-averaged interior temperature of a freezer between -20°F (-28.889°C) and 5°F (-15°C) during the scored periods.
  - Reduced points are earned if the time-averaged interior freezer temperature is between -30°F (-34.444°C) and -20°F (-28.889°C) or between 5°F (-15°C) and 15°F (-9.444°C). Reduced point values are scaled linearly.
  - The freezer volume published in the manufacturer's specifications shall be a minimum of 2 ft<sup>3</sup> (0.0566 m<sup>3</sup>).
  - The freezer may be used to store food and only enough ice to fill the freezer's ice bin (or equivalent).
- c) **Oven:** All available points are earned for establishing an interior temperature of an oven between 400°F (176.667°C) and 450°F (204.444°C) during scored periods.
  - Reduced points are earned if the time-averaged interior oven temperature is between 250°F (-34.444°C) and 400°F (-28.889°C) or between 5°F (-15°C) and 15°F (-9.444°C). Reduced point values are scaled linearly.
  - The oven volume published in the manufacturer's specifications shall be a minimum of 2 ft<sup>3</sup> (0.0566 m<sup>3</sup>).
  - The oven may not contain any food or beverages during the measurement period.
  - Teams are provided two attempts to meet this requirement, with each attempt separated by at least 8 hours of time.
- d) **Cooktop:** All available points are earned for bringing at least 8 cups (1.892 L) of water in a pot to a rolling boil during a scored period.



- Reduced points are earned if the temperature of the water is between 50% and 100% of the boiling temperature of water for the location where measurements are collected. Reduced point values are scaled linearly.
- Teams are provided two attempts to meet this requirement, with each attempt separated by at least 8 hours of time.

### *Hot Water Subcontest*

Significant water and energy are often wasted as occupants wait for hot water to emerge from their showerhead. All available points are earned for providing water of at least 105°F (40.556°C) before an average of 2 cups (0.473 L) of water has passed through each of the showerhead, lavatory, and kitchen sink faucets under normal operation. If more than one of each fixture exists in the house, the fixture likely to be most-commonly used shall be the one evaluated.

- a) Reduced points are earned for an average draw between 2 (0.473 L) and 20 (4.73 L) cups. Reduced point values are scaled linearly. If more than 20 (4.73 L) cups of water, on average, is required to be drawn to reach a temperature of 105°F (40.556°C), no points are earned.
- b) Teams are offered three attempts to meet this requirement, with each attempt separated by at least 8 hours of time. The team may not cycle water through their system in advance of this evaluation in a way intended to manipulate the evaluation results.

### *Laundry Subcontest*

All available points are earned for washing laundry by running an automatic clothes washer containing six organizer-supplied bath towels through three complete, uninterrupted, “normal” (or equivalent) cycles on one of the specified days in the Build Challenge calendar, which is available on the [Groups.io Project Site](#).

- a) The clothes washer shall operate automatically and have at least one wash and rinse cycle.
- b) Cycle “interruption” includes the adjustment of supply temperature or flow in a manner not anticipated by the manufacturer or addressed in its operation manual.
- c) The organizers will consult the operation manual to identify appropriate cycle settings. “Normal” or “regular” settings shall be selected, if available. Otherwise, settings most closely resembling typical “normal” or “regular” settings shall be selected.
- d) The evaluation begins when a team indicates it is ready for the organizers to evaluate. Multiple attempts per load are not allowed.

### *Electric Lighting Subcontest*

All available points are earned at the conclusion of each scored period by achieving a time-averaged interior illumination level of 300 lx or greater when evaluated according to the Build Challenge Event schedule.

- a) Reduced points are earned if the time-averaged interior illumination level is between 300 lx and 100 lx. Reduced point values are scaled linearly. No points are earned for a time-averaged interior illumination level below 100 lx.

- b) The organizers will identify at least two zones in each house and measure the illumination level at the approximate center of each zone at an approximate height of 3 ft (0.914 meters [m]). Care will be taken to ensure that the measurement reflects the functional illumination of the room. The time-averaged interior illumination level deviating farthest from the target lighting level for a particular scored period is the illumination level of record.

### *Home Electronics Subcontest*

All available points are earned for successfully operating smart home electronics, including a television, a computer, a smart outlet, and energy monitoring circuits. Teams may choose when to target earning points within the available times indicated in the Build Challenge calendar, which is available on the [Groups.io Project Site](#). The available points are divided equally across the three elements listed below:

- a) The television display shall be a minimum of 27 in. (68.58 cm), and the computer display shall be a minimum of 15 in. (38.1 cm), each as according to the manufacturer's stated display size. The television and computer displays shall be able to be operated simultaneously and controlled independently of each other. Points are earned for demonstrating that each can be powered and operated successfully.
- b) Each home shall have at least one smart outlet or light that can be controlled remotely and set to a schedule. Points are earned for demonstrating successful operation of the outlet or light.
- c) Each home shall have the ability for the homeowner to monitor circuit-level energy use. Points are earned for demonstrating complete and successful circuit-level energy monitoring to the organizers.

### *House Occupancy Subcontest*

Each team shall host at least six members of its community for at least 2 hours as specified in the Build Challenge calendar, which is available on the [Groups.io Project Site](#). The House Occupancy Subcontest will feature at least six individuals in addition to two decathletes operating the house. The goal of this Subcontest is to validate a fully functional house with visitors and to enable a successful evaluation of the house for the Comfort & Environmental Quality Contest. To earn full points for the House Occupancy Subcontest, teams shall:

- a) Host at least six guests, including at least one organizer-invited Observer.
- b) Serve a complete meal with an adequate amount of food for all guests at appropriate serving temperatures and in a timely manner.
- c) Prepare and cook all food and beverages in the house during a scheduled period of time in accordance with the Build Challenge calendar, which is available on the [Groups.io Project Site](#).
- d) Serve and have guests eat the meal in the finished square footage.
- e) Comply with the following safety requirements:
  - Do not use any flames, including candle flames.
  - Do not serve or use any alcoholic beverages.
  - Use only drinking water purchased in sealed containers.

- Wash and rinse all dishes and cookware before use.
- Store all food and beverages properly while on the competition site.
- Do not use coolers to store food, beverages, or ice on the competition site.

### *Electric Vehicle Charging Subcontest*

All available points are earned for charging an electric vehicle from a battery state below 25% to “full” within a time period available in the Build Challenge calendar, which is available on the [Groups.io Project Site](#). Teams may choose when to begin the charging, but each task must begin and end within the times indicated in the Build Challenge calendar and once a team has initiated the task, additional attempts are not permitted. Teams may drive the car before start of the Subcontest to reduce the battery charge state an appropriate starting level.

- a) The vehicle must be entirely electric. Hybrid vehicles and nonelectric vehicles are not permitted.
- b) The competition prototype house must include the infrastructure required to charge the vehicle.
- c) Any vehicle used must be a model commercially available at the beginning of the Build Challenge Event.
- d) The vehicle must have four wheels and, at a minimum, seat two individuals side-by-side.
- e) The charging of the vehicle must be witnessed by an organizer-approved Observer.

## **4.7 Market Potential**

### *Contest Intent*

This Contest evaluates the building’s responsiveness to its stated target market, likely appeal to intended occupants and the construction industry, and ability to transform how energy is used in buildings given its approach and wide-scale desirability.

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 construction productivity. It will also include construction documentation that helps ensure best practices and quality workmanship.

### *Build Challenge Criteria*

A jury of professionals from the home-building industry shall assign an overall score for the design’s responsiveness to the characteristics and requirements of the team-defined target market and market impact potential. The Jury will consider the submitted deliverables and perform an extensive evaluation of the as-built house. The team must define a target client, with a minimum level of detail including household income, location, and requirements.

Teams shall define a target client with a minimum level of specificity as indicated in Table 4. The target market defined for the competition prototype must be for year-round occupancy. The

Jury will evaluate all construction details, style, and design details as demonstrated by the competition prototype as part of the Market Potential Contest.

### **Livability**

- How well does the design reflect current market expectations for livability and convenience?
- How well does the house support a safe, functional, convenient, comfortable, and enjoyable place to live?
- How successfully do the design details of the competition prototype meet the unique needs and desires of the target client?
- How successful is the design of the house's lighting, entertainment, and other controls?
- How successfully does the design encourage a homeowner to use fewer resources than a typical homeowner?

### **Market Analysis**

- How effective is the team market analysis, and how well does the design integrate key findings from the market analysis?
- How successfully do the house, material, equipment, and design details demonstrate appeal for the target client?
- How effectively does the team highlight the house's energy features and strategies to improve the marketability of the house to the target client?
- How effectively does the team demonstrate the market need for the competition prototype house and associated components?
- To what extent is the design able to leverage growing interest in off-site construction or other innovations to improve quality, cost, and productivity?
- To what extent will the innovations have immediate and/or long-term commercial impact in the marketplace (e.g., offer opportunities for more effective production and delivery of housing in the United States)?
- To what extent is there market potential for the design as built, including ability for trades to reproduce and/or scale it to other sites?
- To what extent could the design and integrated elements positively impact the U.S. residential energy efficiency and renewable energy industry?

### **Buildability**

- How effective are drawings and documentation at demonstrating construction materials and practices conducive to housing industry adoption at scale?
- How successfully does the design support buildability, including thoroughness of the construction documentation?
- How challenging would the competition prototype be to construct successfully?

- How effectively could the house be adopted and built in the private sector?

### Market Potential Innovation

In addition to and separate from the score assigned to each team for the Market Potential Contest, the jury shall assign each team a score for innovation, which is scored as one-quarter of the Innovation Contest.

- How innovative was the team in its approach to market potential, increasing the likelihood that the design will be adopted in the residential home market and impact national energy performance?
- How innovative was the team’s approach to livability and buildability, inspiring the public to consider the opportunities for housing of the future?

**Table 4. Examples of Target Client Definition**

Characteristic or Requirement	Example 1	Example 2	Example 3
Location of permanent site	Minot, North Dakota	Folsom, California	Boston, Massachusetts
Client demographic	Working professionals	Recent graduate	Retired individual
Household income	\$85,000	\$180,000	\$30,000

## 4.8 Comfort & Environmental Quality

### *Contest Intent*

This Contest evaluates the building’s capability to integrate comfort and indoor environmental quality with energy-efficient performance.

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 disturbances from interior and exterior sources of noise. 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.

Sensors are to be in place for the duration of any measured Subcontest period at the location agreed upon between the team and the organizers to accurately represent house performance. The sensors do not need to be in place when a particular measured Subcontest is inactive, such as during public exhibit hours.

### *Temperature Control Subcontest*

All available points are earned for achieving a time-averaged interior dry-bulb temperature between 68°F (20°C) and 74°F (23.333°C) during at least one of the scored periods.

- a) Reduced points are earned if the time-averaged interior dry-bulb temperature is between 64°F (17.778°C) and 68°F (20°C) or between 74°F (23.333°C) and 78°F (25.556°C). Reduced point values are scaled linearly. No points are earned for a time-averaged interior dry-bulb temperature below 64°F (17.778°C) or above 78°F (25.556°C).
- b) The organizers will identify at least two zones in each house and measure the temperature of each zone. The zone temperature deviating farthest from the target temperature range is the zone temperature of record.

### *Humidity Control Subcontest*

All available points are earned at the conclusion of each scored period by achieving a time-averaged interior relative humidity between 35% and 50% during at least one of the scored periods.

- a) Reduced points are earned if the time-averaged interior relative humidity is between 25% and 35% or between 50% and 70%. Reduced point values are scaled linearly. No points are earned for a time-averaged interior relative humidity below 25% or above 70%.
- b) The organizers will identify at least two zones of each house and measure the humidity of each zone. The zone humidity deviating farthest from the target humidity range is the zone humidity of record.

### *Indoor Air Quality Subcontest*

All available points are earned at the conclusion of each scored period by keeping the time-averaged interior carbon dioxide (CO<sub>2</sub>) level below 1,000 parts per million (PPM) following occupancy of six individuals for 1 hour. The CO<sub>2</sub> levels are measured when the house is occupied as part of the House Occupancy Subcontest.

- a) Reduced points are earned for time-averaged interior CO<sub>2</sub> levels between 1,000 PPM and 2,000 PPM. Reduced point values are scaled linearly. No points are earned for time-averaged interior CO<sub>2</sub> levels above 2,000 PPM.
- b) The organizers will identify at least one zone in each house and measure the CO<sub>2</sub> level of each zone. If more than one measurement is collected, the CO<sub>2</sub> level deviating farthest from the target CO<sub>2</sub> level is the CO<sub>2</sub> level of record.

### *Air Tightness Subcontest*

All available points are earned for a measured air tightness of less than or equal to 0.05 cubic feet per minute (cfm) 50/ft<sup>2</sup>.

- a) Reduced points are earned for measurements between 0.05 cfm 50/ft<sup>2</sup> and 0.25 cfm 50/ft<sup>2</sup>. Reduced point values are scaled linearly. No points are earned for measurements above 0.25 cfm 50/ft<sup>2</sup>.
- b) Air tightness will be evaluated in advance of the competition at the team site by a qualified third-party provider.

### *Exterior Noise Infiltration Subcontest*

The sound insulation decibel (dB) values for each of the 1/3 octave bands will be calculated between 100 hertz and 5 kilohertz. All available points are earned for a measured sound pressure

level from outside noise intrusion less than or equal to 35 A-weighted decibels (dBA) based on the peak hour sound level equivalents (Leq).<sup>9</sup>

- a) Reduced points are earned for measurements between 35 dBA and 50 dBA. Reduced point values are scaled linearly. No points are earned for a measured exterior noise infiltration greater than 50 dBA.
- b) The organizers will identify at least two zones of each house and measure the exterior noise infiltration at a pre-agreed-upon location in each zone. The zone exterior noise infiltration deviating farthest from the target range is the zone of record.

### *Internally Generated Noise Subcontest*

Heating, ventilating, and air-conditioning (HVAC) systems, electronics, mechanical equipment and other noise-emitting office devices, as well as occupants themselves, can be sources of indoor noise. All available points are earned for a maximum background noise in the home, measured in home because of interior noise sources (HVAC systems, lighting, appliances, and other building services operating simultaneously), less than or equal to 40 dBA, based on the peak Leq.<sup>9</sup>

- a) Reduced points are earned for measurements between 40 dBA and 55 dBA. Reduced point values are scaled linearly. No points are earned for a measured maximum background noise in the home greater than 55 dBA.
- b) The organizers will identify at least two zones of each house and measure the exterior noise infiltration at a pre-agreed-upon location in each zone. The zone exterior noise infiltration deviating farthest from the target range is the zone of record.

## **4.9 Innovation**

### *Contest Intent*

This Contest evaluates the design's success incorporating innovations and/or creative approaches that enhance energy efficiency, energy production, grid interaction, and building operations, as well as overall functionality and appeal.

Effective designs incorporate innovations that can be embraced by the construction industry and consumers on a large scale. Teams are encouraged to find solutions that use new or existing technologies, as well as other creative measures to improve building operations and desirability.

### *Build Challenge Criteria*

In addition to contest-specific criteria identified previously, the Architecture, Engineering, Market Potential, and Resilience Juries shall consider the following specific criteria in their evaluation:

- What approach did the team take toward integrating innovations into the design?
- To what extent does the design use innovations or innovative approaches to satisfy an existing market need or desire?

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<sup>9</sup> <http://www.usgbc.org/node/4631859?return=/credits>

- How successfully did the team use discovery, research, prototyping, analysis, and collaboration?
- What is the validation of the innovation potential through the as-built design and implementation?
- To what extent do the design and innovative features address the interests and needs of target buyers and users (e.g., not only in terms of providing a comfortable living environment but also one with attractive and desirable elements that meet the target users' needs)?
- To what extent does the team's approach to innovation relate to the team intent, mission, strategies, or goals?
- To what extent will the innovations endure relative to the anticipated life cycle of the house?
- To what extent do the innovations improve or maintain the safety of occupants of the house?

## 4.10 Presentation

### *Contest Intent*

This Contest evaluates the team's ability to accurately and effectively convey its design and energy performance strategy to relevant audiences.

The value proposition of energy efficiency and renewable energy opportunities must be clearly conveyed to industry leaders and the public at large. A smart design on its own is insufficient. Presentation quality can dramatically affect market perception and the likelihood of innovation adoption.

### *Build Challenge Criteria*

A jury of communication professionals shall assign an overall score for the success of each team's communication strategies, materials, and efforts to educate, inform, engage, and interest the public. Presentation quality includes complete and consistent documentation that clearly conveys the goals of the team and its design, tells a story that resonates, and engages the public effectively. The jury will consider the submitted deliverables, perform an extensive evaluation of the team's tour sequence for public visitors at the Local Build locations, the elements and visitor experience at the Build Challenge Event Site, and evaluate the public outreach materials utilized by the team.

The jury will consider the following specific criteria in its evaluation:

### **Strategy**

- How well did the team's communication materials and activities collectively convey a comprehensive, consistent, and integrated communications strategy?
- How clearly defined are the team's communication audiences and goals?
- How successful are the team's communication and outreach strategies?



## **Implementation**

- What is the quality of all presentations to the jury, the public in the team's local market, and the experience of the public at the Build Challenge Event in Washington, D.C.?
- How successfully did the team conduct outreach, education, and engagement in its local market?
- How successfully does the team incorporate online and digital communications strategies and products to engage audiences?
- How effective are the team's educational and outreach messages to intended audiences?
- How informative, interesting, engaging, and audience-appropriate is the team's public presentation and approach for providing tours?
- How effectively does the team use features, displays, models, or other materials to engage and educate the public?
- How extensively and successfully is the team's local outreach, education, and engagement?
- How effective is the team's strategy for accommodating large crowds and long lines?
- How well do the on-site communication materials educate and inform the visiting public?
- What is the quantity of visitors and quality of visitor experiences to each team's house or exhibit, locally and in Washington, D.C., including consideration of each location's climactic conditions for visitors?

## 5 Build Challenge Juried Contest Evaluation Process

The evaluation process is multifaceted and includes the following:

- Contest juror panels (each with three to five jurors) assess the team's projects.
- One jury convenes for each of the Architecture, Market Potential, Engineering, Resilience, Financial Feasibility & Affordability, and Presentation Contests.
- Each jury will review all teams. The jury will review the assigned deliverables associated with all competing teams and will evaluate the presentations from each Division, as part of house tours for the National Showcase teams and as jury-specific presentations for the Local Build teams. All jury presentations will take place in Washington, D.C. The juries will then assign a percentage integer value according to this process for every team, awarding a 1<sup>st</sup> through n<sup>th</sup> place for all teams in each Division.

A jury's evaluation of each team's project consists of the following three steps:

1. Step 1: Deliverables Review
2. Step 2: As-Built House Evaluation
  - The juries will receive a scheduled presentation from each of the National Showcase Division teams through a scheduled private walk-through tour of each house on the National Mall as part of the 2020 Smithsonian Folklife Festival.
  - The juries will receive a scheduled presentation from each of the Local Build Division teams accompanied by photographs and video of the as-built house at an industry venue in Washington, D.C.
3. Step 3: Deliberation.

### 5.1 Step 1: Deliverables Review

Each juror will spend approximately 1–2 hours reviewing the submitted deliverables to explore the relevant details of each team's project. An outline of the reviews is listed in Table 5.

**Table 5. Jury Reviews**

<b>Jury</b>	<b>Time Commitment for Phase 1 Deliverables Review</b>	<b>Relevant Deliverables for Review</b>	<b>Time Commitment for Phase 2 Team Presentation</b>
Engineering	1–2 hours per team	Engineering Narrative Energy Model Analysis and Results Architectural Photography and 3D Tour As-Built Drawings As-Built Specifications Audiovisual Presentation, including video of house	30 minutes per team
Financial Feasibility & Affordability	1–2 hours per team	Financial Feasibility and Affordability Narrative Construction Cost Estimate Operational Cost Estimate Architectural Photography and 3D Photo Tour As-Built Drawings As-Built Specification Audiovisual Presentation, including video of house	30 minutes per team
Resilience	1–2 hours per team	Resilience Narrative Architectural Photography and 3D Photo Tour As-Built Drawings As-Built Specifications Audiovisual Presentation, including video of house	30 minutes per team
Architecture	1–2 hours per team	Architecture Narrative Architectural Photography and 3D Photo Tour As-Built Drawings As-Built Specifications Audiovisual Presentation, including video of house	30 minutes per team
Market Potential	1–2 hours per team	Market Potential Narrative Architectural Photography and 3D Photo Tour As-Built Drawings As-Built Specifications Audiovisual Presentation, including video of house	30 minutes per team
Presentation	1–2 hours per team	Presentation Narrative Local Attendance and Engagement Stats Team website and/or social media accounts Architectural Photography and 3D Photo Tour Public exhibit materials Audiovisual Presentation, including video of house	30 minutes per team

## 5.2 Step 2: As-Built House Evaluation

Each jury will complete an extensive evaluation of the house as-built by the competing team. Prior to the Build Challenge Event at the Smithsonian Folklife Festival, the house will be documented by professional architectural or real estate photographers hired by the organizers, including extensive exterior and interior photography and a 3D photographic walk-through. When possible, a 3D photographic walk-through will also be taken of the house under construction. The on-site jury presentations take place on the National Mall in Washington, D.C., and offer the jurors an opportunity to ask the decathletes for clarification of questions that may arise during the deliverables review and evaluation of the as-built house.

## 5.3 Step 3: Deliberation

During the deliberation phase, which takes place after the in-depth evaluation of the as-built house, the jury is encouraged, but not required, to place each team into one of five classes (outlined in Table 6) based on each team's performance relative to the juror's expectations with regard to the Contest criteria.

Juries are not required to place a uniform number of teams in all classes or to place at least one team in every class. For example, if a jury determines that no teams are worthy of Class 1, there would be no teams with scores greater than 90%. After reviewing the teams in each class, the jury shall assign each team a percentage integer from 0% to 100%. Ties are not permitted.

After assigning each team a percentage integer from 0% to 100%, the jury shall submit its percentage integers to the Build Challenge Manager, who will convert them to a score based on the total number of available points for the contest being judged. The Build Challenge Manager will round off any noninteger percentage scores to the nearest integer. Prior to posting scores in the scoring server, the Build Challenge Manager will apply any applicable penalties that may have been incurred.

The highest scoring team(s) are announced during a scheduled announcement at the Build Challenge Event. Pending the jurors' availability, the organizers will invite one or more jurors to make the announcement. The scores for all of the teams are posted immediately following the announcement.

The jury must submit written or recorded scoring justifications for each team to the Build Challenge Manager. The jury's scoring justifications may be provided as feedback to each team so it might better understand the jury's evaluation. The justifications may be posted on the [Solar Decathlon website](#).

## 5.4 Evaluation Rating Scale

The jury scores each parameter according to the following scale in Table 6.

**Table 6. Evaluation Scale**

<b>Class 5</b>	0%–20%	MISSES EXPECTATIONS: Missing all requirements; no explanation of how the design addresses the criteria
<b>Class 4</b>	20%–40%	APPROACHES EXPECTATIONS: Missing some requirements; minimal explanation of how the design addresses the criteria
<b>Class 3</b>	40%–60%	MEETS EXPECTATIONS: All requirements met; acceptable explanation of how the design addresses the criteria
<b>Class 2</b>	60%–90%	EXCEEDS EXPECTATIONS: All requirements met; full demonstration of how the solution addresses the criteria
<b>Class 1</b>	90%–100%	ECLIPSES EXPECTATIONS: All requirements met; distinguished excellence in the how the design exceeds the criteria

## 5.5 Team Guidelines

- a) It is ultimately the team’s responsibility to be ready for the juries at the times indicated in the jury presentation schedule provided on the [Groups.io Project Site](#).
- b) Up to six decathletes may be present during the presentations to the juries. No other team members may be present.
- c) The jury presentations are held to a very strict schedule for each of the teams. The importance of following this schedule is twofold: (1) ensuring each team receives equal time with the juries and (2) deviating from the schedule will have an immediate effect on other scheduled activities. A small deviation in the defined schedule for the juries could result in a very difficult situation to resolve in another component of the competition. If a team is not ready for a jury to begin its evaluation at the scheduled time, then the total time the jury spends with that team will be reduced.
- d) During jury presentations, the jury has 25 minutes to meet with team, followed by a 5-minute deliberation period. During the 25 minutes with each team, the entire time is allocated for team members to lead the jury through their design and answer any questions the jury may have. After 25 minutes, all team members shall leave the area so that the jury can hold a private 5-minute discussion about the team that has just presented. Following the discussion, each jury has 5 minutes to prepare for the next team presentation.
  - o All teams will present to juries on the National Mall, including showing juries through their competition prototype house module or competition exhibit supplemented by presentations utilizing digital technologies or other means.
  - o For the Presentation Contest jury, the team shall present its Public Outreach Activity to the jury on the National Mall. Each team is expected to spend up to 5 minutes presenting the personalized public outreach activity to the Presentation Contest Jury as it would be presented to the public. The version given to the Presentation Jury must represent the version presented to the public throughout the competition week. The team should briefly describe how it would modify the Public Outreach Activity to accommodate large crowds or long lines. The remaining time shall be used to present the team communications strategy, including brand management and past activities for outreach locally, and to answer questions.

- e) Presentation boards and other electronic or visual media are permitted to be on display during jury visits.
- f) Teams may not record the jury visit or the private jury discussion period.
- g) Areas of the house or exhibit excluded from the accessible exhibit route may be considered by the juries and considered in their evaluations.
- h) The organizers will provide all juries with summaries of relevant rule and code violations for each team so they are aware of violations before giving credit for aspects of the project that are not in compliance.

## 5.6 Public Exhibit Requirements

The team shall prepare two versions of its public outreach.

### *Local Exhibition*

- All teams are required to exhibit their house to their own community at least two weekends in May or June 2020, as noted in the Build Challenge calendar, which is available on the [Groups.io Project Site](#).
- Each team shall prepare and offer a comprehensive tour of the house to all visitors. Any team members or associated individuals can offer tours of the house to the public.
- The tour shall educate the visitors about the Solar Decathlon, the team's target market and goals, the design solution itself, and how visitors could adopt technologies or practices in their own homes.
- Tours are expected to last between 5 and 30 minutes and can be guided or supported by team members at stations throughout the house.

### *Build Challenge Event Exhibition*

- As part of the 2020 Smithsonian Folklife Festival, teams will host hundreds of thousands of visitors and are expected to educate people about the Solar Decathlon, the team's target market and goals, the team's design solution, and ideas for how visitors could adopt technologies or energy-efficient practices in their own homes.
- National Showcase Division teams will provide tours of their as-built competition prototype house module.
- Local Build Division teams will utilize their unique exhibit to tell visitors about their team, competition house design, and other elements.

### *Common Requirements*

- Both versions of each team's public outreach shall be informative, interesting, and accessible by people of all abilities.
- Teams are encouraged to employ effective and creative methods to control wait times and engage visitors waiting in line during public tour hours.
- Digital technologies (such as virtual reality, television screens, or apps), printed signage, and components (such as scale models, wall sections, or material samples) may be used to entice and educate the visiting public.

## 6 Build Challenge Deliverables

Throughout the project, the organizers will require teams to submit deliverables necessary for ensuring safety and for generating sufficient interest in the Solar Decathlon Build Challenge Events. These design deliverables (outlined in Table 7) serve the following important functions:

- In the **Project Introduction**, the team shall disclose to the organizers their initial design decisions, all nonstandard design features, communications strategies, site operations plans, and health and safety considerations that require further review prior to the continuation of the project into the design development phase. The team shall provide a project management plan for the next phases of the Challenge.
- At all stages, the **drawings and project manual** shall demonstrate compliance with the Solar Decathlon Build Challenge Building Code and Rules so the inspectors are able to grant final on-site approval by verifying that the constructed project on the competition site was accurately represented by the approved drawings and project manual.
- At all stages, the **drawings and project manual** are expected to provide sufficient detail to enable a residential contractor to generate an accurate, detailed cost estimate and to efficiently construct the building as the design team intended it to be built.
- Because the juries have a very limited opportunity to evaluate the constructed projects on the competition site, the **submitted Jury Documentation deliverables** are the only means for a team to provide a detailed presentation of its project to the juries. In the weeks leading up to Build Challenge Event, each juror shall evaluate the submitted Jury Documentation deliverables. The primary purpose of the juries' visits on the competition site is to verify that the project, as assembled on the competition site, was accurately represented in the jury deliverables and to ask the decathletes any clarifying questions that may arise during the evaluation of the design via the jury deliverables.

**Table 7. List of Deliverables**

<b>Deliverable Name</b>	<b>Required Content</b>	<b>Use of Submission</b>	<b>Due Date</b>
D1: Project Introduction	Team short description Project management plan Design summary Initial Design Renderings	Feedback to team	Feb. 19, 2019
D2: Design Development Deliverable	50% complete construction drawings Initial project report	Evaluated as part of Approval to Proceed to Phase 2 and first prize disbursement	March 26, 2019
D3: Design Presentation Deliverable	20-minute presentation on design Optional poster	Evaluated as part of Approval to Proceed to Phase 2 and first prize disbursement	April 9, 2019
D4: Construction Documentation	Public project renderings 95% complete construction documentation (drawings and specifications) Interim project report	Evaluated as part of Approval to Proceed to construction and second prize disbursement	Nov. 5, 2019
D5: As-Built Documentation	Updated public project renderings 100% complete construction documentation (reflecting house under construction) Construction progress photos	To be used by juries for scoring teams and by organizers for scoring measurement	Feb. 18, 2020
D6: Project Summary	Final project report Public project summary Public exhibit materials, including signage, uniform, and website	To be used for public outreach about the team, reviewed by juries	March 31, 2020
D7: Jury Deliverables	Jury narratives Architectural photography of as-built house 3D tour of house Final construction documentation	To be used by juries for scoring the team	May 14, 2020
D8: Final Report	Postevent project report	To be used by organizers for lessons learned	Sept. 1, 2020



## 6.1 D1: Project Introduction

The Project Introduction deliverable is reviewed by organizers, and feedback is provided to teams to help increase their likelihood of success in the remainder of the Challenge. It is not used as the basis of the Approval to Proceed and prize disbursement in accordance with the Approval-to-Proceed Procedures, which are available on the [Solar Decathlon website](#).

The Project Introduction is not made publicly available until after the completion of the competition, with the exception of the team description, goals, and renderings, which may be shared on the [Solar Decathlon website](#). The documentation is reviewed by the organizers.

The team shall provide information that outlines the team’s structure, approach to the competition, general work schedule, course integration, and fundraising schedules. The project management plan is limited to 30 pages.

### *Format Requirements*

<input type="checkbox"/> Packaged into a single PDF file (Renderings and/or audiovisuals may be submitted separately, if desired.)
<input type="checkbox"/> Up to 30 pages
<input type="checkbox"/> File name abbreviation: INTRO

### *Content Requirements*

<input type="checkbox"/> Updated 100-word description of team and its goals for public release
<input type="checkbox"/> Strategy for winning the Challenge, including a contest-by-contest approach (3–5 pages)
<input type="checkbox"/> Team structure, including detailed descriptions of roles and responsibilities (2 pages)
<input type="checkbox"/> Description of the team’s approach to successfully build the house, including a detailed project schedule, explanation of any coursework integration, description of transport plan of house module or exhibit to the National Mall, and summary of any research positions offered to enable successful student commitment (4 pages)
<input type="checkbox"/> Summary of potential innovations and nonstandard elements being pursued (1–2 pages)
<input type="checkbox"/> Fundraising approach, schedule, and current progress, along with a current total estimated project budget and description of any current industry partnerships (2 pages)
<input type="checkbox"/> Schematic Project representation (renderings, graphic floor plan; section drawings; mechanical, electrical, and plumbing system drawings; photography of scale model; animation; and so on) of schematic design (8–10 images or drawings, minimum 1080 pixels in shortest dimension)
<input type="checkbox"/> Team photograph including as many members of the team as possible and associated file identifying the name of each individual shown and the photographer (1 image, minimum 1080 pixels in shortest dimension)
<input type="checkbox"/> Description of public exhibit, communications, and outreach strategy and coverage included to date, including a summary of team’s current online presence, including social media accounts and website URLs (1–2 pages)
<input type="checkbox"/> Health and Safety Plan outline, including approach to meeting OSHA training requirement (1–2 pages)
<input type="checkbox"/> Identification of the licensed design professional expected to stamp structural documentation (1 page)

## **6.2 D2: Design Development Documentation Submission**

The Design Development Documentation Submission shall represent 50% complete construction documentation. The documentation shall clearly indicate all design details, house systems, and methodologies expected to be present in the competition prototype on the competition site. While details may not be fully complete or finalized, the Design Development Submission shall provide sufficient information for the organizers to conduct a thorough Solar Decathlon Build Challenge Rules and Building Code compliance review. The submission must address the team's approach to safety, including identifying team-specific concerns and constraints. All major decisions with regard to the project design are expected to be complete. The Design Development Documentation Submission will not be reviewed by any contest juries. However, it may be made publicly available following submission.

The Design Development Documentation is reviewed by organizers, and feedback is provided to teams to help increase their likelihood of success in the remainder of the Challenge. It is used as the basis of the Approval to Proceed and prize disbursement. It is also used as the basis for presentation at 2019 Design Challenge Weekend.

(Continued on next page)

## Design Development Drawings

### Format Requirements

<input type="checkbox"/> Packaged into a single bookmarked PDF document
<input type="checkbox"/> Up to 150 pages
<input type="checkbox"/> ANSI D (22 in. x 34 in. [55.88 cm x 86.36 cm]) sheet size
<input type="checkbox"/> File name abbreviation: DDDRAW

### Content Requirements

<ul style="list-style-type: none"><li><input type="checkbox"/> Design drawings, including at a minimum:<ul style="list-style-type: none"><li>a) General, including accessible tour route and finished square footage</li><li>b) Site Plan<ul style="list-style-type: none"><li>○ For Local Build teams, the house location and site work necessary, with particular attention paid for public visitor tour access and routes</li><li>○ For National Showcase teams, the proposed ramp locations and directions, how the unit will be safely accessed while remaining on the transportation trailer, etc.</li></ul></li><li>c) Landscape, including plantings, containers, and watering methodology</li><li>d) Structural, including building, decking, and associated structures</li><li>e) Architectural, including dimensioned floor plans, building sections, detailed sections, reflected ceiling plans, roof plans, elevations, window and door schedules, and exterior structures</li><li>f) Interiors, including finishes, furniture layout, and cabinetry</li><li>g) Fire protection, including sprinklers and required detection systems</li><li>h) Plumbing, including layout, schedules, diagrams, and solar thermal (if applicable)</li><li>i) Mechanical, including layout, schedules, diagrams, and installation requirements</li><li>j) Electrical, including AC and DC layout, one-line diagrams, three-line diagrams, and sizing calculations</li><li>k) Telecommunications, including instrumentation, wiring, and associated elements</li><li>l) Operations, including description of transport plan of house module or exhibit to the National Mall, setup methodology, and staging</li></ul></li></ul>
---

## *Design Development Project Manual*

### ***Format Requirements***

<input type="checkbox"/> Packaged into a single bookmarked PDF document
<input type="checkbox"/> File name abbreviation: DDPM

### ***Content Requirements***

<input type="checkbox"/> Project overview
<input type="checkbox"/> Detailed water budget
<input type="checkbox"/> Statement of grid islanding capability, including summary of any unlisted electrical components, storage strategy, and associated equipment
<input type="checkbox"/> Summary of reconfigurable features
<input type="checkbox"/> Health and safety approach
<input type="checkbox"/> Energy analysis and modeling
<input type="checkbox"/> Structural Professional Acknowledgement Letter signed by licensed professional indicating acceptance of the Construction Documentation deliverable deadline and support of team
<input type="checkbox"/> Structural calculations
<input type="checkbox"/> Construction specifications
<input type="checkbox"/> Logistics plan, including a description of transport plan of house module or exhibit to the National Mall

### *Design Development Renderings (Design Development Digital Project Representation)*

The teams shall submit renderings, photographs, graphics, and/or animations representing the competition prototype design and competition entry for use on the [Solar Decathlon website](#) and in outreach materials generated by the organizers. High-quality and varied submissions are expected to lead to greater visibility for the team. This submission can include renderings, photography of scale models or mockups, refined graphics, computer-generated walk-throughs, 360-degree virtual tours, or other representations as determined by the team. The organizers will select a subset of submitted documentation for public distribution.

#### ***Format Requirements***

<input type="checkbox"/> Packaged into a single zipped file (for elements hosted online, a link shall be included in the submission.)
<input type="checkbox"/> Photographs shall be at least 1080 pixels in their shortest dimension and shall be accompanied by a file containing the name and affiliation of the photographer or graphic creator and identification of any individuals visible.
<input type="checkbox"/> Videos, if submitted, shall be wide-screen format and accompanied by a verbatim transcript of the audio narrative to meet DOE's Office of Energy Efficiency and Renewable Energy <a href="#">Section 508 compliance standards</a> and identification of the creator and any individuals visible in the video. Closed-captioning does not need to be included within the video file. Permission must be provided for any copyrighted content or audio used as part of the video.
<input type="checkbox"/> File name abbreviation: DDRENDER

#### ***Content Requirements***

<input type="checkbox"/> Teams should submit a minimum of five images, with at least one exterior, one interior, and one bird's-eye view
<input type="checkbox"/> Photographs shall be at least 1080 pixels in their shortest dimension and shall be accompanied by a file containing the name and affiliation of the photographer or graphic creator and identification of any individuals visible.
<input type="checkbox"/> Videos, if submitted, shall be wide-screen format and accompanied by a verbatim transcript of the audio narrative to meet <a href="#">Section 508 compliance standards</a> and identification of the creator and any individuals visible in the video. Closed-captioning does not need to be included within the video file. Permission must be provided for any copyrighted content or audio used as part of the video.

### 6.3 D3: Design Presentation

Each team shall develop presentation files on its design, which are presented at 2019 Design Challenge Weekend. The presentations, together with D2: Design Development Documentation deliverable are used as the basis of the Approval to Proceed and prize disbursement.

#### *Build Challenge Design Presentation*

A 20-minute presentation on the project to be delivered in person during 2019 Design Challenge Weekend, with an additional 5 minutes for questions, for a total 25-minute team presentation.

#### ***Format Requirements***

<input type="checkbox"/> Packaged into a single PDF and/or PPTX presentation
<input type="checkbox"/> Presentation slides with an aspect ratio of 16:9
<input type="checkbox"/> Teams are encouraged to embed all videos in the team submission and to notify the organizers before arriving at the competition to allow organizers to ensure that the appropriate software is available to play the video.
<input type="checkbox"/> File name abbreviation: BCPRES

#### ***Content Requirements***

<input type="checkbox"/> Team structure and industry partnerships
<input type="checkbox"/> Target market description
<input type="checkbox"/> Design summary
<input type="checkbox"/> Approach to winning each contest

#### *Build Challenge Poster (optional)*

Each team may develop a Project Poster that showcases its design and response to Division parameters. A Poster Session during 2019 Design Challenge Weekend displays all team projects.

Teams should print their poster and bring it to 2019 Design Challenge Weekend.

#### ***Format Requirements***

<input type="checkbox"/> Packaged into a single PDF file
<input type="checkbox"/> Shall be 3 ft wide x 2 ft tall (0.9 m wide x 0.6 m tall)
<input type="checkbox"/> File name abbreviation: BCPOSTER

#### ***Content Requirements***

<input type="checkbox"/> Team structure and industry partnerships
<input type="checkbox"/> Target market description
<input type="checkbox"/> Design summary

## 6.4 D4: Construction Documentation Submission

The final Construction Documentation submission shall represent 95% complete construction documentation, with sufficient detail for a contractor to build the competition prototype house as it is expected to exist for the Build Challenge. The documentation shall include complete and final design details, house system specifications, and construction. While it is recognized that a few minor details may change during construction, the Construction Documentation submission shall provide sufficient information for the organizers to conduct a final Solar Decathlon Rules and Building Code compliance verification. The submission must address the team's approach to safety, including identification of team-specific concerns and constraints. The construction documentation submission will not be reviewed by any juries. However, it may be made publicly available following submission.

The Construction Documentation submission is used as the basis of the Approval to Proceed.

### *Construction Drawings*

#### ***Format Requirements***

<input type="checkbox"/> Packaged into a single bookmarked PDF document
<input type="checkbox"/> Up to 150 pages
<input type="checkbox"/> ANSI D (22 in. x 34 in. [55.88 cm x 86.36 cm]) sheet size
<input type="checkbox"/> File name abbreviation: CDDRAW

#### ***Content Requirements***

<ul style="list-style-type: none"><li><input type="checkbox"/> Complete construction drawings, including at a minimum:<ul style="list-style-type: none"><li>a) General, including solar envelope compliance, accessible tour route, finished square footage, water delivery and removal compliance information, and constructed footprint calculations</li><li>b) Site Plan<ul style="list-style-type: none"><li>○ For Local Build teams, the house location and site work necessary, with particular attention paid for public visitor tour access and routes</li><li>○ For National Showcase teams, the proposed ramp locations and directions, how the unit will be safely accessed while remaining on the transportation trailer, etc.</li></ul></li><li>c) Landscape, including plantings, containers, and watering methodology</li><li>d) Structural, including building, decking, and associated structures</li><li>e) Architectural, including dimensioned floor plans, building sections, detailed sections, reflected ceiling plans, roof plans, elevations, window and door schedules, and exterior structures</li><li>f) Interiors, including finishes, furniture layout, and cabinetry</li><li>g) Fire protection, including sprinklers and required detection systems</li><li>h) Plumbing, including layout, schedules, diagrams, and solar thermal (if applicable)</li><li>i) Mechanical, including layout, schedules, diagrams, and installation requirements</li><li>j) Electrical, including AC and DC layout, one-line diagrams, three-line diagrams, and sizing calculations</li><li>k) Telecommunications, including instrumentation, wiring, and associated elements</li><li>l) Operations, including house or exhibit transportation, setup methodology, and staging.</li></ul></li></ul>
--

## Project Manual

### Format Requirements

<input type="checkbox"/> Packaged into a single bookmarked PDF document
<input type="checkbox"/> File name abbreviation: CDPM
<input type="checkbox"/> Up to 150 pages

### Content Requirements

<input type="checkbox"/> Project overview
<input type="checkbox"/> Statement of grid islanding capability, including summary of any unlisted electrical components, storage strategy, and associated equipment
<input type="checkbox"/> Summary of reconfigurable features
<input type="checkbox"/> Complete energy analysis and model
<input type="checkbox"/> Construction specifications
<input type="checkbox"/> Draft cost estimate
<input type="checkbox"/> Logistics plan, including a description of transport plan of house module or exhibit to the National Mall

## Stamped Structural Submission

The structural submission shall represent a complete structural design, including structural calculations and specifications. The entire submission shall be stamped by a licensed design professional, such as a structural engineer or architect, who is licensed to stamp residential structural drawings and calculations in the team's Authority Having Jurisdiction and with educational and professional qualifications comparable to those required for licensure in Washington, D.C.

### Format Requirements

<input type="checkbox"/> Packaged into a single bookmarked PDF document
<input type="checkbox"/> File name abbreviation: CDSTRUCT

### Content Requirements

<input type="checkbox"/> Stamped structural calculations and specifications demonstrating compliance with the Solar Decathlon Build Challenge Building Code
---



## Health and Safety Plan

### Format Requirements

<input type="checkbox"/> Packaged into a single bookmarked PDF document
<input type="checkbox"/> File name abbreviation: CDHEALTH

### Content Requirements

<input type="checkbox"/> Health and Safety Plan meeting the requirements outlined in an attachment
<input type="checkbox"/> Proof of OSHA 30-hour training for the required team members outlined in an attachment

## Public Project Renderings

The teams shall submit renderings, photographs, graphics, and/or animations representing the competition prototype design and competition entry for use on the [Solar Decathlon website](#) and in outreach materials generated by the organizers. High-quality and varied submissions are expected to lead to greater visibility for the team. This submission can include renderings, photography of scale models or mock-ups, refined graphics, computer-generated walk-throughs, 360-degree virtual tours, or other representations as determined by the team. The organizers will select a subset of submitted documentation for public distribution.

### Format Requirements

<input type="checkbox"/> Packaged into a single, zipped file. If elements are hosted online, a link shall be included in the submission.
<input type="checkbox"/> Photographs shall be at least 1080 pixels in their shortest dimension and shall be accompanied by a file containing the name and affiliation of the photographer or graphic creator and identification of any individuals visible.
<input type="checkbox"/> Videos, if submitted, shall be wide-screen format and accompanied by a document including a verbatim transcript of the audio narrative to meet <a href="#">Section 508 compliance standards</a> and identification of the creator and any individuals visible in the video. Closed-captioning does not need to be included within the video file. Permission must be provided for any copyrighted content or audio used as part of the video.
<input type="checkbox"/> File name abbreviation: CDRENDER

### Content Requirements

<input type="checkbox"/> Teams shall submit a minimum of five images, with at least one exterior, one interior, and one bird's-eye view
---

## 6.5 D5: As-Built Documentation

The As-Built Documentation provides an opportunity for teams to update their presentations based on their construction progress. The As-Built Documentation deliverables are expected to provide a summary of each team's approach to meeting the contest requirements and to inform

the organizer’s scoring of measured contests. The organizers will provide feedback as necessary to ensure that the houses built are compliant with the Rules and safe for the public to enter.

### *As-Built Drawings*

#### ***Format Requirements***

<input type="checkbox"/> Packaged into a single bookmarked PDF document
<input type="checkbox"/> Up to 150 pages
<input type="checkbox"/> ANSI D (22 in. x 34 in. [55.88 cm x 86.36 cm]) sheet size
<input type="checkbox"/> File name abbreviation: ABDRAW

#### ***Content Requirements***

<input type="checkbox"/> Complete construction drawings representing the as-built competition prototype house and with sufficient detail for a residential general contractor to build the house without additional input from the team.
--

### *As-Built Specifications*

#### ***Format Requirements***

<input type="checkbox"/> Packaged into a single bookmarked PDF document of sufficient detail for a residential general contractor to build the house without additional input from the team
<input type="checkbox"/> File name abbreviation: ABSPEC

#### ***Content Requirements***

<input type="checkbox"/> Construction specifications
--

### *Public Project Renderings*

The teams shall submit updated renderings, photographs, graphics, and/or animations representing the competition prototype design and competition entry for use on the [Solar Decathlon website](#) and in outreach materials generated by the organizers. High-quality and varied submissions are expected to lead to greater visibility for the team. This submission can include renderings, photography of scale models or mock-ups, refined graphics, computer-generated walk-throughs, 360-degree virtual tours, or other representations as determined by the team. The organizers will select a subset of submitted documentation for public distribution.

#### ***Format Requirements***

<input type="checkbox"/> Packaged into a single, zipped file. If elements are hosted online, a link shall be included in the submission.
<input type="checkbox"/> Photographs shall be at least 1080 pixels in their shortest dimension and shall be accompanied by a file containing the name and affiliation of the photographer or graphic creator and identification of any individuals visible.

- |  |
|--|
| <input type="checkbox"/> Videos, if submitted, shall be wide-screen format and accompanied by a document including a verbatim transcript of the audio narrative to meet <a href="#">Section 508 compliance standards</a> and identification of the creator and any individuals visible in the video. Closed-captioning does not need to be included within the video file. Permission must be provided for any copyrighted content or audio used as part of the video. |
| <input type="checkbox"/> File name abbreviation: ABRENDER  |

***Content Requirements***

- |   |
|---|
| <input type="checkbox"/> Teams shall submit a minimum of five images, with at least one exterior, one interior, and one bird's-eye view |
|---|

## Construction Photography

### Format Requirements

<input type="checkbox"/> Photographs shall be at least 1080 pixels in their shortest dimension and shall be accompanied by a file containing the name and affiliation of the photographer(s) and identification of any individuals visible.
<input type="checkbox"/> File name abbreviation: ABPHOTOS

### Content Requirements

<input type="checkbox"/> At least 10 photographs showing construction to date of the competition prototype
--

## 6.6 D6: Project Summary and Public Exhibit Materials

The team shall submit an updated description of the project team and design approach, renderings, graphic floor plans, logos, and other relevant information for use on the [Solar Decathlon website](#) and for organizer outreach about the Solar Decathlon Build Challenge Events. The team shall submit all public exhibit materials the team plans to employ on the competition site, for organizer review of proper use of Solar Decathlon branding, sponsor recognition, content, and so on. Teams must receive a Certificate of Occupancy from their local Authority Having Jurisdiction no later than May 14, 2020.

### Project Summary

#### Format Requirements

<input type="checkbox"/> Packaged into a single bookmarked PDF file
<input type="checkbox"/> 10 pages maximum
<input type="checkbox"/> File name abbreviation: SUMMARY

#### Content Requirements

<input type="checkbox"/> A 100-word or less description of the team house. (1 paragraph)
<input type="checkbox"/> Design philosophy and house design, indicating goals, architectural style, target market, and so on (1 page)
<input type="checkbox"/> Unique house features. What makes the house unlike any other? (1 page)
<input type="checkbox"/> Technological innovations incorporated into the house. (1–2 pages)
<input type="checkbox"/> Define the target client for the team house and how the design responds to this market's needs. (1 paragraph)
<input type="checkbox"/> Team organization, number of members, and permanent (noncollegiate institution) email addresses for all team members. (1 page, or attachment)
<input type="checkbox"/> Future plans for the house. Where will it go after the competition? (1 paragraph).

## *Team Photograph*

### ***Format Requirements***

- |  |
|--|
| <input type="checkbox"/> Photographs shall be at least 1080 pixels in their shortest dimension and shall be accompanied by a file containing the name and affiliation of the photographer or graphic creator and identification of any individuals visible |
| <input type="checkbox"/> File name abbreviation: TEAMPHOTO   |

### ***Content Requirements***

- |  |
|--|
| <input type="checkbox"/> Include all team members (if possible) and strive for creativity. |
|--|

## *Team Logo*

### ***Format Requirements***

- |   |
|---|
| <input type="checkbox"/> Vector or high-resolution format appropriate for print (EPS preferred) |
| <input type="checkbox"/> File name abbreviation: TEAMLOGO                                       |

### ***Content Requirements***

- |  |
|--|
| <input type="checkbox"/> Graphic logo  |
| <input type="checkbox"/> Associated text file containing name, phone number, and email of person submitting logo |

### *Digital Project Representation*

The teams shall submit updated renderings, photographs, graphics, and/or animations representing the competition prototype design and competition entry for use on the [Solar Decathlon website](#) and in outreach materials generated by the organizers. High-quality and varied submissions are expected to lead to greater visibility for the team. This submission can include renderings, photography of scale models or mock-ups, refined graphics, computer-generated walk-throughs, 360-degree virtual tours, or other representations as determined by the team. The organizers will select a subset of submitted documentation for public distribution.

#### ***Format Requirements***

<input type="checkbox"/> Packaged into a single, zipped file. If elements are hosted online, a link shall be included in the submission.
<input type="checkbox"/> Photographs shall be at least 1080 pixels in their shortest dimension and shall be accompanied by a file containing the name and affiliation of the photographer or graphic creator and identification of any individuals visible.
<input type="checkbox"/> Videos, if submitted, shall be wide-screen format and accompanied by a document including a verbatim transcript of the audio narrative to meet <a href="#">Section 508 compliance standards</a> and identification of the creator and any individuals visible in the video. Closed-captioning does not need to be included within the video file. Permission must be provided for any copyrighted content or audio used as part of the video.
<input type="checkbox"/> File name abbreviation: RENDER

#### ***Content Requirements***

<input type="checkbox"/> Teams shall submit a minimum of five images, with at least one exterior, one interior, and one bird's-eye view
---

### *Competition Prototype Graphic Floor Plan*

The graphic floor plan is expected to be posted to the [Solar Decathlon website](#) and used in various communications materials to introduce the public to each competition prototype. The floor plan should be presented in a way to demonstrate the layout of the house, interior furnishings, and all site elements.

#### ***Format Requirements***

<input type="checkbox"/> Natively generated vector PDF file
<input type="checkbox"/> File name abbreviation: FLOORPLAN

#### ***Content Requirements***

<input type="checkbox"/> Complete floor plan showing all exterior elements, including landscaping, ramps, decks, and interior elements, including furniture and fixtures
--

## Public Exhibit Materials

### Format Requirements

<input type="checkbox"/> Packaged into a single bookmarked PDF file
<input type="checkbox"/> All public exhibit materials shall be represented at their full scale within the PDF; therefore, it is expected that the PDF may contain sheets at several different scales.
<input type="checkbox"/> File name abbreviation: EXHIBIT

### Content Requirements

<input type="checkbox"/> Design of on-site signage, team handout, digital displays, or other products intended to convey information to the public
<input type="checkbox"/> Plan depicting location of all public exhibit materials
<input type="checkbox"/> Team uniform design
<input type="checkbox"/> Links to team website and/or social media properties

## 6.7 D7: Jury Documentation Deliverables

The Jury Documentation deliverables provide an opportunity for teams to present their projects to each jury prior to arrival on the competition site. The jury deliverables are expected to provide a summary of each team's approach to meeting the contest requirements for each of the juried contests. The jury deliverables are reviewed by the respective jury prior to the competition. The narratives may include any combination of text and graphics. The narratives may link to multimedia hosted online, which are reviewed by jurors as time permits. The narratives will not be made public prior to the release of the respective contest results.

### Jury Narratives

#### Format Requirements

<input type="checkbox"/> Packaged into a single bookmarked PDF file for each jury
<input type="checkbox"/> File name abbreviations: <ol style="list-style-type: none"><li>a) Architecture Jury: JURYARCH</li><li>b) Engineering Jury: JURYENG</li><li>c) Market Potential Jury: JURYMARKET</li><li>d) Resilience Jury: JURYRESIL</li><li>e) Financial Feasibility &amp; Affordability Jury: JURYAFF</li><li>f) Presentation Jury: JURYPRES</li></ol>

### ***Content Requirements***

<input type="checkbox"/> Architecture narrative, including architectural photography (10 pages maximum plus up to 10 photographs)
<input type="checkbox"/> Market Potential narrative (10 pages maximum)
<input type="checkbox"/> Resilience narrative (10 pages maximum)
<input type="checkbox"/> Engineering narrative, including energy analysis (10 pages maximum plus energy model, analysis and results) Note: energy model and analysis will also be used for calculating the team's score in the "Net-Zero Plus Energy" subcontest
<input type="checkbox"/> Presentation narrative, including links to team website and/or social media accounts (10 pages maximum plus on-site public exhibit materials)
<input type="checkbox"/> Financial Feasibility and Affordability narrative (10 pages maximum plus cost estimate and appendices)

### ***Final Drawings***

#### ***Format Requirements***

<input type="checkbox"/> Packaged into a single bookmarked PDF document
<input type="checkbox"/> Up to 150 pages
<input type="checkbox"/> ANSI D (22 in. x 34 in. [55.88 cm x 86.36 cm]) sheet size
<input type="checkbox"/> File name abbreviation: DRAWINGS

### ***Content Requirements***

<input type="checkbox"/> Complete construction drawings representing the as-built competition prototype house and with sufficient detail for a residential general contractor to build the house without additional input from the team. Inclusions of a logistics plan, including a description of transport plan of house module or exhibit to the National Mall
--

### ***Final Specifications***

#### ***Format Requirements***

<input type="checkbox"/> Packaged into a single bookmarked PDF document of sufficient detail for a residential general contractor to build the house without additional input from the team
<input type="checkbox"/> File name abbreviation: SPECS

### ***Content Requirements***

<input type="checkbox"/> Construction specifications
--



## Audiovisual Presentation

### Format Requirements

<input type="checkbox"/> Wide-screen, high-definition video file (such as .mov, .mp4, and so on)
<input type="checkbox"/> 3-minute maximum length
<input type="checkbox"/> Accompanied by a document including a verbatim transcript of the audio narrative to meet <a href="#">Section 508 compliance standards</a> and identification of the creator and any individuals visible in the video. Closed-captioning does not need to be included within the video file. Permission must be provided for any copyrighted content or audio used as part of the video.
<input type="checkbox"/> File name abbreviation: VIDEO

### Content Requirements

<input type="checkbox"/> Must include video footage of the complete constructed house as built prior to the competition
<input type="checkbox"/> May contain still photos and graphics
<input type="checkbox"/> Gives the jurors a realistic preview of what they will experience during the on-site walk-throughs
<input type="checkbox"/> Includes an audio narrative that explains to viewers what they're seeing and describes the underlying philosophy behind the design and team approach to the competition

## 6.8 D8: Final Report

The Final Report shall reflect the results of the team’s Solar Decathlon project. It is used by the organizers to improve future events and provide lessons-learned opportunities.

### *Format Requirements*

<input type="checkbox"/> Packaged into a single bookmarked PDF file
<input type="checkbox"/> 20 pages maximum
<input type="checkbox"/> File name abbreviation: REPORT

### *Content Requirements*

<input type="checkbox"/> Summary of fundraising activities—final project budget and lessons learned
<input type="checkbox"/> Results of media outreach activities, including statistics
<input type="checkbox"/> Results of on-site exhibition activities—estimates of the number of visitors, assessment of visitor experiences, and lessons learned (what went well, what didn’t, and what you would do differently)
<input type="checkbox"/> Evaluation of the team’s online presence, including statistics and lessons learned (what went well, what didn’t, and what you would do differently)
<input type="checkbox"/> Team perspective on the effectiveness of the organizers’ communications efforts with both the teams and the public
<input type="checkbox"/> Description of future plans for the house
<input type="checkbox"/> Short description of each team officer’s future plans for employment, continued study, or other endeavors
<input type="checkbox"/> Suggested competition improvements
<input type="checkbox"/> Any other information you feel would be helpful to the organizers or future teams
<input type="checkbox"/> Contact list of all team members who worked on the project, including permanent (noncollegiate institution) email addresses

## Glossary

### **Architecture Contest**

A Contest that evaluates a building's architectural design for its creativity, overall integration of systems, and ability to deliver outstanding aesthetics and functionality along with energy-efficient performance

### **Build Area**

The area containing the competition prototype for the Build Challenge

### **Build Challenge**

A Challenge of the Solar Decathlon Competition that tasks teams to design, fund, build, operate, and present a complete house to the public

### **Build Challenge Event**

The activities that take place for the Local Build Division exhibit, which runs May 14–June 14, 2020, and the National Showcase Event at the 2020 Smithsonian Folklife Festival in Washington, D.C., in late June and early July. These activities include, but are not limited to, registration, setup, inspections, contests, special events, public exhibits, and removal.

### **Build Challenge Event Site**

The area provided by the organizers for showcasing team solutions to the public as part of the Build Challenge

### **Build Challenge Manager**

The head rules official responsible for writing and enforcing the rules and conducting the Build Challenge

### **Challenge**

Each of two avenues of participation for Solar Decathlon Competition teams: the Design Challenge and the Build Challenge

### **Comfort & Environmental Quality Contest**

A Contest that evaluates a building's capability to integrate comfort and indoor environmental quality with energy-efficient performance

### **Construction period**

The period of time between the completion of the Construction Documentation activities and the beginning of the contests and local public exhibit period

### **Communications manager**

The organizer responsible for the team's public outreach and communications activities

### **Communications materials**

All printed or electronic publications designed to convey information to the public

**Competition**

All aspects of the Solar Decathlon related to the Challenges, the 10 Contests, and the scoring of those Contests within each Challenge

**Competition prototype**

The complete assembly of physical components installed within the solar envelope as part of the Build Challenge

**Contest**

The Solar Decathlon competition consists of 10 separately scored Contests

**Decathlete**

A team member who meets the decathlete eligibility rules, as defined in Section 2.3

**Decision on the Solar Decathlon Rules**

The Build Challenge Manager's interpretation or clarification of the Solar Decathlon Rules

**Design Challenge**

A Challenge of the Solar Decathlon Competition that tasks teams to design and present complete building designs

**Director**

The organizer representing the U.S. Department of Energy who has final decision-making authority regarding all aspects of the project

**Removal**

The period of time between the closing of the Build Challenge Event and the completion of competition site cleanup

**Dwelling unit**

A single unit that provides complete independent living facilities for one or more people, including permanent provisions for living, sleeping, eating, cooking, and sanitation

**Energy Performance Contest**

A Contest that evaluates a building's energy use and production, as well as its capability to provide energy services—whether connected to the electricity grid or operating with on-site and/or stored power

**Energy-positive house**

A zero energy ready home that is so efficient it produces more energy than it consumes, leaving you with extra energy to use in other ways such as powering your mobile devices, power tools, or even your electric car

**Engineering Contest**

A Contest that evaluates the effective integration of high-performance engineering systems in energy-efficient and energy-producing buildings

**Event production manager**

The organizer responsible for the project's special events and volunteer activities associated with either Design Challenge Weekend or the Build Challenge Event

**Event sponsor**

An entity selected by Solar Decathlon organizers to help ensure the success of the project

**Faculty advisor**

A team member who is a faculty member and representative of a participating school in the project

**Financial Feasibility & Affordability Contest**

A Contest that evaluates a building's financial costs and ability to address growing affordability challenges in the housing industry

**Finished area**

The sum of the finished and conditioned areas measured at the floor level to the exterior finished surface of the outside walls

**Groups.io Project Site**

An online community forum that includes official communications suitable for viewing by all teams and organizers. The URL is <https://solardecathlon.groups.io/g/2020BuildChallenge/topics>

**Industry partner**

A business partner to the collegiate institution that offers expertise and experience to the project

**Innovation Contest**

A Contest that evaluates a design's success incorporating innovations and/or creative approaches that enhance energy efficiency, energy production, grid interaction, and building operations, as well as overall functionality and appeal

**Juried contest**

A contest with results based on a jury evaluation

**Juror**

An organizer selected by the appropriate Challenge Manager to participate as a member of a specific contest jury

**Jury**

A group of jurors evaluating a specific juried contest of the Build Challenge or a Division of the Design Challenge

**Market Potential Contest**

A Contest that evaluates a building's responsiveness to its stated target market, likely appeal to intended occupants and construction industry, and ability to transform how energy is used in buildings given its approach and wide-scale desirability

**Measured Subcontest**

A Subcontest with results based on task completion or monitored performance in the Build Challenge

**Mixed-Use Multifamily**

A blend of residential and commercial building area

**Observer**

An organizer, assigned by the Build Challenge Manager, to observe team performance and records the results of specific contest activities but does not provide interpretations of the Rules

**Operations Contest**

A Contest that evaluates how effectively and efficiently a building operates to carry out intended functions while also ensuring persistence of performance

**Organizer**

A DOE or NREL employee, subcontractor, juror, or observer working on the project

**Personal protective equipment**

Safety glasses, protective clothing, helmets, or other garments or equipment designed to protect the wearer's body from injury

**Presentation Contest**

A Contest that evaluates the team's ability to accurately and effectively convey its design and energy performance strategy to relevant audiences

**Project**

All activities related to the U.S. Department of Energy Solar Decathlon

**Protest Resolution Committee**

A group of three organizers selected by the Build Challenge Manager to resolve team protests in the Build Challenge

**Public exhibit**

Areas of the competition site open to the public during designated hours as part of the Build Challenge

**Qualified Electrical Worker**

A team member who has the requirements for qualified electrical work on the competition site

**Resilience**

The ability to anticipate, withstand, respond to, and recover from disruptions

**Resilience Contest**

A Contest that evaluates a building's ability to withstand and recover from prevailing disaster risks for its intended location, maintain critical operations during grid disruptions that commonly occur post-disasters, and ensure long-term durability in response to local climatic conditions

**Rules**

All principles or regulations governing conduct, action, procedure, arrangement, and so on, for the duration of the project, represented in aggregate by this Solar Decathlon Build Challenge Rules document (see separate Design Challenge Rules document as applicable)

**Rules official**

An organizer authorized to interpret the rules and officiate one or more of the contests

**Setup**

The period of time between the allowed arrival of trucks on-site and the beginning of the Build Challenge Event on the National Mall

**Scored period**

Any 15-minute period beginning at 0, 15, 30, or 45 minutes after the hour during the Build Challenge Event

**Scoring server**

A server that collects data and calculates composite scores

**Site operations manager**

The organizer responsible for all event site operations

**Solar Decathlon Building Code**

A set of design and construction standards set forth for the protection of public health and safety during the Build Challenge Event

**Solar Decathlon Building Official**

The rules official responsible for writing, interpreting, and enforcing the Solar Decathlon Build Challenge Building Code

**Sponsor**

A business or organization that provides funds for the competition

**Staff**

An individual working for the organizers whose role is not described elsewhere in these definitions

**Subcontest**

An individually scored element within a contest

**Team**

The combination of team members representing a single entry to a Challenge of the competition

**Team crew**

A team member who is involved with a team's project who may be unaffiliated with a participating school

**Team member**

An enrolled student, recent graduate, faculty member, or other person who is affiliated with one of the participating schools and is integrally involved with a team's project activities; decathletes, faculty advisors, and team crew members are all considered team members

**U.S. Department of Energy Solar Decathlon**

A collegiate competition, comprising 10 Contests, that challenges student teams to design and build highly efficient and innovative buildings powered by renewable energy

**Volunteer**

An individual selected by the volunteer coordinator to support activities on the competition site and whose role is not described elsewhere in these definitions

**Volunteer coordinator**

An organizer selected by the event production manager to manage volunteer activities on the competition site