



U.S. DEPARTMENT OF ENERGY

**Solar Decathlon**

**Build Challenge**

## **2023 Build Challenge Rules**

March 2023

The U.S. Department of Energy (DOE) 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.

The Solar Decathlon Competition Guide defines the framework of the competition. This document contains the 2023 Build Challenge Rules, which describe all aspects of how the Build Challenge will be conducted, scored, and awarded. The information in the Rules is supplemented by the Competition Guide.

## List of Acronyms

ADA	Americans with Disabilities Act
ANSI	American National Standards Institute
AHJ	Authority Having Jurisdiction
CFM	cubic feet per minute
CO <sub>2</sub>	carbon dioxide
dB	decibel
dBa	A-weighted decibels
DOE	U.S. Department of Energy
EDT	Eastern Daylight Time
EST	Eastern Standard Time
HERS	Home Energy Rating System
HVAC	heating, ventilating, and air conditioning
kWh	kilowatt-hours
Leq	sound level equivalents
Lx	lux
NREL	National Renewable Energy Laboratory
OSHA	Occupational Safety and Health Administration
PPM	parts per million
PV	photovoltaic
SUI	Solar Utilization Index
Wh	watt-hours

## Summary of Changes Since the January 2023 Release

The following is a summary of the changes and updates to this 2023 Build Challenge Rules document since the January 2023 release:

- Explanations of the Public Exhibition Period were updated in the Summary of Important Dates and the Public Exhibition paragraph in Section 2.1. The updated text changed from requiring at least two weekends of public exhibition activities during the Public Exhibition Period to requiring at least one weekend. A clarification was added that houses are not required to be open every day during the Exhibition Period but that multiple days are highly encouraged.
- The description of the D7 Deliverable due on March 14, 2023, in the Summary of Important Dates was updated to clarify that teams must have either scheduled or completed meetings with the Organizer Instrumentation Team to confirm receipt and proper set up of measured contest instrumentation by this date.
- Section 3.6.1 Registration and Attendance was updated to reflect the increase in Build Challenge student decathletes that are allowed to register for in-person attendance at the Competition Event.
  - Similarly, Section 5.2 was updated to reflect the increase from five to seven student decathlete presenters allowed for each jury presentation.
- Section 4.8 Indoor Air Quality sub-contest was updated to correct an inconsistency in language in order to match the number of people in the house for the House Occupancy sub-contest in Section 4.7. The Indoor Air Quality sub-contest had referenced six individuals and was updated to say “at least eight” individuals to remain consistent with the House Occupancy sub-contest.
- Section 4.9 Energy Production sub-contest was updated to clarify that this activity will be scored based on any 24-hour period during the Measured Evaluation Period, rather than a single 24-hour period determined in advance.

## Summary of Changes Since the November 2022 Release

The following is a summary of the changes and updates to this 2023 Build Challenge Rules document since the November 2022 release:

- Section 3.7.4 was added to define and further explain the Measured and Monitored Subcontests.
- Language in the following sections was revised to correct errors or clarify the explanation of Contests:
  - Section 4.6 Integrated Performance (Measured)
  - Section 4.7 Occupant Experience (Measured)

- Section 4.8 Comfort and Environmental Quality (Measured)
- Section 4.9 Energy Performance (Measured).
- Section 5.2 was updated to provide additional detail on jury presentation topics.

Other minor corrections and clarifications were made throughout.

## 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. Numerous attributes will ultimately determine whether buildings succeed or fail in terms of the human experience, including affordability, comfort, health, durability, safety, and adequate resources. Yet, professional curricula across the United States and around the world do not consistently provide students with 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.

To help address this gap, the U.S. Department of Energy (DOE) Solar Decathlon® Build Challenge focuses on two critical goals: to integrate high-performance design and construction education into degree programs, and to inspire the public and industry through innovations implemented by student teams. As a collegiate competition with 10 Contests that challenges student teams to design and build highly efficient and innovative buildings powered by renewable energy, the Solar Decathlon has grown since it began in 2002 to have an international footprint, with global events and tens of thousands of alumni around the world. The Solar Decathlon Build Challenge is helping create the next generation of the building workforce, with the skills and passion to build or retrofit high-performance, energy-efficient, net zero buildings.

More information about the Solar Decathlon is available in the [Solar Decathlon Competition Guide](#) and on the [Solar Decathlon website](#).

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*Authors: NREL’s Joe Simon, Michael Young, Taylor Ryan, Marlana Praprost, Jes Brossman, Nick Cindrich, Rachel Romero, and Stacey Rothgeb.*

# 1 Summary of Important Dates

The following are key milestones for the 2023 Build Challenge:

- **July 2021:** 2023 Build Challenge Rules are released.
  - The Team Application is available on the [Solar Decathlon website](#). Teams can begin work as early as the release of the Rules.
  - After a team completes its application, the team is provided access to Build Challenge communications and resources, including Building Science Education, topical webinars, and energy modeling software.
- **October 19, 2021, 5 p.m. EDT:** Team Application deadline
  - The application can be accessed from the [Solar Decathlon website](#).
  - Each team pays a nonrefundable \$100 fee; identifies a Faculty Lead and a Student Team Lead and provides the name, email, and phone number for each of those individuals; submits a preliminary roster of student team members; and submits a Build Challenge Proposal.
- **November 30, 2021, 5 p.m. EST:** D1—Project Introduction Deadline
  - Deadline by which all teams must complete the Project Introduction, which includes a Conceptual Design of the team’s entry.
- **February 15, 2022, 5 p.m. EST:** D2—Project Management Plan Deliverable Deadline
  - The Project Management Plan deliverable includes information about the team’s project construction partner and site.
- **March 29, 2022, 5 p.m. EDT:** D3—Construction Documentation Deliverable Deadline
- **April 12, 2022, 5 p.m. EDT:** D4—Design Presentation Deliverable Deadline
- **April 22–24, 2022:** Solar Decathlon Competition Event
  - 2023 Build Challenge teams present to industry leaders who determine which teams will receive prize funding from DOE and which teams advance to the Construction phase of the Challenge.
- **July 2022:** Updated 2023 Build Challenge Rules Released
  - Minimal revisions, primarily focused on clarifying intent and adding definition to dates or schedules.
  - Possibility of additional Rules update in Fall 2022.
- **August 2, 2022, 5 p.m. EDT:** D4.5—Updated Construction Schedule Deliverable Deadline
- **August 2, 2022, 5 p.m. EDT:** D5—Permit Documentation Deliverable Deadline
- **October 18, 2022, 5 p.m. EDT:** D6—Construction Progress Deliverable Deadline
- **January 30, 2023:** Final Build Challenge Rules Released
  - Minimal revisions expected, primarily focused on clarifying intent or adding definition to dates or schedules.

- **March 14, 2023, 5 p.m. EDT: D7—Construction Completion Deliverable Deadline**
  - Teams must have either scheduled or completed meetings with the Organizer Instrumentation Team to confirm receipt and proper setup of measured contest instrumentation.
- **March 20, 2023:** Date by which houses should be sufficiently complete to begin evaluation in Measured Contests.
- **March 20–April 7, 2023:** Monitored Contest Evaluation Period
  - All homes are to be evaluated independently of each other, and time-averaged Monitored Contests will be conducted for all teams during this period.
  - Point penalties of 1 point per day of delay will be assessed to teams not ready to begin Monitored Contest evaluations on March 20, 2023.
- **March 28, 2023, 5 p.m. EDT: D8—Project Story Deliverable Deadline**
  - Including Jury Documentation, As-Built Documentation, House Photography and Videography, and summary of public exhibit success and ongoing social media engagement by this deadline.
- **April 7, 2023:** Measured Contest Completion Deadline
  - All Measured Contests must be complete by this date.
  - Any Contests or Subcontests not complete by this date will receive zero points.
- **April 4–18, 2023:** Required Local Exhibition Period
  - Teams may open their houses to the public for local exhibition earlier and/or later than these dates, but all houses shall be open for local exhibition during this period for at least one full weekend.
  - Teams must complete an inspection and be approved by the Solar Decathlon Building Official in order to open for public exhibition.
- **April 11 and 18, 2023, 5 p.m. EDT: D9—Final Presentation Deliverable Deadlines**
  - *Engineering, Architecture, Market Analysis, Durability and Resilience, and Embodied Environmental Impact* Jury Presentations will be due on April 11, 2023.
  - *Presentation* Jury Presentation will be due on April 18, 2023.
- **April 20–23, 2023:** Solar Decathlon Competition Event
  - All teams will present to juries at the National Renewable Energy Laboratory (NREL) campus in Golden, Colorado, USA, with virtual participation options also available.
  - All final team scores calculated as part of the Measured Contest activities will be announced.
  - All competing teams will earn points according to the Build Challenge Rules, and the team with the most points overall will win.
  - All competing teams will be provided an opportunity to present their projects to other competitors, industry professionals, and related guests.
- **May 10, 2023, 5 p.m. EDT: D10—Final Report Deliverable Deadline.**



## 2 Build Challenge Structure

Teams entering the Build Challenge design and build a residential unit in their local community. For more information on the Solar Decathlon, including the relationship between the Design Challenge and the Build Challenge, see the [Solar Decathlon Competition Guide](#).

The Build Challenge comprises 10 Contests, each worth 100 points. 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.

The team must build a single dwelling unit for evaluation. 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 the American National Standards Institute (ANSI) [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.

Teams shall design and build an energy-positive house in their region that can be effectively exhibited and operated. As such, renewable energy must be evaluated and integrated into the project and built house. The design should respond to a unique, team-specified target market that would benefit from collegiate institution innovation and engagement.

Teams may build multifamily housing where the design is part of a duplex, townhome, or multifamily development. However, the house presented must represent a complete dwelling unit, and only one dwelling unit will be evaluated as part of the Contests.

The house must be between 400 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, with ramps in accordance with the Americans with Disabilities Act (ADA). The organizers will have a third-party inspector verify the ADA tour route through each house prior to providing approval to compete.

Teams are required to present their solutions during the Competition Events occurring on the NREL campus in Golden, Colorado (both in-person and virtual participation will be accommodated). The organizers do not plan to provide financial assistance for lodging or travel expenses.

### 2.1 Challenge Phases

#### *Design Activities*

Following notification of acceptance into the design phase of the Build Challenge, each team begins work on its design solution. During this phase, teams refine their concept, recruit industry partners, confirm the location for the construction of the house, and prepare deliverables.

Each team sends up to five students total to attend the Solar Decathlon Competition Event in person, April 21–24, 2022, at NREL in Golden, Colorado, to present their design progress for

determination of the 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. As part of the 2022 Competition Event, team progress will be evaluated by independent juries and assessed by experts for an Approval to Proceed to the next phase and for receipt of prize funds, as outlined in the Approval to Proceed Procedures, which will be made available on the [Project Site](#). Up to 30 teams are expected to receive prize funding from the Department of Energy following receipt of an Approval to Proceed. All teams who receive an Approval to Proceed will be eligible to remain in the competition.

Conceptual Design activities run from registration in the 2023 Build Challenge (October 2021) through April 2022.

### **Construction Activities**

Following receipt of an Approval to Proceed in April 2022, teams shall complete their designs including all elements of the Construction Documentation deliverable, and include all appropriate construction drawings, details, energy models, specifications, site plans, and project plans per the schedule of deliverables. 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.

Following the successful completion of their Construction Documentation, teams build their house. Throughout the process, teams are expected to follow safe construction practices and document activities that may be relevant to the juries. Teams are responsible for all costs associated with materials and construction of the house design.

Construction activities run from April 2022 through house completion, expected in early 2023.

### **Public Exhibition**

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 or in their professional careers. All tours and aspects of each team's public outreach shall be informative, interesting, and accessible by people of all abilities. 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.

Public exhibition activities run from April 4 to April 18, 2023. Team houses are not required to be open every day during this period, but a minimum of one full weekend is required and multiple days are highly encouraged.

### **Competition**

Following the successful construction of the house, each team will compete in the Solar Decathlon 2023 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. 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. The organizers will arrange to have each house photographed and documented using interactive 3D photography with walkthroughs; this information will be provided to the juries for review in advance of deliberation. During the competition phase, teams will also 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.

Competition activities will run from April 20–23, 2023.

### ***Optional Project Deferral to Participate as Exhibition-Only in 2024***

Teams that will not be ready to compete in April 2023 will have the option to defer their project completion and public showcase to April 2024. Readiness to compete is to be determined by each team, and the deadline to select the 2024 deferral is December 20, 2022. Deferring the 2023 Build Challenge project to “exhibition only” in 2024 involves the following:

- Forfeiture of eligibility to compete for points and trophies in the 2023 Build Challenge.
- Continued support from Build Challenge organizers and access to Solar Decathlon resources.
- Evaluation of house performance in the Measured Contest activities.
- Optional attendance at the Solar Decathlon 2023 Competition Event to present on project progress in the Exhibition group.
- Attendance at the Solar Decathlon 2024 Competition Event, in which teams will present their project to industry jurors for feedback and qualitative evaluation.
- Public exhibition of house to local community in Spring 2024, including public tours, media outreach, engagement with DOE, and more.

## **2.2 Required Tasks**

- Attend monthly all-team meetings for project updates and important information from the organizers about Build Challenge requirements, as outlined in Section 2.
- Attend monthly Community Engagement webinars.
- Ensure all student team members complete the online Building Science Education course or receive a confirmation from the team’s Faculty Lead indicating that equivalent training is provided as part of the student’s curriculum.
- 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.

- Submit all materials by the stated deadlines. Note that all deadlines are 5 p.m. Eastern Time (EDT from March to November each year, and EST from November to March).
- Participate in the 2023 Solar Decathlon Competition Event, and present to Build Challenge jurors.

## 2.3 Team Structure

- Each team must be associated with a collegiate institution and include a Faculty Lead.
- Each team must have at least five students, with one student designated as the Student Team Lead and others filling in the other team officer roles, as outlined in Table 1.
- Multiple collegiate institutions may combine to form a team.
- If a team member who is not a U.S. citizen wants to participate in person at the Competition Event held at NREL, each non-U.S. citizen must complete application paperwork to be able to access the campus; not all requests are accepted due to national security reasons.

**Table 1. Team Officers**

Role	Responsibilities
Student Team Lead	The Student 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 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.
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, including fire watch, public safety, and evacuation procedures.
Community Outreach Officer	The Community Outreach Officer is responsible for sharing the team’s design and innovations with the community, as well as development of communications products such as branding, team website, social media posts, and/or marketing materials; the Community Outreach Officer also leads implementation of public exhibition activities.
Faculty Advisor	A Faculty Advisor is a faculty member who advises the team and represents a competing collegiate institution.
Faculty Lead	The Faculty Lead is a Faculty Advisor who serves as a primary contact for a team; the Faculty Lead is responsible for communicating competition details from organizers to team members, as well as overseeing and closely engaging with the team.

### 2.3.1 Student Decathlete Qualifications

Each student must be pursuing a degree and enrolled in at least one class at a participating collegiate institution or have graduated within the 12 months prior to April 1, 2023. Student team members can be from any discipline and any level of collegiate schooling.

### 2.3.2 Faculty Lead Role

The Faculty Lead(s) agrees to:

- Negotiate and maintain a productive relationship between the Solar Decathlon team and the related collegiate institution(s);
- Verify that participating students complete the Building Science Education course or equivalent curriculum;
- Ensure safety for all people participating in construction;
- Guarantee the necessary information is provided to team members who will be on-site at the Competition Events;
- Attend the competition in person or virtually; and
- Ensure the team builds the house as designed and exhibits to the public.

### 2.4 Application

Teams interested in participating in the Build Challenge are required to complete a Team Application. All teams who submit a complete Build Challenge Application will be accepted into the Design phase of the Build Challenge competition.

### 2.5 Building Code

The Solar Decathlon Build Challenge Building Code applies to all houses built as part of the Solar Decathlon Build Challenge. Homes are subject to local, state, and national codes or standards governing topics such as minimum bedroom size, fire protection requirements, resilience, or other requirements. If there are conflicts between the Solar Decathlon Build Challenge Building Code and local regulations where both conditions cannot be met, teams must discuss the discrepancy with the Solar Decathlon Build Challenge Building Official. The Building Code will be posted on the [Project Site](#) no later than March 2022.

### 2.6 Units of Measurement

English units of measurement are preferred; however, a submission with metric units is acceptable. If metric units are used, metric units should be stated first, with English equivalents in parentheses.

## 3 Build Challenge Requirements

### 3.1 Authority

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

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

#### *Build Challenge Competition Manager*

The Build Challenge Competition Manager is the only rules official authorized to write and modify these rules and may do so at their discretion at any time during the 2023 Build Challenge.

#### *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 [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 [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

#### 3.2.1 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.

#### 3.2.2 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 goals of the competition will not be viewed favorably. DOE reserves the right to change the rules of the competition at any time.

#### 3.2.3 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 [Project Site](#). The site will host messages and files for the teams.
- 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 [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) Building Science Education: All student team members are required to complete the free, organizer-provided Building Science Education course or receive an equivalency waiver from their faculty adviser indicating that equivalent training is part of their curriculum.
- d) Webinars: At least one member from each team is expected to participate in regularly scheduled all-team meetings with the organizers. Additionally, teams are expected to participate in webinars intended to educate and prepare the teams for successful participation in the Challenge, including the monthly Community Engagement webinars.
- e) Meetings: The teams and organizers may have one or more private meetings on an as-needed basis. Attendance is expected unless prior notice is given to the Build Challenge Manager.
- f) Individual Email: For expediency and to protect design confidentiality amongst teams, teams and organizers may communicate directly via email. Organizers will not share team information discussed via email publicly unless appropriate for all teams or the public.

### **3.2.4 Prize Structure**

Up to 30 competing teams will be selected for prize funds via the process outlined in the Approval to Proceed Procedures, which will be 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.

Prize disbursements are expected to be distributed at the conclusion of the Design phase, following the process outlined in the Approval to Proceed Procedures. Up to 30 teams that successfully obtain Approval to Proceed will earn an award of \$50,000 per team.

- a) 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.
- b) 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.

- c) Through participation in the competition, each team agrees to accept the decisions of the organizers. The results are final. No right to counsel is authorized.

### **3.2.5 Effective Date**

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

### **3.2.6 Decisions on the Rules**

If needed, the [Project Site](#) will contain a “Decisions on the Rules” document 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 all teams of the addition.

### **3.2.7 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.

### **3.2.8 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 Solar Decathlon 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 [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.

### **3.2.9 Protests**

- a) Official written protests may be filed by a team for any reason following the release of scores or decisions on the Rules. 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 within 24 hours of the action being protested. The final opportunity to file a protest is 5 p.m. MDT on Sunday, April 23, 2023.
  - Exception: If results of one or more Juried Contests are announced on the final day of the Competition Event, they cannot be protested.
- d) The protest shall be submitted by emailing the Build Challenge Manager at [SDbuild@nrel.gov](mailto:SDbuild@nrel.gov). The protest shall be attached as a PDF to the email, and the email subject should include “Solar Decathlon 2023 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 penalty, 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 [Project Site](#).

### 3.3 Participation

Collegiate institutions may be multidisciplinary and may choose to have multiple internal groups of students complete designs, but only one design project may be submitted.

If a collegiate institution has multiple teams competing concurrently in the Solar Decathlon across the Design and Build Challenges, each team must have distinct designs.

### **3.3.1 Team Structure**

Each team shall provide contact information via the [Project Site](#) for the team officers listed in Table 1 and shall keep the contact information current for the duration of the project.

- a) Teams shall provide the contact information for only one person in each officer position.
- b) Faculty members are only eligible to fill the Faculty Advisor team officer position. Decathletes must fill all other team officer positions.

### **3.3.2 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.
- 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, including any setup of exhibits or houses, a minimum level of personal protective equipment shall be worn by each team member and team crew member:
  - Hard hat (ANSI Z89.1 or equivalent, Type I, Class G or better)
  - Safety glasses with side shields (ANSI Z87.1 or equivalent)
  - 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).
- e) Team members who expect to participate in 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.

### **3.3.3 Conduct**

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

### **3.3.4 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.

### **3.3.5 Competition Withdrawals**

Any team wishing to withdraw from the Build 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.

### **3.3.6 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 day following the due date. The maximum penalty associated with next-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.

## 3.4 Build Challenge House Requirements

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> (37.16 square meters [m<sup>2</sup>]) and less than 3,000 ft<sup>2</sup> (278.71 m<sup>2</sup>).

- a) 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.
- b) Teams may compete using one unit of a multifamily property, where additional dwelling units are placed adjacent to or otherwise surrounding the competition prototype.

The teams must meet the requirements for residential construction set by their local AHJ. The house must be built to meet the stricter of either the Solar Decathlon Build Challenge Building Code or the locally adopted building and energy codes.

### 3.4.1 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.

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.

The house exit route shall be accessible to the public and lead from the main house exit to a publicly accessible street or path.

### 3.4.2 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. 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.

Juries shall consider how the design addresses local building code provisions and site restrictions at the target client's site.

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.

## 3.5 Energy

### 3.5.1 Photovoltaic Technology Limitations

Bare photovoltaic (PV) cells and encapsulated PV modules must be commercially available by or approved by the organizers prior to the beginning of the Competition Event.

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 the Competition Event.

### **3.5.2 Energy Monitoring**

Teams shall install full branch-circuit level monitoring equipment within their competition prototype. This circuit-level energy monitoring shall provide data in a way that can be consumed by a homeowner, such as through an app or website showing which appliances, functions, or devices used energy, not just how much and when energy was used.

### **3.5.3 Energy Sources**

After the conclusion of construction and until the conclusion of the Community Exhibition, global solar radiation incident on the lot is the only source of primary energy that may be consumed in the operation of the house. Homes may be grid-connected or grid-independent, but any electrical energy consumed by the house that is not generated onsite must be offset with site-generated renewable energy.

- a) Fireplaces, firepits, candles, and other devices using non-solar fuels are not permitted in the designs.
- b) Combustion appliances are not permitted in designs, whether new construction or retrofit.
- c) The use of batteries is permitted as detailed below in the “Energy Storage” and “Inspections” sections of these rules.

### **3.5.4 Net Zero Plus Energy**

All houses must be built with sufficient on-site PV energy generation to achieve net zero energy on an annual basis.

### **3.5.5 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 storage, such as batteries, and associated enclosure(s) must be compliant with the Solar Decathlon Build Challenge Building Code.
- b) The use of primary (non-rechargeable) 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 (non-hardwired) 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.

- 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).

## **3.6 Build Challenge Events**

Build Challenge Events include the Competition Event on April 21–24, 2022, at NREL in Golden, Colorado; the Community Exhibition activities, which occur primarily in early 2023; and the Final Competition Event on April 20–23, 2023, which will also take place at NREL (both in person and virtually).

### **3.6.1 Registration and Attendance**

All Solar Decathlon Build Challenge Competition Event participants must register using the online registration site to submit required forms.

For both the 2022 and 2023 Competition Events, if held as in-person events, participating teams may register up to seven (7) student decathletes and up to two (2) faculty advisors to represent the team on-site at the event. These on-site limits will be strictly enforced and badging of visitors to the National Renewable Energy Laboratory will only occur for Build Challenge teams on Thursday, April 20 during check-in. Visitor badges will be unique to each individual and may not be shared/transferred to others. Only the individuals that are registered for in-person attendance at the Solar Decathlon Competition Event are authorized to be on the NREL property. NREL Laboratory Protection staff are authorized to challenge anyone on NREL premises for an identification badge. Those without a badge will be directed to the Site Entrance Building to be issued the appropriate badge and any person without the proper authority to be on NREL sites will be escorted off site.

Additional student decathletes can register for virtual participation in the Competition Event. Note that only student decathletes are permitted to present to juries; non-decathletes (e.g., faculty advisors) are prohibited from interacting with their student decathletes and jurors during jury presentation activities. See Section 5.2 for more information on presentation guidelines and requirements.

### **3.6.2 Program Branding 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 “2023 Build Challenge.”

- a) The Solar Decathlon logo must be prominently displayed during the Community Exhibition, either through organizer-created or team-created materials.
- b) Signage on display at the Community Exhibition shall be compliant with any branding guidelines issued by the organizers and will include recognition of Solar Decathlon national sponsors. Logos and/or display materials will be provided in February 2023 by organizers, along with guidance for placement and sponsorship level recognition.

### **3.6.3 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.

- a) 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>) at the Community Exhibition. Other products include, but are not limited to, signs, exhibits, posters, plaques, photos, wall art, and furnishings.
- b) For multimedia or audio presentations a team chooses to play during their Community Exhibitions, no more than 20% of the total time, 1 minute, or whichever is less may be dedicated to the recognition of team sponsors.
- c) 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.
- d) Team uniforms are exempt.

#### **3.6.4 Logistics at Build Challenge Events**

- a) Each team is responsible for the transport of any necessary team equipment or exhibits to the Competition Event. Each team is responsible for any damage to or loss of such items.
- b) Each team is responsible for procuring all necessary equipment, tools, and supplies to build its house.
- c) Each team is responsible for transportation, accommodations, lodging, food, and beverages, as applicable.
- d) Each team is responsible for making its own reservations and arrangements, and for covering all necessary costs, as applicable.

#### **3.6.5 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 AHJ 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 Build Challenge Events.
- 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) The Build Challenge Manager shall check each team's inspection status to determine which houses are eligible to participate in the Contests. All final inspections shall be passed by the deadline indicated in these Rules. Failure to pass inspections by the required deadline may disqualify a team from participation in Competition Event and is considered a rules violation. A team must have passed inspections to be eligible to participate in the Contests.
- d) 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 Build Challenge Activities

### 3.7.1 House Occupancy

Under normal circumstances, no more than 50 people may be located in the finished square footage of the team's house at any one time for safety reasons.

### 3.7.2 House Operators

Only student decathletes, as defined in Section 2.3.1, are permitted to operate the house and participate in the Contests.

- a) During the execution of Measured Contests, only decathletes are permitted to operate the house and interact with organizer-appointed observers. Non-decathletes may be present for Measured Contest activities but must refrain from providing any guidance or direction to decathletes. Additionally, only decathletes are permitted to present to and answer questions from juries during the Jury Presentations at the Final Competition Event. Non-decathletes may be present but cannot interact with jurors during the presentation periods.
- b) Non-decathlete team members are permitted to give tours to the public and be present on the exhibition site.

### 3.7.3 Late Design Changes

The final constructed project 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 compile a summary of all known inconsistencies discovered during the inspections process and submit the summary to the respective juries.

### 3.7.4 Measured and Monitored Contest Activities

Team houses are evaluated for their measured performance in four of the ten Contests. Each Measured Contest consists of various Subcontests, which are explained in Sections 4.6 through 4.9. Some of the Subcontests are evaluated based on discrete activities that result in a single measurement at one point in time or over a short period of time ("Measured Subcontests"), and some of the Subcontests are evaluated based on data captured by organizer-provided sensors that monitor house performance over extended periods of time ("Monitored Subcontests").

- a) **Measured Subcontests:** As described in Section 1 Summary of Important Dates, team houses *must* complete all Measured Subcontest activities by April 7, 2023, in order to earn points. Measurements will be manually recorded in organizer-provided forms. An organizer-appointed observer will oversee Measured Subcontest activities and verify measurement form entries via a virtual meeting.

The Measured Subcontest activities are intended to be completed on a single day, as indicated in the Measured Contest Schedule.



- b) **Monitored Subcontests:** March 20 through April 7, 2023, is the Monitored Subcontest Evaluation Period during which all team houses will undergo data collection and evaluation in Monitored Subcontests. Teams that are not ready/able to begin any of the Monitored Subcontest activities on March 20 will incur a penalty of one point per day until the team informs the Organizers that it is ready/able to begin at least one of the Monitored Sub-contests.

Any Measured or Monitored Subcontests not completed by April 7, 2023, will result in a score of zero points for that Subcontest.

In February 2023, Build Challenge Organizers will provide the Measured and Monitored Contest Schedule along with detailed guidance. Additionally, teams *must* participate in a measured contest planning meeting with the Build Challenge Organizers and provide the Organizers with a completed measured contest schedule prior to completing the measured contests.

### **3.7.5 Public Exhibit**

- a) Teams are required to provide an accessible tour experience 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 Community Exhibition.
- c) Teams may 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 Community Exhibition shall be compliant with branding guidelines and shall include recognition of Solar Decathlon national sponsors. Logos will be provided by organizers, along with guidance for placement and sponsorship level recognition.

### **3.7.6 Team Uniforms**

- a) During all Build Challenge Events and special events specified by the organizers, team members are encouraged to wear uniforms representing their team.
- b) 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).

## 4 Build Challenge Contests

The Solar Decathlon Build Challenge consists of 10 separately scored Contests, and some Contests contain one or more Subcontests. Each Contest is worth 100 points. The team with the highest total points at the end of the competition wins. Points are earned through jury evaluation and measured performance. Measured Contests are evaluated based on the criteria indicated in the Contest details.

**Table 2. Contests and Subcontests**

Contest No.	Contest Name	Contest Type	Points	Subcontest Name	Subcontest Points
1	Architecture	Juried	100	None	n/a
2	Engineering	Juried	100	None	n/a
3	Market Analysis	Juried	100	None	n/a
4	Durability and Resilience	Juried	100	None	n/a
5	Embodied Environmental Impact	Juried	100	None	n/a
6	Integrated Performance	Measured	100	Hot Water	30
				Interior Light Levels	20
				Internally Generated Noise	10
				Airtightness	20
				Passive Performance	20
7	Occupant Experience	Measured	100	Kitchen Appliances	30
				Clothes Washing	10
				Clothes Drying	10
				Home Electronics	5
				House Occupancy	15
				Electric Vehicle Charging	15
				Grid Responsive Electronics	15
8	Comfort and Environmental Quality	Measured	100	Temperature Control	30
				Humidity Control	20
				Indoor Air Quality	20
				Comfort Gradient	20
				Exterior Noise Infiltration	10
9	Energy Performance	Measured	100	Energy Efficiency	30
				Energy Production	20
				Net Zero Energy	30
				Solar Energy Utilization	20
10	Presentation	Juried	100		n/a

## 4.1 Architecture

This Contest evaluates the building's architecture for creativity in matching form with function, overall integration of systems, and ability to deliver both outstanding aesthetics and functionality.

A jury of architects shall assign an overall score for each team's project after completing the procedure outlined in the Rules.

The jury shall consider the following in its evaluation:

- **Architectural Concept and Design**, including approach, coherence, uniqueness, responsiveness, and challenges.
- **Architectural Implementation**, including build quality, appearance, effectiveness, functionality, materiality, passive strategies, and efficiency.
- **Documentation**, including accuracy, level of completion, clarity, and techniques used to convey the design to the jury.
- **Innovation**, with regard to scale and proportion, indoor/outdoor connections, composition, and holistic and integrated design.

## 4.2 Engineering

This Contest evaluates the effective design of high-performance engineering systems, technologies, and techniques that enable energy efficiency adoption and renewable energy production.

A jury of engineers shall assign an overall score for each team's project after completing the procedure outlined in the Rules.

The jury shall consider the following in its evaluation:

- **Approach**, including research, multidisciplinary collaboration, use of market-leading technologies, and engineering integration.
- **System and Component Design**, including component selection, passive strategies, integrated functionality, envelope design, occupant comfort, lighting, energy production, plumbing, structure, and landscaping.
- **Efficiency and Performance**, including likely savings, expected performance, use of renewable energy resources, maintenance, and operability.
- **Documentation**, including construction drawings and energy model accuracy, level of completion, clarity, and techniques used to convey the design to the jury.
- **Innovation**, with regard to research processes and the use of new, unique, or atypical technologies or engineering solutions that improve on the status quo.

### 4.3 Market Analysis

This Contest evaluates the building’s appeal, affordability, and attainability to the stated target market. This includes addressing specific market needs, such as affordability and financial feasibility, and socioeconomic barriers to increase likelihood of adoption by intended occupants and the construction industry for impactful, cost-effective design.

A jury of professionals shall assign an overall score for each team’s project after completing the procedure outlined in the rules.

The team must define a target client, with a minimum level of detail including household income, location, and requirements as indicated in Table 3. The target market defined for the competition prototype must be for year-round occupancy.

**Table 3. 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

The jury shall consider the following in its evaluation:

- **Affordability and Cost-Effectiveness**, including the estimated up-front cost of construction and costs of operations and maintenance, the affordability to the team’s target market, and the level to which the design appropriately balances cost with performance and quality.
- **Market Analysis**, including responsiveness to the characteristics and requirements of the team-defined target market, demonstration of market need, and the effectiveness of the house’s energy features to improve the marketability of the house.
- **Livability**, including current market expectations for livability and convenience, the house’s support for a safe, functional, and enjoyable place to live, and the expected likelihood of the design to encourage a homeowner to use fewer resources than a typical homeowner.
- **Buildability**, including effectiveness of drawings, documentation, and construction details that enable the design to be adopted and built by a typical construction company.
- **Scalability**, including U.S. market impact potential, integration of off-site construction techniques, the ability for trades to reproduce the design at scale, and the extent to which the design could have immediate and/or long-term commercial impact in the marketplace.
- **Innovation**, with regard to approach to livability and buildability, inspiring the public to consider opportunities for housing of the future.

## 4.4 Durability and Resilience

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

A jury of professionals shall assign an overall score for each team's project after completing the procedure outlined in the rules.

The jury shall consider the following in its evaluation:

- **Durability**, including the ability of the building envelope to maintain long-term performance despite routine environmental conditions.
- **Performance**, including the extent to which the house provides occupants critical load capabilities and the ability to withstand and recover from potential disasters because of risks posed by weather and other natural or human-caused events.
- **Resource Management**, including the extent to which the building relies on external supply of energy and water; and how much the design integrates passive strategies, reduces lifecycle impacts, enables the reclamation and reuse of water, and requires less energy than a comparable code-compliant building.
- **Resilience**, including the ability of the building to maintain critical operations during disruptions and quickly restore normal operations.
- **Innovation**, with regard to unique or innovative approaches to building resilience, occupant safety, house performance, and occupant health.

## 4.5 Embodied Environmental Impact

This Contest evaluates cumulative environmental impact of all processes over the course of the building life cycle, including extraction of raw materials, production and manufacturing processes, shipping, construction, operation, and end-of-life.

A jury of professionals shall assign an overall score for each team's project after completing the procedure outlined in the rules.

The jury shall consider the following in its evaluation:

- **Design Decisions and Conclusions**, including the changes to initial approaches following analysis and the consideration of reclamation, refurbishment, repair, reuse, and recycling of materials throughout the building's life cycle.
- **Life Cycle Assessment**, including the calculated whole-life energy use, greenhouse gas emissions, and other environmental impacts; and the quality of analysis and determination of the environmental impact of material production, manufacturing, house operation, and end-of-life.
- **Embodied Environmental Impact**, including the expected or likely total impact of material extraction, manufacturing, transportation, construction, use, and end-of-life decommissioning of the building.
- **Innovation**, with regard to "circular economy," "re-x," operations, and the building's total environmental impact.

## 4.6 Integrated Performance (Measured)

This Contest evaluates the interdependencies of building design elements to achieve optimized whole building performance. In a truly integrated design, when any element is altered or removed from the building, overall building performance is diminished.

### *Hot Water Subcontest (Measured)*

Significant water and energy are often wasted as occupants wait for hot water to emerge from their faucets. All available points are earned for providing water of at least 105°F (40.556°C) before an average of 2 cups (473 mL) 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 Build Challenge Organizers will determine which fixture will be measured.

- a) Reduced points are earned for an average draw between 2 and 20 cups (473 mL and 4730 mL). Reduced point values are scaled linearly. If more than 20 cups (4.73 L) of water, on average, are 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.

### *Interior Light Levels Subcontest (Monitored)*

All available points are earned by maintaining a time-averaged interior illumination level between 300 lux (lx) and 1,500 lx for each measured 15-minute period over 3 days according to the Build Challenge Monitored Contest Schedule. There will be four 2-hour periods on each of the 3 days timed to evaluate illumination levels at night, dawn, midday, and dusk.

- a) Reduced points are earned if the time-averaged interior illumination level is between 100 lx and 300 lx, or between 1,500 lx and 2,000 lx. Reduced point values are scaled linearly. No points are earned for a time-averaged interior illumination level below 100 lx or above 2,000 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 a height of 3 ft (0.914 m) above the floor. 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.

### *Internally Generated Noise Subcontest (Measured)*

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 based on interior noise sources (HVAC systems, lighting, appliances, and other building services operating simultaneously) less than or equal to 40 A-weighted decibels (dBA).

- 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 interior noise generation at a previously agreed upon location in each zone. The zone interior noise generation deviating farthest from the target range is the zone of record.

**Air Tightness Subcontest (Measured by third-party)**

All available points are earned for a measured air tightness of less than or equal to 0.05 CFM50/ft<sup>2</sup>. Evaluation will be completed in advance of the competition by an independent, third-party energy rater selected and hired by the organizers, who will follow a process that is consistent for all teams.

- a) Reduced points are earned for measurements between 0.05 CFM50/ft<sup>2</sup> and 0.25 CFM50/ft<sup>2</sup>. Reduced point values are scaled linearly. No points are earned for measurements above 0.25 CFM50/ft<sup>2</sup>.
- b) To calculate CFM50, the interior volume of each house is required to be known. Each team shall provide this value to the organizers.

**Passive Performance (Monitored)**

Teams are evaluated on the home’s ability to sufficiently retain interior thermal comfort for occupants over a 48-hour period without the use of any active heating or active cooling. No electricity may be used during the Contest period except for the following life-safety loads: refrigerator, freezer, lighting, electronics, and mechanical ventilation. Mechanical ventilation is optional and can be turned on or off at any time during this Contest.

All available points are earned for maintaining the hourly average interior dry-bulb temperature within the adaptive comfort range shown below for every hour of the Contest. The comfort range extends horizontally along the x-axis in both directions beyond what is shown in the graph.

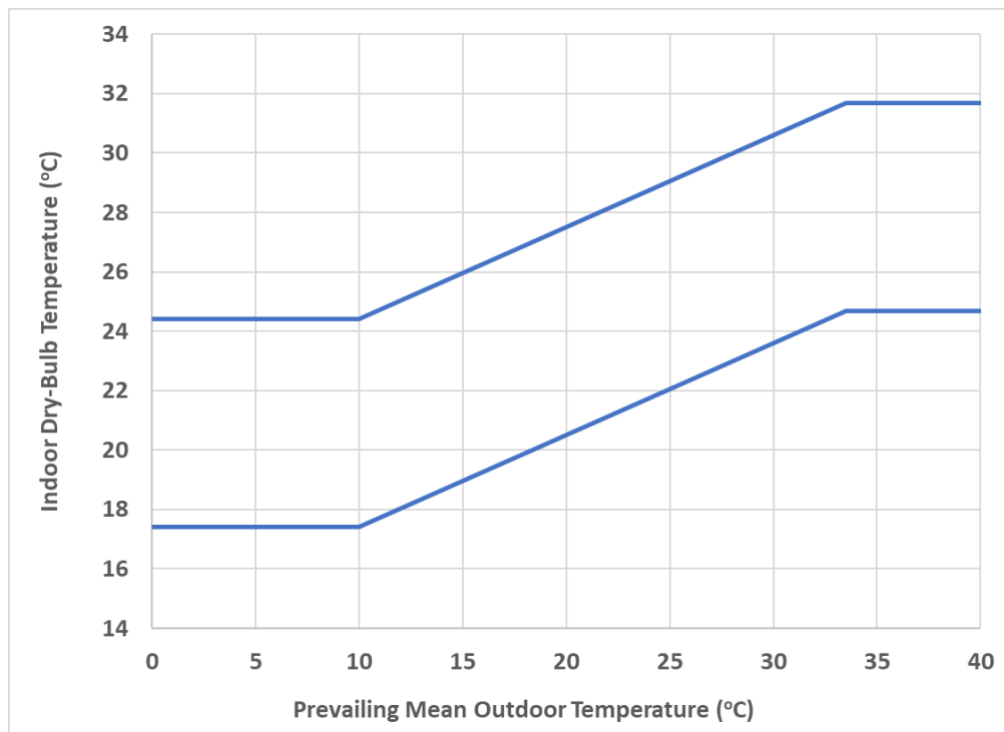


Figure 1. Adaptive Comfort Range Based on Prevailing Mean Outdoor Temperature

The equations for the sloped portion of the adaptive comfort zone between prevailing mean outdoor temperatures of 10°C (50°F) and 33.5°C (92.3°F) are given below:

- Upper 80%
  - (degC): indoor dry-bulb temperature =  $(0.31 * t_{pmo}) + 21.3$
  - (degF): indoor dry-bulb temperature =  $(0.31 * t_{pmo}) + 60.5$
- Lower 80%
  - (degC): indoor dry-bulb temperature =  $(0.31 * t_{pmo}) + 14.3$
  - (degF): indoor dry-bulb temperature =  $(0.31 * t_{pmo}) + 47.9$

where  $t_{pmo}$  is the prevailing mean outdoor temperature.

The prevailing mean outdoor temperature is the mean outdoor dry-bulb temperature at the home for the seven days prior to the beginning of the Passive Performance Contest (to be measured by organizer-provided monitoring equipment). The prevailing mean outdoor temperature determines the scoring range for the Contest.

Reduced points are earned for maintaining the hourly average interior dry-bulb temperature within the adaptive comfort range for some but not every hour of the Contest.

The organizers will identify at least three zones in each house and measure the temperature of each zone. The zone temperature deviating least from the target temperature range is the zone temperature of record. The Contest will begin at a day and time determined by each team and the competition organizers. Additional guidance on the timing of this Subcontest is provided in the Build Challenge Monitored Contest Schedule.



## 4.7 Occupant Experience (Measured)

This Contest evaluates how the building design prioritizes occupant experience, productivity, and quality of life.

### *Kitchen Appliances Subcontest (Measured and Monitored)*

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

- a) **Refrigerator (Monitored):** 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 identified in the Build Challenge Monitored Contest Schedule.
  - 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 (5.556°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 m<sup>3</sup>).
  - The refrigerator may only be used to store food and beverages.
- b) **Freezer (Monitored):** 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 identified in the Build Challenge Monitored Contest Schedule.
  - 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 (Measured):** All available points are earned for achieving an interior temperature of an oven between 400°F (204.444°C) and 450°F (232.222°C) during scored periods identified in the Build Challenge Measured Contest Schedule.
  - Reduced points are earned if the time-averaged interior oven temperature is between 250°F (121.111°C) and 400°F (204.444°C) or between 450°F (232.222°C) and 550°F (287.778°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 (Measured)**: 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 identified in the Build Challenge Measured Contest Schedule.
- 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.

### ***Clothes Washing Subcontest (Measured)***

All available points are earned for washing laundry by running an automatic clothes washer containing six organizer-supplied bath towels through one complete, uninterrupted, “normal” (or equivalent) cycle.

- 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 during a scored period identified in the Build Challenge Measured Contest Schedule. Multiple attempts per load are allowed.

### ***Clothes Drying Subcontest (Measured)***

All available points are earned for drying laundry by returning a load of laundry to a total weight less than or equal to the towels’ total weight before washing. For a particular day, both the Clothes Washing and Clothes Drying tasks must start and finish within a two-hour time period to be eligible for points.

- a) Reduced points are earned if the “dry” towel weight is between 100% and 110% of the original towel weight.
- b) Reduced point values are scaled linearly. No points are earned for a measured weight above 110% of the original towel weight.
- c) A load of laundry is eligible for clothes drying points only if the team previously achieved a complete, uninterrupted clothes washing cycle during the same time period.
- d) The drying method may include active drying (e.g., machine drying), passive drying (e.g., on a clothesline), or any combination of active and passive drying.

### ***Home Electronics Subcontest (Measured)***

All available points are earned for successfully operating smart home electronics, including a television, a computer, a smart outlet, and energy monitoring circuits. The available points are divided equally across the three following elements:

- 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. Laptops are permissible as a computer display and must be plugged in to show they are charging at the time of evaluation. 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 remotely monitor circuit-level energy use. Points are earned for demonstrating complete and successful circuit-level energy monitoring to the organizers.

### ***House Occupancy Subcontest (Measured)***

Each team shall host at least six members of its community in the house for at least 2 hours. The House Occupancy Subcontest will feature at least six guests 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 and Environmental Quality Contest. To earn full points for the House Occupancy Subcontest, teams shall:

- a) Host at least six guests.
- 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.
- 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.
  - Wash and rinse all dishes and cookware before use.
  - Store all food and beverages properly.
  - Do not use coolers to store food, beverages, or ice.

### ***Electric Vehicle Charging Subcontest (Measured)***

All available points are earned for charging an electric vehicle from a battery state below 40% to at least 75% within a 24-hour time period identified in the Build Challenge Measured Contest Schedule. Teams may choose when to begin the charging, but each task must begin and end within the agreed-upon measurement schedule; 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 to an appropriate starting level.

- a) The vehicle must be entirely electric. Hybrid vehicles and nonelectric vehicles are not permitted.
- b) The competition 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 Competition 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.

### ***Grid-Responsive Electronics Subcontest (Measured)***

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 for a duration of at least 15 minutes in response to a simulated request from the local utility. The measurement will take place at a prearranged time mutually agreed upon by the team and the Build Challenge Organizers. Additional guidance on the timing of this Subcontest is provided in the Build Challenge Measured Contest Schedule.

- 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.

## **4.8 Comfort and Environmental Quality (Measured)**

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

### ***Temperature Control Subcontest (Monitored)***

All available points are earned for maintaining a time-averaged interior dry-bulb temperature between 68°F (20°C) and 74°F (23.333°C) during the scored periods identified in the Build Challenge Monitored Contest Schedule.

- 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 three 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.
- c) To be eligible to earn points, a team must demonstrate an ability to raise or lower temperature by at least 5°F from the ambient temperature using mechanical means.

### ***Humidity Control Subcontest (Monitored)***

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 identified in the Build Challenge Monitored Contest Schedule.

- 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 three 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.
- c) To be eligible to earn points, a team must demonstrate an ability to raise or lower humidity by at least 5% from ambient or demonstrate that the climate zone of the target market does not require humidity control.<sup>1</sup>

### **Indoor Air Quality Subcontest (Monitored)**

All available points are earned at the conclusion of the 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 at least eight 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 one zone in each house and measure the CO<sub>2</sub> level throughout the scored period identified in the Build Challenge Measured Contest Schedule.
- c) Additional guidance on the timing of this Subcontest is provided in the Build Challenge Monitored Contest Schedule.

### **Comfort Gradient (Monitored)**

All available points are earned at the conclusion of the scored period for achieving a maximum delta of time-averaged interior dry-bulb temperatures of 3°F (1.66°C) across all measurement locations.

- a) Reduced points are earned if the time-averaged interior dry-bulb temperature gradient is between 3°F (1.66°C) and 10°F (5.55°C). No points are earned for a time-averaged interior dry-bulb temperature gradient greater than 10°F (5.55°C).
- b) The organizers will identify at least three zones in each house and measure the temperature of each zone.
- c) Additional guidance on the timing of this Subcontest is provided in the Build Challenge Monitored Contest Schedule.

### **Exterior Noise Infiltration Subcontest (Measured)**

The sound insulation decibel (dB) values for three of the 1/3 octave bands will be calculated between 100 hertz and 5 kilohertz—specifically 200, 1,000 and 4,000 hertz. All available points are earned for a measured sound pressure level from outside noise intrusion less than or equal to 35 dBA based on an assumed peak hour sound level equivalents (Leq) of 90 dBA.<sup>2</sup>

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<sup>1</sup> To qualify for this exception, teams must demonstrate that their house can comply with the comfort requirements of ASHRAE Standard 55.

<sup>2</sup> <http://www.usgbc.org/node/4631859?return=/credits>

- 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 previously agreed upon location in each zone. The zone exterior noise infiltration deviating farthest from the target range is the zone of record.

## **4.9 Energy Performance (Measured)**

This Contest evaluates whole-building energy consumption and how it is offset by renewable energy systems.

### ***Energy Efficiency Subcontest (Measured by third-party)***

All available points are earned for a Home Energy Rating System (HERS) score of 40 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.

Reduced points are earned for a HERS score between 40 and 60. Reduced points are scaled linearly. No points are earned for a HERS score above 60.

### ***Energy Production Subcontest (Monitored)***

All available points in this Subcontest are earned by successfully generating at least 20 kilowatt-hours (kWh) in any 24-hour period (beginning at 12 a.m. local time) during the Measured Evaluation Period. A positive energy production indicates successful solar installation and operability.

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 Energy Subcontest (Measured by third-party)***

Each team's modeled energy production and estimated energy consumption will be evaluated by the organizers for the target site, and 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.

Full points are earned for achieving a modeled annual net production of energy (i.e., annual net consumption less than 0 kWh). 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 greater than 2,000 kWh.

### ***Solar Energy Utilization Subcontest (Monitored)***

This Subcontest evaluates each team's approach to maximizing on-site solar energy use and the team's ability to control not only how much energy is used in the building, but when it is used. The Solar Utilization Index (SUI) will be measured over the course of a 3-day measurement period identified in the Build Challenge Monitored Contest Schedule. The SUI is defined as the percentage of on-site solar energy that is used at the time of generation for direct use in the building, and it is calculated as follows:

$$SUI = \frac{\sum_{i=1}^{T/\Delta t} P_{i,osr} \cdot \Delta t}{\sum_{i=1}^{T/\Delta t} L(i)}$$

where:

$L$  = the Energy Load for time step  $i$ , or  $L(i) = P_{i,import} \cdot \Delta t + P_{i,osr} \cdot \Delta t - P_{i,export} \cdot \Delta t$

$P_{i,osr}$  = the power from the on-site renewables at time step  $i$

$P_{i,import}$  = the power imported from outside the energy boundary at time step  $i$

$P_{i,export}$  = the power exported from inside the energy boundary to outside at time step  $i$

$\Delta t$  = the length of time of the time step  $i$

$T$  = the total time of the evaluation.

All available points are earned by achieving a SUI value greater than 0.70 (70%). Reduced points are earned if this average value is between 70% and 0%. Reduced points are scaled linearly.

## 4.10 Presentation

This Contest evaluates effective communication of design and construction strategies to relevant audiences and communities, including written, verbal, multimedia, and visual presentation materials.

A jury of communications professionals shall assign an overall score for each team's project after completing the procedure outlined in the Rules.

The jury shall consider the following in its evaluation:

- **Communication and Marketing Strategy**, including approach to inspire future professionals, incumbent industry and community leaders, and the public at-large to pursue energy efficiency and renewable energy opportunities through a comprehensive, consistent, and integrated communications strategy to present effective verbal and visual communications to a clearly defined audience.
- **Execution**, including presentation quality, elements, and structure that conveys the goals of the team and its design, tells a story that resonates, and engages the team's local community effectively.
- **Community Outreach Activities**, including the quantity, quality, and effectiveness of actions to educate individuals through means such as in-person tours, digital activities, and site visits.

## 5 Build Challenge Juried Contest Evaluation Process

Each Juried Contest shall be evaluated by a jury panel made up of three to five jurors who will assess the team projects. All juries will review each team. The juries will review the assigned deliverables associated with all competing teams, along with the jury presentations. The juries will then assign a percentage integer value according to this process for every team, awarding a 1st through  $n$ th place for all teams in each Juried Contest. Ties are not permitted.

### 5.1 Juror Process

Each jury shall follow the following steps:

#### ***Step 1: Deliverables Review***

Each juror will review the relevant submitted deliverables to form an initial understanding of the relevant details of each team's project.

#### ***Step 2: As-Built House Evaluation***

Each jury will complete an extensive evaluation of the house as built by the competing teams. Each house will be documented by a professional, organizer-provided 3D walk-through and real estate–style photography.

#### ***Step 3: Witness Presentation by Team to Jury***

Each jury will witness a presentation by each team to the jury. The jury presentation period will 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.

#### ***Step 4: Deliberation***

During the deliberation phase, the jury shall assign each team a percentage integer from 0% to 100% and 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 jury must submit written or recorded scoring justifications for each team to the Build Challenge manager.

### 5.2 Team Process

It is ultimately the team's responsibility to be ready for the jury presentations at the times indicated in the jury presentation schedule provided on the [Project Site](#).

- a) Up to seven decathletes may present (virtually and/or in-person) during each jury presentation. Other team members may attend but cannot participate in the presentation or Q&A period.
- b) 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.
- c) Teams will present to each jury for 15 minutes followed by 15 minutes of Q&A. These six jury presentations will be open to the public and will be scheduled throughout the 2023 Competition Event.
  - o Jury presentations should focus on the details of the project relevant to the Contest being evaluated. Summary information about the project as a whole is included in



the 3-minute audiovisual presentation required in Deliverable D8: Project Story, and jurors will review this overview presentation prior to the competition event.

- d) Juries will deliberate and assign final scores upon completion of all team presentations in their Contest category.
- e) Areas of the house or exhibit excluded from the accessible exhibit route may be considered by the juries and considered in their evaluations.
- f) 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.

## 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 4) 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 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.

Listed below are summaries of each deliverable required for the 2023 Build Challenge. Additional detail explaining formatting and content requirements for each deliverable can be found in the *Deliverable Requirements* document on the Project Site.

**Table 4. Design Deliverables**

<b>Deliverable Name</b>	<b>Required Content</b>	<b>Due Date</b>
<b>D1: Project Introduction</b>	<ul style="list-style-type: none"> <li>• Team Short Description</li> <li>• Conceptual Design</li> <li>• Initial Conceptual Design Renderings</li> </ul>	November 30, 2021
<b>D2: Project Management Plan</b>	<ul style="list-style-type: none"> <li>• Initial Project Report, including Project Management Plan</li> <li>• Schematic Design Drawings</li> <li>• Construction Partner Details</li> <li>• Construction Site Details</li> </ul>	February 15, 2022
<b>D3: Construction Documentation</b>	<ul style="list-style-type: none"> <li>• 75%+ Complete Construction Documentation</li> <li>• Public Project Renderings</li> <li>• Construction Schedule</li> </ul>	March 29, 2022
<b>D4: Design Presentation</b>	<ul style="list-style-type: none"> <li>• 20-Minute Design Presentation</li> <li>• Public Project Renderings</li> <li>• Optional Poster</li> </ul>	April 12, 2022
<b>D4.5: Updated Construction Schedule</b>	<ul style="list-style-type: none"> <li>• Updated project construction schedule, informed by vendor and contractor commitments, and signed by the Faculty Lead</li> <li>• Optional narrative to provide additional explanation of schedule</li> </ul>	August 2, 2022
<b>D5: Permit Set Documentation</b>	<ul style="list-style-type: none"> <li>• Updated Project Report, including Project Management Plan</li> <li>• Permit Set – Construction Documentation</li> <li>• Updated Public Project Renderings</li> </ul>	August 2, 2022
<b>D6: Construction Progress</b>	<ul style="list-style-type: none"> <li>• Copy of Construction Permit from AHJ</li> <li>• Construction Progress Photos</li> <li>• Updated Construction Documentation</li> </ul>	October 18, 2022
<b>D7: Construction Completion</b>	<ul style="list-style-type: none"> <li>• Organizer Approval of Measurement Equipment Installation</li> <li>• Demonstration of ADA-Compliant Accessible Tour Route</li> <li>• Updated Construction Photos</li> </ul>	March 14, 2023
<b>D8: Project Story</b>	<ul style="list-style-type: none"> <li>• Final Project Report, including Project Management Plan, Public Project Summary, Summary of Online and Public Exhibit Success, and Team Roster</li> <li>• Jury Documentation</li> <li>• As-Built Construction Documentation</li> <li>• House Photography</li> <li>• 3-Minute Audiovisual Presentation</li> </ul>	March 28, 2023
<b>D9: Final Presentation Deliverable</b>	<ul style="list-style-type: none"> <li>• Final Jury Presentation Files</li> <li>• Video of Public Tour &amp; Team Story B-Roll</li> </ul>	April 11 and 18, 2023
<b>D10: Final Report</b>	<ul style="list-style-type: none"> <li>• Post-Event Project Report</li> </ul>	May 10, 2023

## **6.1 D1: Project Introduction**

The Project Introduction deliverable is reviewed by organizers, and feedback is provided. The project introduction is not made publicly available, with the exception of the team description, goals, and renderings, which may be shared on the Solar Decathlon website. Additional details on formatting, length limitations for individual content areas, and expectations will be provided on the [Project Site](#). The Project Introduction is limited to 30 pages.

## **6.2 D2: Project Management Plan**

The Project Management Plan is reviewed by organizers, and feedback is provided. It shall clearly indicate the team's project plan, including team management structure, schematic design drawings, construction partner details, and construction site details. The Project Management Plan will not be reviewed by any Contest juries. However, it will be evaluated as part of the Approval to Proceed and Prize Award decision, and it may be made publicly available following submission.

## **6.3 D3: Construction Documentation**

The Construction Documentation Deliverable shall represent 75%+ complete construction documentation. The documentation shall clearly indicate all design details, house systems, and methodologies expected to be present in the 2023 Build Challenge project. While details may not be fully complete or finalized, the Construction Documentation deliverable shall provide sufficient information for the organizers to conduct a thorough review of compliance with the Solar Decathlon Build Challenge Rules and Building Code. 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 Construction Documentation Submission will not be reviewed by any Contest juries. However, it will be evaluated as part of the Approval to Proceed and Prize Award process, and it may be made publicly available following submission.

## **6.4 D4: Design Presentation**

Each team shall develop Design Presentation files, which are representative of the material presented at the Competition Event. The Design Presentation, together with the Design Development Documentation deliverable are used as the basis of the Approval to Proceed and prize disbursement.

## **6.5 D4.5: Updated Construction Schedule**

Each team shall submit an updated construction schedule that provides the most realistic estimate of when the team expects to obtain the necessary materials and labor support to complete each major milestone in the project. The schedule should be realistic, informed by vendor and contractor commitments, and signed by the team Faculty Lead. Project task relationships should be established, showing concurrent and dependent tasks, and should be anchored by the estimated permit approval and start date.

## **6.6 D5: Permit Set Documentation**

The final Permit Set Documentation submission shall represent 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 information. 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.

## **6.7 D6: Construction Progress**

The Construct Progress deliverable is reviewed by organizers, and feedback is provided if needed. The construction progress deliverable is not made publicly available, with the exception of the construction progress photos, which may be shared on the Solar Decathlon website. Additional details on formatting, length limitations for individual content areas, and expectations will be provided on the [Project Site](#).

## **6.8 D7: Construction Completion**

The Construction Completion deliverable is reviewed by organizers, and feedback is provided if needed. The construction completion deliverable is not made publicly available, with the exception of the construction photos, which may be shared on the Solar Decathlon website. Additional details on formatting, length limitations for individual content areas, and expectations will be provided on the [Project Site](#).

## **6.9 D8: Project Story**

The Project Story is reviewed by organizers, and feedback is provided if needed. This will eventually be made publicly available, though elements such as the Jury Documentation will be withheld until after scoring is complete. Additional details on formatting, length limitations for individual content areas, and expectations will be provided on the [Project Site](#).

## **6.10 D9: Final Jury Presentation Files**

Each team shall develop presentation files for its design, which are presented at the Competition Event. The presentations, together with the Project Story and Jury Documentation deliverable, and evaluation of the as-built house are used as the basis for evaluation by juries in accordance with these Rules. The Final Jury Presentation files will be made public following the completion of the competition.

## **6.11 D10: Post-Event Project 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.

- Summary of fundraising activities, final project budget, and lessons learned
- Results of media outreach activities, including statistics
- Results of on-site exhibition activities, including total number of visitors
- Evaluation of the team's online presence
- Team perspective on the effectiveness of the organizers' communications efforts and the fairness of the Rules

- Description of the final plans for the house
- Short description of each team member's future plans for employment, continued study, or other endeavors
- Suggested competition improvements
- Any other information that would be helpful to the organizers or future teams.