



U.S. DEPARTMENT OF ENERGY
SOLAR DECATHLON

**Competition Guide:
2022 Design Challenge
2023 Build Challenge**

March 2022

Foreword

Congratulations on your decision to participate in the U.S. Department of Energy (DOE) Solar Decathlon[®] and all the excitement that comes with the competition! The Solar Decathlon showcases the future of the built environment: high-performance buildings so energy efficient that their annual energy use can easily be offset with renewable energy. This is an opportunity to help take buildings to the next level through a variety of advancements, including:

- Reducing carbon emissions, both embodied and operational
- Making buildings more affordable for families
- Incorporating grid-interactive technologies
- Improving construction productivity
- Considering environmental justice, the fair treatment of all people with respect to environmental policy
- Providing greater comfort and healthier indoor environments
- Optimizing operational efficiency with resilient solutions that will stand the test of time.

In support of this ambitious challenge, the Solar Decathlon tasks collegiate teams with developing innovative building solutions. Participating students get hands-on experience and unique training that prepares them to enter the clean energy workforce and influence others to pursue energy efficiency and renewable energy technologies. The winners of the Solar Decathlon competition are the teams that best blend technology, market potential, and design excellence with smart energy efficiency and renewable energy production.

Structured to reward projects that innovate in whole building design, teams are expected to demonstrate how the techniques, products, and solutions integrated into their competition entries can significantly impact the buildings market. The projects are developed by multidisciplinary teams, providing the opportunity to learn not only about building science but also about financial analysis, teamwork, oral and visual presentation, and other skills key to ensuring the viability of building projects in the competition and beyond.

As we enter this Solar Decathlon, we continue to be inspired and energized by you and your ideas for the future. The outstanding quality of participating students is also noticed by the sponsors, jurors, design partners, and the buildings industry at large. With each new competition, we see significant growth and interest in how industry leaders engage students about job and professional development opportunities.

DOE is very excited to engage collegiate teams to become part of the next generation of building designers and engineering professionals. This document is designed to help ensure your success. We encourage you to read it in full and closely follow its guidance to help position your team most effectively and to enhance the value of your participation.

We look forward to seeing your work!

Table of Contents

- The Solar Decathlon 1**
- 1. Inspiring Tomorrow’s Building Industry Leaders 1**
- 2. History 1**
- 3. Building Science to Ensure High-Performance Buildings 2**
- 4. A True Decathlon: 10 Contests 2**
- 5. Design Challenge (Annual) 3**
- 6. Build Challenge (Biennial) 4**
- 7. Two Challenges 6**
 - 7.1 Procedure for Transitioning Between Challenges 6
- 8. Descriptions of the 10 Contests 8**
 - 1. Architecture 8
 - 2. Engineering 8
 - 3. Market Analysis 8
 - 4. Durability and Resilience 9
 - 5. Embodied Environmental Impact 9
 - 6. Integrated Performance 10
 - 7. Occupant Experience 10
 - 8. Comfort and Environmental Quality 10
 - 9. Energy Performance 10
 - 10. Presentation 11

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The Solar Decathlon

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.

1. Inspiring Tomorrow's Building Industry Leaders

Energy efficient. Decarbonized. Innovative. Resilient. Smart. Inclusive. Market ready. These words describe more than the ideal building. They distinguish the students who have participated in DOE's premier building competitions.

The Solar Decathlon offers a unique experience that enables collegiate teams to develop critical career skills, learn from both national experts and peers, and gain valuable insights from world-class thought leaders and mentors. Specifically, student teams are challenged to design and (if part of the Solar Decathlon Build Challenge) build highly energy-efficient buildings powered by renewable energy. Teams are evaluated on 10 Contests, and the winning teams are those that best blend the topics of architectural and engineering excellence with innovation, market potential, building efficiency, smart energy production, and environmental justice.

“Our fight against the climate crisis is a lot like a decathlon, with all kinds of individual contests we need to get through—and we can't win unless we do well in them all,” said Energy Secretary Jennifer M. Granholm at the 2021 Competition Event. Keep reading to learn more about the history and structure of the Solar Decathlon and for more specifics about each of the 10 Contests.

2. History

The award-winning [Solar Decathlon](#) began with a public event on the National Mall in Washington, D.C., in 2002. DOE has since hosted a total of 10 Solar Decathlon Build Challenge competitions in the United States, growing technology and workforce benefits with each event. The Solar Decathlon has also expanded internationally, including six international regions that have hosted their own events and have several more planned.

The Solar Decathlon Design Challenge competition began in 2014 and is held annually. The competition's impact has grown continuously, including an expansion to allow commercial buildings and more diverse residential building types, a significant increase in the number of competing teams and students, and substantial integration of the program into collegiate institution curricula across the country.

In celebration of the 20th anniversary of the Solar Decathlon in 2022, DOE will commemorate the history, accomplishments, and alumni of the competition.

3. Building Science to Ensure High-Performance Buildings

The Solar Decathlon challenges students to capitalize on the principles of fundamental building science to achieve energy efficiency and renewable energy innovation. This helps ensure designs include the foundational requirements for comfort, durability, health, resilience, and safety—all attributes of high-performance buildings.

To help meet these objectives, participating students are provided with an online, comprehensive Building Science Education series designed to enhance their academic curriculum. In addition, other topical webinars are provided to support team members’ skill development and technical progress. Through the video and webinar series, students have the opportunity to learn more about fundamental building science, design strategies for high-performance buildings, energy efficiency, and energy production than they would in the classroom alone.

4. A True Decathlon: 10 Contests

This Solar Decathlon, which spans the 2022 Design Challenge and 2023 Build Challenge, gives teams the option to participate in either Challenge. Design Challenge teams must create their design from one of six allowable building types, called “Divisions.” Build Challenge teams will build or retrofit a residential unit in their local community and compete nationally.

For each Challenge, all teams are evaluated across 10 Contests, described in more detail in Section 8 of this document. As with athletic decathlons, teams must perform well across all 10 Contests to be victorious. Figure 1 shows the competition structure and Contests.



Figure 1. Structure of the Solar Decathlon

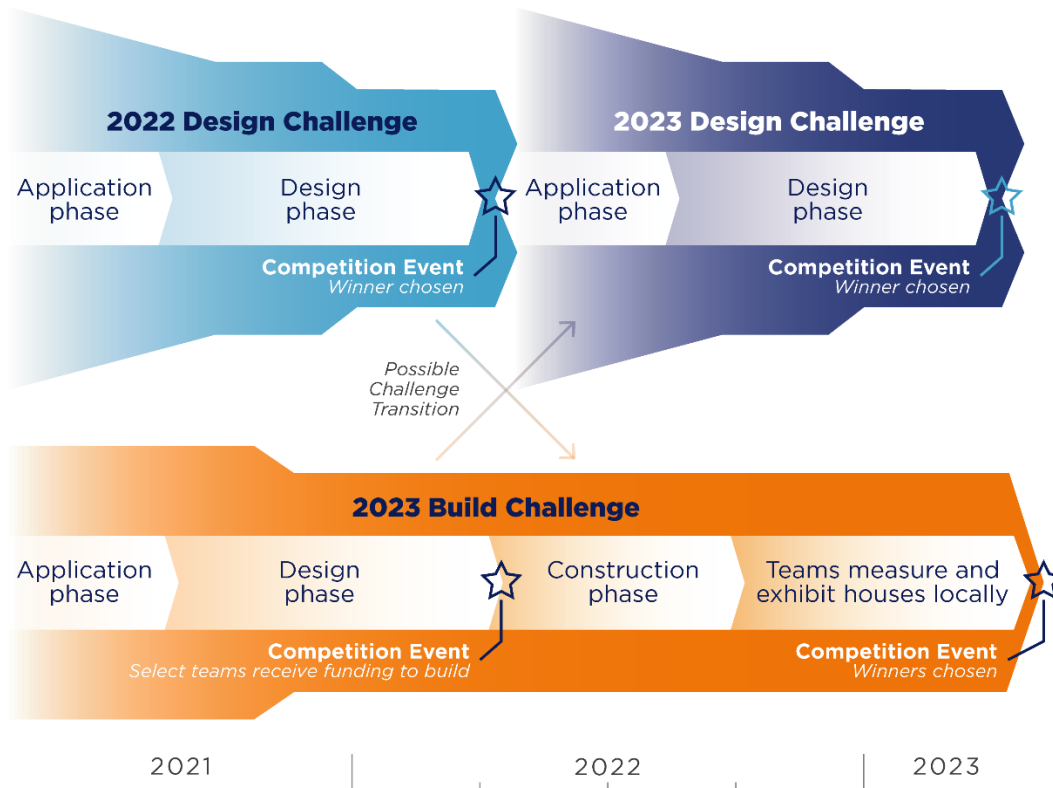


Figure 2. Timeline of the Solar Decathlon

Figure 2 depicts the annual cycle for the Design Challenge in conjunction with the two-year Build Challenge cycle, showing how the two Challenges run parallel amid individual deadlines and activities.

5. Design Challenge (Annual)

Teams that compete in the annual Solar Decathlon *Design Challenge* create residential or commercial building designs over one or two semesters. Designs are evaluated on how well they meet the nation’s rapidly evolving demand for zero energy buildings. Full details are provided in the separate [Design Challenge Rules](#) document, which should be reviewed carefully, and a few key points are noted here:

- Design Challenge teams choose to compete in one of six Divisions:
 - New Housing (NH)
 - Retrofit Housing (RH)
 - Attached Housing (AH)
 - Multifamily Building (MB)
 - Office Building (OB)
 - Education Building (EB).

- Teams apply and begin projects as early as August of the year preceding the competition (for example, beginning in August 2021 for the 2022 Design Challenge). For the Design Challenge application, each team:
 - Identifies a Faculty Lead
 - Selects the Division in which it intends to compete
 - Pays a nonrefundable \$50 application fee.
- Participant Teams are confirmed and announced by December. All teams that successfully complete their Design Challenge application are accepted.
- Each Participant Team will submit short documentation the following February for evaluation.
 - Finalist Teams are selected and invited to compete further with a final Design Portfolio of their design at the annual Competition Event, held at the National Renewable Energy Laboratory (NREL) campus in Golden, Colorado with options for remote attendance.
- Winners from each Division are determined through juried evaluation across all 10 Contests, and winners are awarded with trophies at the Competition Event. Two Design Challenge Grand Winners (one for the Residential Divisions and one for the Commercial Divisions) are also selected from the pool of winners. See the [Design Challenge Rules](#) for more information on awards.

6. Build Challenge (Biennial)

Teams that compete in the Solar Decathlon **Build Challenge** design fully functional houses compliant with Challenge guidelines and then build/remodel, exhibit, and operate houses in their own communities. Each house is extensively measured to evaluate its performance, and teams present to multiple juries in competition with all other teams. For the Build Challenge, each of the 10 Contests are scored independently, and the team with the most points at the end of the competition wins.

Full details are provided in the separate [Build Challenge Rules](#) document, which should be reviewed carefully, and a few key points are noted here:

- The application period will close in October 2021.
- Teams will design and build a house for their local communities, competing nationally against other teams.
- Interested teams may begin projects in advance but must apply by October 2021.
- For the Build Challenge application, each team:
 - Identifies a Faculty Lead or student Team Lead with a preliminary roster of student members
 - Submits a required Build Challenge Proposal including a conceptual house design, letters of team support from collegiate institution leadership and industry partners, and a project management plan.

- Pays a nonrefundable \$50 application fee.
- Participant Teams are confirmed and announced by December. All teams that successfully complete their Build Challenge application are accepted.
- Each Participant Team presents its solutions at the Competition Event, held annually in April at the National Renewable Energy Laboratory (NREL) main campus in Golden, Colorado. In 2022, Build teams will present their preliminary designs at the Competition Event, and in 2023 they will present the results of their completed buildings.
 - Up to 20 teams will be selected to receive prize funding from DOE as well as Approval to Proceed to the competition's construction phase. Additional teams may receive Approval to Proceed to the construction phase of the competition but will not receive prize funding. Teams that do not receive Approval to Proceed to the construction phase will have the option to enter the subsequent Design Challenge.
- Winners will be awarded trophies at the 2023 Competition Event.

7. Two Challenges

When considering participation in the Solar Decathlon, prospective students and teams should consider the expectations for each Challenge, summarized in Table 1.

Table 1. Expectations for Participation in Design Challenge and Build Challenge

Expectation	Design Challenge	Build Challenge
Scope of Project	Design and present	Design, build, operate, and exhibit
Team Commitment	One to two semesters	Two academic years
Building Type(s)	Residential and commercial	Residential
Industry Engagement	Design Partners and industry mentors	Hands-on support for site, construction, and oversight
Exhibit Activities	Live presentations to competitors and jurors at the Competition Event; some activities will be available virtually to the public	Local community exhibition and tours of built house, as well as presentations to competitors and jurors at the Competition Event
Financial Resources Required	\$50 Application Fee; Cost of student and faculty travel to the annual Competition Event at NREL in Golden, Colorado; Cost of time for faculty leadership	\$50 Application Fee; Cost of building house, including all materials and infrastructure (often a mix of funds from institution, alumni, industry, and sponsorship); Cost of travel for 12–20 students and faculty to multiple events (2022 Competition Event and 2023 Competition Event, both at NREL); Cost of time for faculty leadership, student stipends, and scholarships
Financial Resources Provided by Competition Organization	None	\$50,000 for up to 20 teams, distributed as Prize Funding

All competition options are designed to integrate into a variety of collegiate curricula and provide positive, life-changing experiences for students. They are also invaluable for helping faculty prepare students to meet future opportunities. Most importantly, the Challenges are designed to help students launch their careers and have a substantial impact on the energy future of the United States and the world.

7.1 Procedure for Transitioning Between Challenges

2023 Build Challenge to 2022 Design Challenge Transition

Teams participating in the 2023 Build Challenge may transition to the 2022 Design Challenge with approval from the Solar Decathlon organizers.

To successfully complete this transition and maintain eligibility for the competition, teams must do the following before February 22, 2022:

- Notify the organizers via email of intent to transition, copying the team lead and faculty advisor.
- Submit the Semifinal Submission deliverable for the 2022 Design Challenge (due on February 22, 2022).

This will allow transitioning teams to participate in the Solar Decathlon Semifinals, February 25–26, 2022, to be evaluated for selection as a Finalist Team in the 2022 Design Challenge. After February 22, 2022, Build Challenge teams wishing to transition should sign up for the 2023 Design Challenge and participate according to the Rules.

2022 Design Challenge to 2023 Build Challenge Transition

Teams participating in the 2022 Design Challenge have two options to transition to the 2023 Build Challenge. Both require approval from the Solar Decathlon organizers.

Option One

To maintain eligibility to compete for Approval to Proceed and Build Challenge prize funding in April 2022, teams must do the following before March 29, 2022:

- Notify the organizers via email of intent to transition, copying the team lead and faculty advisor.
- Provide all Build Challenge deliverables to date by April 12, 2022.

Option Two

To transition after the 2022 Solar Decathlon Competition Event, and therefore relinquish eligibility to compete for Build Challenge prize funding, 2022 Design Challenge Finalist Teams must do the following between April 24, 2022, and June 1, 2022:

- Notify the organizers via email of intent to transition, copying the team lead and faculty advisor.
- Provide all Build Challenge deliverables to date within two (2) months of starting Build Challenge for review by organizers.
- Acknowledge the forfeiture of eligibility for prize funding awarded to 2023 Build Challenge teams in April 2022 upon the receipt of Approval to Proceed.
- Acknowledge that the transition to the 2023 Build Challenge is subject to receipt of Approval to Proceed from the Build Challenge jury and competition manager.
- Use the 2022 Design Challenge submission as the basis of Build Challenge design development.

After June 1, 2022, Design Challenge teams wishing to transition will need to complete a team application for the 2025 Build Challenge, beginning in July 2023, and participate according to the Rules.

8. Descriptions of the 10 Contests

Teams in both Challenges are evaluated to determine how effectively they integrate energy efficiency into well-designed, high-performance buildings that “push the envelope” for consumers and industry. More specifically, all Participant Teams compete in the following 10 Contests. See the [Design Challenge Rules](#) and [Build Challenge Rules](#) for specific evaluation criteria.

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.

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

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.

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

3. Market Analysis

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

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

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

4. Durability and Resilience

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

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

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.

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

6. Integrated Performance

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.

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

7. Occupant Experience

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

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

8. Comfort and Environmental Quality

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

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

9. Energy Performance

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

Effective whole-building energy analysis and decision-making is the foundation for energy performance. Energy performance incorporates energy consumption, clean energy generation, and the capability of the building to provide grid services.

10. Presentation

This Contest evaluates effective communication of design strategies to relevant audiences, including written, verbal, multi-media, and visual presentation materials.

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

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



2 Challenges | 10 Contests | 1 Decathlon



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U.S. DEPARTMENT OF ENERGY
SOLAR DECATHLON

2022 Design Challenge Rules

March 2022

List of Acronyms

AH	Attached Housing
ANSI	American National Standards Institute
Btu	British thermal unit
DOE	U.S. Department of Energy
EB	Education Building
EDT	Eastern Daylight Time
EST	Eastern Standard Time
EUI	energy use intensity
HERS	Home Energy Rating System
HPwES	Home Performance with ENERGY STAR®
HVAC	heating, ventilating, and air conditioning
kBtu	kilo-British thermal unit
MB	Multifamily Building
NH	New Housing
NREL	National Renewable Energy Laboratory
OB	Office Building
pv	photovoltaic
RESNET	Residential Energy Services Network
RH	Retrofit Housing
USCS	United States Customary System

Foreword—Why Solar Decathlon Design Challenge?

Buildings account for 40% percent of total energy consumption in the United States, and 20% of global energy consumption.¹ Through direct use of fossil fuels and fossil-fuel-produced electricity, buildings have a substantial impact on the environment and long-term resource availability. Beyond environmental impact, buildings are a focal point for emerging crises related to environmental justice, affordability, health, disaster risks, and water shortages.

Shifting the building paradigm from resource-intensive to regenerative requires a skilled workforce of design professionals with multidisciplinary skills in high-performance building strategies. This demands whole building design that addresses comprehensive building science, energy efficiency, indoor air quality, occupant experience, human health, optimized mechanical systems, embodied environmental impact, affordability, resilience, and resource conservation. However, professional curricula and degree programs across the United States and around the world are inconsistent, with many lacking the resources needed to adequately address these complex issues.

To help address this gap, the U.S. Department of Energy (DOE) Solar Decathlon® Design Challenge focuses on two critical goals: to incorporate high-performance building design strategies into curriculum, and to inspire students to pursue sustainable building careers. Designed to support educational programs in training the next generation of designers, the Solar Decathlon's 10 Contests aim to transform the building industry by challenging student teams to think beyond a zero energy ready building and address complex real-world issues—energy insecurity, food systems, waste streams, climate change, carbon emissions, inequity, and social inequality through building design.

Design Challenge outcomes demonstrate substantial success toward these goals, including:

- Participation by more than 5,000 students from 197 collegiate institutions across 23 countries and 46 U.S. states
- A network of more than 1,000 industry partners
- A 300% increase in the number of Participant Teams since program inception
- 92% of Design Challenge students surveyed recommend participation to their peers.

A movement has started. The Solar Decathlon Design Challenge is equipping the next-generation building workforce with the skills and passion to create future-ready buildings.

¹ U.S. Energy Information Administration. April 2021. "Monthly Energy Review," Table 2.1. <https://www.eia.gov/totalenergy/data/monthly/>.

Table of Contents

Foreword—Why Solar Decathlon Design Challenge?	ii
1 Challenge Overview	1
1.1 Summary of Important Dates	2
2 Building a Team	1
2.1 Team Requirements.....	1
2.2 Student Qualifications	1
2.3 Faculty Lead Role	1
2.4 Design Partners	2
2.5 Industry Engagement.....	2
2.6 Mentor Program	2
3 Project Requirements	3
3.1 Zero Energy Building Requirements.....	3
3.2 Divisions.....	6
4 Contests	8
4.1 Architecture.....	9
4.2 Engineering	9
4.3 Market Analysis	9
4.4 Durability and Resilience	10
4.5 Embodied Environmental Impact.....	10
4.6 Integrated Performance	11
4.7 Occupant Experience.....	11
4.8 Comfort and Environmental Quality.....	11
4.9 Energy Performance.....	12
4.10 Presentation	12
5 Evaluation Process	13
5.1 Evaluation Rating Scale	13
5.2 Project Summary	14
5.3 Solar Decathlon Semifinal Competition to Select Finalists	14
5.4 Final Submission to Select Winners.....	15
5.5 Competition Event.....	15
5.6 Grand Jury Award	16
5.7 Bonus Certificates for Creativity.....	17
6 Deliverables	18
6.1 Project Summary Submission Instructions.....	19
6.2 Semifinal Submission Instructions.....	20
6.3 Final Submission Instructions	22
6.4 Faculty Report Submission Instructions.....	27
Glossary	29
Appendix A: Resources	33

Solar Decathlon Design Challenge Competition Rules Authors: NREL’s Rachel Romero, Amanda Kirkeby, Jes Stershic, and Paul Torcellini.

1 Challenge Overview

This document outlines the Rules and evaluation criteria for teams competing in the Solar Decathlon Design Challenge, a collegiate competition with 10 Contests that challenge student teams to design innovative high-performance, low-carbon buildings powered by renewable energy. For additional information, refer to the [Solar Decathlon Competition Guide](#).

Over one to two semesters, Design Challenge participants prepare creative solutions that address real-world issues in the building industry. The experience offers students a unique opportunity to:

- Engage with real-world Design Partners,
- Collaborate with industry experts,
- Exchange design strategies with other teams around the world,
- Learn from national thought leaders and collegiate peers,
- Experience zero energy building design firsthand, and
- Engage with organizations about careers related to improving the built environment.

Finalist Teams invited to attend the Competition Event, and project materials from winning teams are published on the [Solar Decathlon website](#). The competition and winners are promoted through a variety of outreach efforts, which provide participants and their collegiate institutions with an opportunity to promote their work. Select winners may receive further invitations to present at industry conferences following the Solar Decathlon Competition Event. Collegiate institutions that participate in the Design Challenge are recognized as leaders who are preparing career-ready professionals with cutting-edge skills. Industry partners who collaborate with teams gain national and local recognition and have the opportunity to interact with promising future design and construction professionals.

1.1 Summary of Important Dates

The following are key milestones for the 2022 Design Challenge:

- **July 2021:** 2022 Design Challenge Rules are released.
 - Team Application opens on the [Solar Decathlon website](#). To complete the application, teams use the [Project Site](#), which is an online platform used to communicate timely information from organizers and submit deliverables.
 - Once a team completes the application, they are a “Participant Team” and can begin work on their design.
 - Resources are provided on the [Project Site](#), including an on-demand Building Science Education course, topical webinars, and energy modeling software.
- **September 16, 2021:** Ready, Set, Solar Decathlon Event
 - A virtual event covering competition expectations, deliverables, timeline, and resources available to Participant Teams.
 - All students and faculty, new and returning, interested in participating are highly encouraged to attend.
- **October 26, 2021, 5 p.m. EDT:** [Team Application](#) is due on the [Project Site](#).
 - The Team Application must indicate which Division the team intends to enter.
 - Each team must pay a nonrefundable \$50 fee.
 - Teams are required to identify a Faculty Lead and a Student Team Lead.
- **November 30, 2021, 5 p.m. EST:** Teams submit a Project Summary via the [Project Site](#).
 - This submission is optional; however, teams will receive feedback on project compliance based on this submission.
- **January 2022:** An updated version of the Solar Decathlon 2022 Design Challenge Rules is released with clarifications and any needed corrections.
- **February 22, 2022, 5 p.m. EST:** Semifinal Submission deliverables are due on the [Project Site](#). These include:
 - Updated Project Summary
 - 8-minute Presentation Slides
 - Final Division selection
 - Building Science Education completion, or equivalency waiver from faculty.
- **February 25–26, 2022:** Solar Decathlon Semifinal Competition
 - Participant Teams present to industry leaders at the Solar Decathlon Semifinal competition.
 - Presentations are evaluated against criteria indicated in this Rules document.

- Up to 10 Finalist Teams per Division will be selected to compete in the Competition Event.
- All Participant Teams are encouraged to complete their designs and the associated submissions regardless of finalist status. Teams that complete the final submission deliverables will be invited to participate in the Competition Event.
- **April 5, 2022, 5 p.m. EDT:** Final deliverables are submitted via the [Project Site](#). These include:
 - Updated Project Summary
 - Design Narrative
 - Multimedia Project Pitch
 - Team Photos
 - Supplemental Documentation (optional).
- **April 19, 2022, 5 p.m. EDT:** Teams must submit their Presentation Slides for the Competition Event.
 - Presentations are not accepted after this date.
- **April 22–24, 2022: Solar Decathlon Competition Event**
 - Finalist Teams present to industry leaders for Division Winner selection on the NREL Main Campus in Golden, Colorado, USA.
 - All Participant Teams take part in related competition events.
 - Design Challenge winners are announced.
- **May 24, 2022:** The Faculty Report is due to the organizers at SDdesign@nrel.gov.

2 Building a Team

2.1 Team Requirements

The competition is open to all collegiate and degree-issuing institutions, including community and technical colleges. International institutions are welcome to participate. Teams should abide by the following criteria:

- Each team must be associated with a collegiate institution and include a Faculty Lead. Multiple collegiate institutions may combine to form a team. One Faculty Lead may counsel multiple teams.
- Each team must have at least three students, with one student designated as the Student Team Lead. There is no maximum number of student team members.
- The strongest teams are multidisciplinary, composed of students from a variety of degree programs. See Section 2.2 for more detail.
- A collegiate institution may only submit one Team Application per Division (see Section 0). A team may choose to have several internal groups of students complete designs and then submit only one project design at the submission deadline.
- The Team Application costs \$50 per team in each Division and is nonrefundable.
- At least one student and one Faculty Advisor from each Finalist Team are required to participate in the Competition Event.

2.2 Student Qualifications

Great teams are cross-functional. Student team members can be from any discipline and any level of collegiate schooling. Teams may also include students from more than one collegiate institution. Past teams have included students who majored in fields such as architecture, engineering, building science, physics, construction management, environmental studies, policy, interior design, marketing, business, economics, communications, and landscape architecture.

In addition, students must meet the following:

- Students are limited to one team for the competition year of the Design Challenge, although collegiate institutions may have more than one team.
- Each student must be pursuing a degree and enrolled in at least one class between the Team Application deadline and the Competition Event.

2.3 Faculty Lead Role

The Faculty Lead, with assistance from the Student Team Lead, is responsible for communicating competition details from the organizers to the team members. A team may have more than one Faculty Advisor; a Faculty Advisor may counsel multiple teams. One Faculty Lead must be designated to serve as a primary contact, oversee and closely engage with the team, and provide support in the following areas:

- Ensuring familiarity with the Design Challenge Rules and guidance.
- Ensuring all student team members complete the Building Science Education course, or indicating that comparable building science training is part of the core curriculum by

providing an equivalency waiver. The Faculty Lead can also encourage the students to view additional webinars and access training materials that are most relevant to the team.

- Ensuring that the necessary information is provided to team members participating in the Competition Event.

2.4 Design Partners

Teams are strongly encouraged to engage a Design Partner in their project. Design Partners are organizations that have a planned new construction or major retrofit project in their building portfolio and would like to work with a team to develop a zero energy design option for the project. For example, a school district that is planning a major retrofit to an existing school could be a Design Partner and work with a team to receive a zero energy design and cost analysis for the retrofit.

Teams should secure their own Design Partner; a limited number of Design Partner opportunities will be posted on the [Solar Decathlon website](#). The Design Partner should:

- Provide teams with basic project information and requirements.
- Provide up to 30 hours of engagement with the team over the course of the competition for design programming, iterative schematics, and feedback.

A representative from each Design Partner organization may participate in the Competition Event.

2.5 Industry Engagement

Engagement with industry professionals can provide real-world perspective on proposed solutions and provide guidance for selecting and integrating building systems into the design. Successful teams often engage with several industry professionals who have a wide range of expertise, such as builders, architects, city officials, contractors, developers, energy auditors, engineers, manufacturers, and tradespeople in areas such as site development, codes, construction, building materials, mechanical systems, lighting systems, financing, and sales. This engagement can help inform teams' decision-making processes and aid in the review of the project. Industry may provide support, donations, and guidance to students while the students remain responsible for design, detailing, documentation, construction, operation, and competition activities.

2.6 Mentor Program

The Mentor Program pairs Solar Decathlon alumni from any competition year with participating Design Challenge teams to share best practices learned through their experiences. All teams may request a mentor in the Team Application and will be paired with mentors based on availability; teams are not guaranteed a mentor. Mentors provide up to 15 hours of support to student teams during the competition period, which may include nontechnical review and feedback on project management, direction, deliverables, and presentation. Mentors are not permitted to complete any project work on the team's behalf. Student teams are responsible for leading the relationship with their mentor and are expected to keep mentors updated on project progress and outcomes.

3 Project Requirements

Design submissions are required to meet the following specifications:

- The team must select a specific location, building lot or site, and local characteristics as context for the building design and its relationship to surrounding structures and the community.
- Projects must be substantially different from any submitted to DOE competitions in the past. If a school has multiple teams competing in the Solar Decathlon across the Design and Build Challenges, each team must have distinct designs.
- The building design must comply with zero energy building requirements, outlined in Section 3.1.
- The building design must comply with Division requirements outlined in Section 0.
- The team must address criteria for all 10 Solar Decathlon Contests, outlined in Section 4.
- Teams should follow applicable codes for the building's expected jurisdiction. These include local, state, and national codes and standards governing topics such as minimum bedroom size, fire protection requirements, classroom size, and restroom locations and quantities, along with other specific requirements. If there are conflicts between the Design Challenge conditions and local regulations, the local regulations supersede, and teams should clearly document these local requirements in their project submissions.
- United States Customary System (USCS) units of measurement are required; a submission with both metric units and USCS units is acceptable. If metric units are used, state USCS units first, followed by metric equivalents in parentheses—example: 125 feet (ft) (38.1 meters [m]).

3.1 Zero Energy Building Requirements

Zero site energy is integral in reducing the impacts of carbon. As a central project requirement, a design project submission must be a zero energy building—a high-performance building with a renewable energy system that offsets all of the building's annual energy consumption.

The pathway to a zero energy building begins with reducing the energy needs of buildings such that renewable energy can meet the remaining load. Renewable energy must be integrated into the project. After maximizing on-site generation, other options, such as participating in a community-scale renewable energy project or specifying utility-provided renewable power, can be used.

Evaluating Building Energy Performance

Energy analysis is invaluable for predicting energy performance and evaluating trade-offs to achieve energy goals. Energy analysis can be conducted using a variety of software programs. Free tools and resources for these calculations are on the [Project Site](#).

Home Energy Rating System Index

The residential building industry commonly uses the Home Energy Rating System (HERS) Index to indicate energy efficiency. A lower score signifies a more energy-efficient home. To determine the score, homes are compared to a benchmark based on the [2006 International](#)

[Energy Conservation Code](#). The HERS score can be calculated by using any Residential Energy Services Network (RESNET)-accredited HERS software.

HERS rating software calculates heating, cooling, hot water, lighting, and appliance energy loads, consumption, and costs for new and existing single-family and multifamily homes. Software licenses for RESNET-accredited programs, REM/Rate and Ekotrope, are provided to teams; however, using them is not required.

Energy Use Intensity

Building energy consumption is often evaluated based on the energy use intensity (EUI), which is measured as the total energy consumed annually divided by the gross floor area (kilo-British thermal unit [kBtu]/ft² or kilowatt-hours/m²). Alternative metrics for comparison are also useful, such as energy divided by total students (kBtu/student) for the Education Building Division.

EUI can be calculated with respect to source energy as well as site energy. Site energy is measured at the boundary of the site, often by electric or natural gas meters. Source energy accounts for all the upstream losses associated with converting and transporting energy to the building site. In the case of electricity, it is based on a fuel mix and the mining/extraction of those resources, the power plant losses, and the losses with transmission and distribution of electricity. Source energy is calculated by taking the site energy and applying a site-to-source multiplier for each energy source²:

$$Energy_{source} = Energy_{site} * Conversion\ factor_{site\ to\ source}$$

Target EUIs based on source energy for Education Buildings, Multifamily Buildings, and Office Buildings are shown in Table 1. These EUI values include all building loads, including plug loads; heating, ventilating, and air conditioning (HVAC); and lighting. Plug loads include vertical transportation and any other load in the building. The targets do not include exterior lighting loads, which are covered in Table 2.

² See “[A Common Definition for Zero Energy Buildings](#)” for methodology in calculating EUI and source energy from site energy.

Table 1. Source Energy³ Use Intensity Targets for Education,⁴ Multifamily,⁵ and Office Buildings⁶

Climate Zone	Education Building Source EUI (kBtu/ft ² -yr)	Multifamily Building ⁷ Source EUI (kBtu/ft ² -yr)	Office Building Source EUI (kBtu/ft ² -yr)
0A	69	80	80
0B	71	96	96
1A	66	81	81
1B	67	89	89
2A	64	77	77
2B	60	79	79
3A	57	74	74
3B	58	73	73
3C	53	55	55
4A	56	75	75
4B	55	71	71
4C	52	60	60
5A	57	80	80
5B	56	79	79
5C	50	61	61
6A	63	96	96
6B	58	86	86
7	66	88	88
8	71	100	100

Table 2. Exterior Lighting Allowances for Education, Multifamily, and Office Buildings

Exterior Location	Lighting Power Allowance	Controls
Entry doors	13 watts/linear foot of doorway	Dusk to dawn, reduction of 75% when no motion detected
Exterior stairs	0.70 watt/ft ²	Dusk to dawn, reduction optional depending on local codes
Walkways	0.10 watt/ft ²	Dusk to dawn, reduction of 75% when no motion detected
Driveways and parking lots	0.04 watt/ft ²	Dusk to dawn, reduction of 75% when no motion detected

³ For the methodology for calculating source energy, see “[A Common Definition for Zero Energy Buildings.](#)”

⁴ This is adapted from the “Advanced Energy Design Guide for K–12 School Buildings: Achieving Zero Energy”; see <https://www.ashrae.org/technical-resources/aedgs/zero-energy-aedg-free-download>.

⁵ This is based on a simulation result for office and light retail. Documentation is not available at this time.

⁶ This is based on preliminary simulations from “Advanced Energy Design Guide for Small to Medium Office Buildings: Achieving Zero Energy”; see <https://www.ashrae.org/technical-resources/aedgs/zero-energy-aedg-free-download>.

⁷ EUI values for Multifamily Building can be applied to either the commercial portion of the space or the entire building, including vertical transportation, common areas, plug loads, HVAC, and lighting.

3.2 Divisions

Design Challenge Divisions represent different residential and commercial building types. Design Challenge teams must specify a single Division in which they will participate.

Each collegiate institution may submit up to six applications but may *not* have more than one team in any Division.

Residential Divisions:

New Housing (NH)

New Housing is defined as a residential new construction for one to two dwelling units.

1. New build for one to two dwelling units.
2. Independent, detached structure.
3. Building size: 300–4,500 ft² (28–418 m²) per dwelling unit.
4. HERS Score before renewable energy generation: 45 or less.
5. Meets [DOE Zero Energy Ready Home National Program Requirements \(Rev. 07\)](#).

Retrofit Housing (RH)

Retrofit Housing is defined as renovating an existing building for one to two dwelling units to zero energy construction through upgrades to systems, such as plumbing, electrical, mechanical, and envelope. This includes adaptive reuse.

1. Modifies an existing building for one to two dwelling units.
2. Independent, detached structure.
3. Building size: 300–4,500 ft² (28–418 m²) per dwelling unit.
4. HERS Score before renewable energy generation: 50 or less.

Attached Housing (AH)

Attached Housing is defined as multiple dwelling units within a single building.

1. Row homes or flats, 3–12 dwelling units; building is up to 3 stories above grade.
2. New construction or retrofit allowed.
3. Building size: 500–2,500 ft² (46–232 m²) per dwelling unit.
4. HERS Score before renewable energy generation: 50 or less.
5. For new construction, must meet [DOE Zero Energy Ready Home National Program Requirements \(Rev. 07\)](#).

Commercial Divisions:

Multifamily Building (MB)

A Multifamily Building is defined as a structure that contains multiple dwelling units.

1. Minimum of 8 dwelling units; building is up to 10 stories above grade.
2. New construction or retrofit allowed.
3. Building size: 350–2,000 ft² (33–186 m²) per dwelling unit.
4. Up to 50% of total area may be devoted to commercial use, such as retail, office, and industrial; remaining area is dedicated to residential use.
5. For new construction, dwelling units must meet [DOE Zero Energy Ready Home National Program Requirements \(Rev. 07\)](#). For the commercial portion of building, the source EUI must be less than the source EUI target shown in Table 1 in Section 3.1.

As an alternative, the entire building can comply with the source EUI target as shown in Table 1 in Section 3.1.

Office Building (OB)

An Office Building is defined as a commercial office building with full fit and finish including support functions, such as mechanical and electrical spaces, circulation, vertical transportation, and restrooms.

1. Building size: 10,000–250,000 ft² (929–23,226 m²) with 1–15 stories.
2. New construction or retrofit allowed.
3. Up to 50% of total area may be devoted to other commercial use, such as retail, laboratory, and industrial; remaining area is dedicated to office space.
4. To meet the zero energy building requirements, the source EUI target before renewables must be less than that shown in Table 1 in Section 3.1.

Education Building (EB)

An Education Building is defined as an educational facility for students and includes permanent provisions for food service, recreation, offices, classrooms, and other support functions, such as mechanical spaces, circulation, and restrooms.

1. New construction or retrofit allowed.
2. Any combination of grade levels in the range from pre-kindergarten to 12th grade.
3. The source EUI target before renewables must be less than that shown in Table 1 in Section 3.1.

4 Contests

Project submissions are evaluated across the 10 Contests outlined in Table 3. Jurors evaluate how well teams meet or exceed criteria for each Contest through design and technical documentation, project plans, reports for required analyses, and the quality and content of their presentations. Detailed evaluation criteria for each Contest are provided in the following sections (Sections 4.1–4.10).

Across all Contests, the Solar Decathlon values innovation and creative approaches informed by a strong understanding of fundamental building science. Teams are encouraged to incorporate solutions that use new technologies or creative strategies that leverage existing technologies for improving building performance and feasibility.

All Contests are equally weighted and should be addressed in a seamless, integrated design to demonstrate competency in applying building science and whole building design strategies.

Table 3. Contests

Contests	
	1. Architecture
	2. Engineering
	3. Market Analysis
	4. Durability and Resilience
	5. Embodied Environmental Impact
	6. Integrated Performance
	7. Occupant Experience
	8. Comfort and Environmental Quality
	9. Energy Performance
	10. Presentation

4.1 Architecture



Contest Intent

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

Design Challenge Criteria

The jury evaluates teams on each of the following:

- Integration of building form and function, including exterior and interior architecture with respect to the target market, climate, and zero energy building goals
- Quality of the design and appearance, including floor plan and interior details for flow, furnishings, storage, linkages to outdoors, and efficient use of space
- Consideration of specified site, including views, drainage, regionally appropriate materials, and community connection.

4.2 Engineering



Contest Intent

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

Design Challenge Criteria

The jury evaluates teams on each of the following:

- Effective building envelope design and material selection
- Comprehensive structural system considerations, including foundation
- Mechanical system selection and design, including HVAC systems
- Optimized lighting and electrical system design
- Plumbing system design for efficient water management.

4.3 Market Analysis



Contest Intent

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

Design Challenge Criteria

The jury evaluates teams on each of the following:

- Execution of market analysis, including affordability and financial feasibility, to meet current market expectations for owner experience
- Application of market-ready construction materials and their cost-effectiveness in the design
- Life cycle cost comparison between a minimally code-compliant building and the proposed design
- Operational and maintenance cost estimate.

4.4 Durability and Resilience



Contest Intent

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

Design Challenge Criteria

The jury evaluates teams on each of the following:

- Building enclosure integration of all four building science control layers (e.g., thermal, air, bulk moisture, and moisture vapor), including foundation, walls, roof, and openings
- Analysis of the prevailing resilience risks associated with weather, natural or human-caused events, and grid disruptions
- Integration of building design and construction strategies to withstand and recover from identified resilience risks.

4.5 Embodied Environmental Impact



Contest Intent

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.

Design Challenge Criteria

The jury evaluates teams on each of the following:

- Life cycle assessment of the building's embodied environmental impacts, showing assumptions (e.g., intended service life, functional requirements) for the assessment of each life cycle stage
- Design decisions and material selections with regard to carbon reduction, circularity, and embodied environmental impacts
- Discussion of trade-offs between up-front, operational, and end-of-life environmental impacts (e.g., energy, greenhouse gas emissions).

4.6 Integrated Performance

Contest Intent

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.

Design Challenge Criteria

The jury evaluates teams on each of the following:

- Integrated, interdisciplinary solutions that enhance synergies among building sub-systems
- Systems approach to integrating architecture and engineering relative to climate considerations
- Effective use of passive design strategies to meet heating, cooling, ventilation, and lighting needs
- Space-conditioning system integration within the building's structural system
- Optimized installation of renewable energy systems to ensure technical feasibility of the application
- Discussion of lighting system effectiveness, including daylighting and electric lighting to provide ambient, task, and mood lighting.

4.7 Occupant Experience

Contest Intent

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

Design Challenge Criteria

The jury evaluates teams on each of the following:

- Design's functionality, attractiveness, and enhancement of the occupants' quality of life, health, and well-being
- Advanced building control technologies for appliances, equipment, security, and lighting systems that provide comfort, convenience, and safety
- Appliance selection (e.g., kitchen, hot water, laundry, lighting) and design integration for optimum efficiency and convenience
- Strategies for minimizing occupant maintenance.

4.8 Comfort and Environmental Quality

Contest Intent

This Contest evaluates the building's capability to deliver healthy, comfortable environmental quality.

Design Challenge Criteria

The jury evaluates teams on each of the following:

- Complete indoor environmental quality strategy, including HVAC system design, load calculations, equipment sizing, and duct sizing
- Comprehensive source control (e.g., chemicals, dust, pollen, biologicals, radon, and moisture) through material selection, details, and construction practices
- Whole building ventilation and strategies for spot ventilation (e.g., controlling moisture in bathrooms as well as moisture and particles from cooking in kitchens) and filtration
- Acoustical design strategies for controlling unwanted interior and exterior noise.

4.9 Energy Performance

Contest Intent

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

Design Challenge Criteria

The jury evaluates teams on each of the following:

- Comprehensive energy analysis showing how energy performance targets will be achieved (i.e., HERS and/or EUI), including calculations with and without renewable energy
- Strategy for reducing plug and appliance loads
- Strategies for effectively integrating sufficient renewable energy generation (on-site or off-site) to achieve zero annual energy use and offset nonrenewable energy sources.
- Grid-interaction capabilities to include responsiveness of building systems to electric grid conditions to avert system stress and enhance grid reliability.

4.10 Presentation

Contest Intent

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

Design Challenge Criteria

The jury evaluates teams on each of the following:

- Completion, quality, and timeliness of submissions
- Professionalism of presentation package, spoken remarks, and any visual aids (if applicable)
- Ability to prioritize and convey key points about designing a zero energy ready building with enough detail that the project will achieve its goals
- Command of the design solution through effective response to juror questions.

5 Evaluation Process

The evaluation process of the competition is a multistage process:

- Teams submit an initial Project Summary to gain preliminary feedback on compliance with the Rules, Division definitions, and submission formatting (optional, but highly recommended).
- Solar Decathlon Semifinal Competition
 - Teams complete the Semifinal Submission deliverables and present to industry experts at the virtual Solar Decathlon Semifinal event.
 - Finalist Teams are selected to advance to the final stage of Competition.
- All teams regardless of Finalist status submit a final design, and associated deliverables submissions are evaluated by Division Jurors.
- Solar Decathlon Competition Event
 - Teams present to jury panels of industry experts within their Division.
 - Jurors select Division Winners from competing Finalist Teams.
 - Division Winners present to the Grand Jury to select Residential and Commercial Grand Winners.

Detailed descriptions of each stage of competition are outlined below.

5.1 Evaluation Rating Scale

The following scale is used to evaluate the submissions:

Table 4. Evaluation Scale

Design Challenge Scale for Evaluation	
1	MISSES EXPECTATIONS: Missing all items; no explanation of how the design addresses the criteria
2	APPROACHES EXPECTATIONS: Missing some items; minimal explanation of how the design addresses the criteria
3	MEETS EXPECTATIONS: All minimum requirements met; basic explanation of how the design addresses the criteria
4	EXCEEDS EXPECTATIONS: All minimum requirements met; detailed demonstration of applying the design solution to address the criteria
5	ECLIPSES EXPECTATIONS: All minimum requirements met; distinguished excellence in the explanations describing how the design exceeds the criteria

5.2 Project Summary

The first deliverable is an initial Project Summary, which provides an opportunity to submit preliminary information about each project. Though optional, it is highly recommended that teams submit the Project Summary to gain preliminary, qualitative feedback to improve and iterate upon their design. It also familiarizes teams with the submission process and how to comply with Rules requirements.

It is understood that the first submission of the Project Summary might be based on considerations and aspirations, or be otherwise tentative and subject to change in future submissions. The organizers will provide feedback on the following:

- Compliance with Division definition
- Submission formatting compliance.

Deliverables

See Section 6.1 for a full description of deliverable submission requirements.

- Project Summary submitted via the [Project Site](#).

5.3 Solar Decathlon Semifinal Competition to Select Finalists

The Solar Decathlon Semifinal Competition is a virtual event at which all Participant Teams present to panels of industry experts. At this stage, Finalist Teams are selected to advance to the final stage of competition.

Finalist Teams are selected based on the following:

- Teams submit the Semifinal Submission deliverables via the [Project Site](#).
- Each participating team will present a virtual 8-minute presentation to a panel of Division jurors, each with 1–3 industry experts.
- Jurors individually evaluate each team submission within their Division according to the following criteria:
 - Effectiveness of Project Summary in conveying the salient points of the project
 - Discussion of design goals
 - Discussion of target market, building occupant characteristics, and resulting impacts on the design constraints
 - Discussion of local climate and the impact of related building science considerations on design strategies
 - Discussion of building code constraints or standards and their impact on design strategies
 - Quality of team's plan for submitting the final design submission deliverables
 - Compliance with the Rules, including Division definitions and submission formatting

- Other factors, such as geographic locations and technology choices, that help optimize competition diversity and fairness.
- Up to 10 Finalist Teams per Division are selected to compete in the Competition Event based on evaluation of the presentation.
 - Regardless of finalist selection, all Participant Teams submit final design deliverables
 - Exhibition Teams – Teams that are not selected as Finalist Teams who submit a final design submission are invited to participate virtually in the final Competition Event in April 2022 as Exhibition Teams. Exhibition Teams cannot be selected as winners, but will present, gain feedback on their project, and participate in other events at the final Competition Event.
- Teams receive written feedback from Division Jurors via the [Project Site](#) within two weeks of the Semifinal event.

Deliverables

See Section 6.2 for a full description of deliverable submission requirements.

- Project Summary
- 8-minute Presentation Slides

5.4 Final Submission to Select Winners

The Final Submission deliverables fully document the final design. A panel of jurors for each Division evaluates and scores each team submission to select Division Winners.

The evaluation process is as follows:

- 3–4 industry experts are assigned to each Division Jury.
- Jurors individually review all Final Submission deliverables within their assigned Division and determine preliminary scores for each team.
- Preliminary team evaluation results are modified by the jurors based on the live Division Presentations and associated Q&A period during the Competition Event.

Deliverables

See Section 6.3 for a full description of deliverable submission requirements.

- Project Summary (updated)
- Design Narrative
- 3 Project Images
- Multimedia Project Pitch.

5.5 Competition Event

The Competition Event is the culmination of the competition. Finalist Teams compete for Division and Grand Winner Awards, and all teams who submit the Final Submission deliverables have the opportunity to present to industry experts. The Competition Event provides a rich

experience for participants to engage in networking opportunities and attend other team and professional presentations.

Based on performance in the Solar Decathlon Semifinal, up to 10 Design Challenge Finalist Teams in each Division will be invited to compete at the Competition Event, April 22–24, 2022.

- Finalist Teams will deliver an 8-minute Project Presentation live to the Division Jurors, with an additional 15 minutes for questions.
 - Faculty Advisors may not participate in the team’s presentation or Q&A.
- Division Juror panels select first-place, second-place, and third-place award winners in each Division based on the extent to which the design demonstrates the following attributes:
 - Understanding and application of building science
 - Excellence in aligning project design with competition intent
 - Excellence in the Contest criteria subject areas.
- The first-place team for each Division delivers a live presentation at the Awards Ceremony for evaluation by the Grand Jury, which chooses a Commercial Grand Winner and Residential Grand Winner according to the process described in Section 5.6.
 - The Grand Juror Presentation will be 8 minutes in length.
 - No time is reserved for questions during the Awards Ceremony.
- Division Jurors develop written feedback for the teams that is shared via the [Project Site](#) within 2 weeks of the Competition Event’s conclusion.

For the Competition Event:

- At least one student and one Faculty Advisor from each Finalist Team are required to participate in the Competition Event.
- Each team may have a maximum of 5 student team members present to juries. Additional team members may participate virtually in the Division Presentation Q&A.
- All team members may attend the Competition Event virtually.

Deliverables

See Section 6.3 for a full description of deliverable submission requirements.

- 8-minute Presentation Slides.

5.6 Grand Jury Award

The Grand Jury selects two Grand Winners from among the first-place teams based on the presentations given at the Awards Ceremony. One Grand Winner is selected from the residential Divisions, including NH, RH, and AH; the other is selected from the commercial Divisions, including MB, OB, and EB.

The Grand Jury enters the review process with the understanding that all the first-place winners have demonstrated a design that represents the quality expected for zero energy buildings.

The Grand Jury is tasked with evaluating which projects are most inspiring. The 8-minute summary presentations of the design are evaluated against the following:

- Appeal to the target market, community, and occupants
- Architectural design aesthetics and functionality
- Responsiveness of design to building science factors
- Financial feasibility
- Constructability
- Innovation
- Presentation quality within specified time limit.

The Grand Jury evaluates each of these criteria on the scale shown in Table 4 to facilitate its selection of the Grand Winners.

5.7 Bonus Certificates for Creativity

Bonus certificates are given to teams in addition to the Grand Winner awards and the Division awards. These are intended to recognize the excellence, professionalism, hard work, and enthusiasm that teams demonstrate beyond the required deliverables, and are selected by the organizers during the Competition Event. These may recognize excellence in:

- Team Spirit
- Team Virtual Background
- Team Name
- Team Photo
- Social Media Engagement
- First-Time Team
- Team Showcase Award
- Industry Engagement
- Addressing Environmental Justice
- Engagement at Competition Event
- First Complete Design Narrative Submitted
- Director's Award.

6 Deliverables

Throughout the Design Challenge, each team must submit scheduled deliverables for evaluation of its progress and design. The deliverables, file naming conventions, and due dates are below.

Table 5. Summary of Deliverables, File Naming Conventions, and Due Dates

Deliverable	Required Content	File Name	Submit To
<u>November 30, 2021</u>			
Project Summary (2 pages)	Single, bookmarked PDF	22DC_[DIVISION]_[SHORT COLLEGIATE INSTITUTION NAME]_SUMMARY_2021-11-30.pdf	Project Site
<u>February 22, 2022</u>			
Updated Project Summary (2 pages)	Single, bookmarked PDF	22DC_[DIVISION]_[SHORT COLLEGIATE INSTITUTION NAME]_SUMMARY_2022-02-22.pdf	Project Site
8-minute Presentation Slides	Single, bookmarked PDF	22DC_[DIVISION]_[SHORT COLLEGIATE INSTITUTION NAME]_SEMIPRES_2022-02-22.pdf	Project Site
<u>April 5, 2022</u>			
Updated Project Summary (2 pages)	Single, bookmarked PDF	22DC_[DIVISION]_[SHORT COLLEGIATE INSTITUTION NAME]_SUMMARY_2022-04-05.pdf	Project Site
Design Narrative (Up to 60 pages)	Single, bookmarked PDF	22DC_[DIVISION]_[SHORT COLLEGIATE INSTITUTION NAME]_NARRATIVE_2022-04-05.pdf	Project Site
Project Images	.jpg, .tiff, or .png	PHOTO1, PHOTO2, TEAMPHOTO e.g.: 22DC_[DIVISION]_[SHORT COLLEGIATE INSTITUTION NAME]_PHOTO1_2022-04-05.pdf	Project Site
Multimedia Project Pitch	.mov or .mp4	22DC_[DIVISION]_[SHORT COLLEGIATE INSTITUTION NAME]_PITCH_2022-04-05.[EXTENSION]	Project Site
Supplemental Documentation (optional)	Single, bookmarked PDF	22DC_[DIVISION]_[SHORT COLLEGIATE INSTITUTION NAME]_SUP_2022-04-05.pdf	Project Site
<u>April 19, 2022</u>			
Final Presentation Slides	PDF and/or PPTX	22DC_[DIVISION]_[SHORT COLLEGIATE INSTITUTION NAME]_FINALPRES_2022-04-05.[EXTENSION]	Box
<u>May 24, 2022</u>			
Faculty Report	Single, bookmarked PDF	22DC_[DIVISION]_[SHORT COLLEGIATE INSTITUTION NAME]_FACULTY_2022-05-24.pdf	SDdesign@nrel.gov

Note that a “bookmarked” PDF means the file has each major header bookmarked for easy viewing. This makes it easier for the jurors and reviewers to move around within lengthy and technical deliverables. For an example, note the bookmarks for this Rules document PDF. Guidance for creating a bookmarked PDF is provided on the [Project Site](#).

See Sections 6.1 through 6.4 for the requirements for each Design Challenge deliverable, as well as submission instructions.

Naming Files for Submissions

Please use the approved file naming convention below for all submissions; to use the example below, remove the brackets, [], with descriptive language and insert the appropriate abbreviation for your team. For example, the Project Summary naming convention is:

22DC_[DIVISION]_[SHORT COLLEGIATE INSTITUTION NAME]_SUMMARY_2021-11-30.pdf

For the National Renewable Energy Laboratory (NREL) team competing in the Retrofit Housing Division, the file name should be:

22DC_RH_NREL_SUMMARY_2021-11-30.pdf.

6.1 Project Summary Submission Instructions

The Project Summary communicates key aspects of the design project through a high-level description of the project and its highlights. Teams submit the Project Summary as a stand-alone document, developed via the Project Summary template found on the [Project Site](#). Past Project Summaries can be viewed on [past Design Challenges webpages](#), and an example is provided on the [Project Site](#).

For each deliverable submission phase, the Project Summary should follow the formatting outlined below. It is understood that for the first submission of the Project Summary, the details might be based on considerations and aspirations, or be otherwise tentative and subject to change in future submissions. The initial Project Summary will be revised for subsequent submissions.

Project Summary Format Requirements

<input type="checkbox"/> Paper size: Standard 8.5 inches (in.) × 11 in. (216 millimeters [mm] × 279 mm), ANSI A
<input type="checkbox"/> Formatting: Single-spaced, 11-point font for body text (diagrams may have smaller fonts)
<input type="checkbox"/> Borders: 0.5-in. (12.7-mm) minimum, except for tables, figures, and images
<input type="checkbox"/> Maximum length: 2 pages
<input type="checkbox"/> File type: Single, bookmarked PDF
<input type="checkbox"/> File size: Less than 10 MB
<input type="checkbox"/> File name: 22DC_[DIVISION]_[SHORT COLLEGIATE INSTITUTION NAME]_SUMMARY_[SUBMISSION DATE in format of YYYY-MM-DD].pdf

Project Summary Content Requirements

Project Summary
<input type="checkbox"/> List the project name, team name, Division, and collegiate institution(s) in the header.
<input type="checkbox"/> Replace the logo in the upper right with the team or collegiate institution's logo.
<input type="checkbox"/> Replace the building image with one or two graphics that best represent the project.
<input type="checkbox"/> Provide a concise description of the project, including a brief identification of the target market.
<input type="checkbox"/> Describe the relevance of the project to the goals of the competition.
<input type="checkbox"/> Summarize the design strategy and relevant key points.
<input type="checkbox"/> List the relevant project data, including cost estimates.
<input type="checkbox"/> Provide technical specifications for the project.
<input type="checkbox"/> Provide project highlights. Briefly explain how the design meets or exceeds the criteria in each Contest: <ol style="list-style-type: none">1. Architecture2. Engineering3. Market Analysis4. Durability and Resilience5. Embodied Environmental Impact6. Integrated Performance7. Occupant Experience8. Comfort and Environmental Quality9. Energy Performance.

6.2 Semifinal Submission Instructions

Teams submit the Semifinal Submission deliverables via the [Project Site](#). These deliverables provide an interim submission to demonstrate each team's progress and likelihood of completing the final design submission. If a team conducts an internal competition and creates multiple projects, only one Semifinal Submission per team can be submitted and reviewed for acceptance as a Finalist Team.

Semifinal Submission deliverables include:

- Updated Project Summary
- 8-minute Semifinal Presentation Slides.

Project Summary Format Requirements

<input type="checkbox"/> Paper size: Standard 8.5 in. × 11 in. (216 mm × 279 mm), ANSI A
<input type="checkbox"/> Formatting: Single-spaced, 11-point font for body text (diagrams may have smaller fonts); add page numbers for reviewer convenience
<input type="checkbox"/> Borders: 0.5-in. (12.7-mm) minimum, except for tables, figures, and images
<input type="checkbox"/> Maximum length: <ul style="list-style-type: none">○ Project Summary: 2 pages, including tables and figures
<input type="checkbox"/> File type: Single, bookmarked PDF
<input type="checkbox"/> File name: <ul style="list-style-type: none">○ Project Summary: 22DC_[DIVISION]_[SHORT COLLEGIATE INSTITUTION NAME]_SUMMARY_[SUBMISSION DATE in format of YYYY-MM-DD].pdf

Project Summary Content Requirements

Project Summary
<input type="checkbox"/> List the project name, team name, Division, and collegiate institution(s) in the header.
<input type="checkbox"/> Replace the logo in the upper right with the team or collegiate institution's logo.
<input type="checkbox"/> Replace the building image with one or two graphics that best represent the project.
<input type="checkbox"/> Provide a concise description of the project, including a brief identification of the target market.
<input type="checkbox"/> Describe the relevance of the project to the goals of the competition.
<input type="checkbox"/> Summarize the design strategy and relevant key points.
<input type="checkbox"/> List the relevant project data, including cost estimates.
<input type="checkbox"/> Provide technical specifications for the project.
<input type="checkbox"/> Provide project highlights. Briefly explain how the design meets or exceeds the criteria in each of the following Contests: <ol style="list-style-type: none">1. Architecture2. Engineering3. Market Analysis4. Durability and Resilience5. Embodied Environmental Impact6. Integrated Performance7. Occupant Experience8. Comfort and Environmental Quality9. Energy Performance.

Semifinal Presentation Slides Format Requirements

<input type="checkbox"/> File type: PDF and/or PPTX (Presentation Slides must have an aspect ratio of 16:9.)
<input type="checkbox"/> To ensure that all electronically submitted materials work with the organizers' presentation computers, teams should embed all videos in the team submission.
<input type="checkbox"/> File name: <ul style="list-style-type: none">○ 22DC_[DIVISION]_[SHORT COLLEGIATE INSTITUTION NAME]_SEMIPRES_2022-02-22.pdf

6.3 Final Submission Instructions

The Final Submission demonstrates the culmination of each team's design work and provides the final materials needed to evaluate the project.

Final Submission deliverables include:

1. Project Summary (updated)
2. Design Narrative
3. 3 Project Images
4. Multimedia Project Pitch
5. 8-minute Presentation Slides.

Teams also have the option to submit Supplemental Documentation, further detailed in Section 6.3.3. The Project Summary, Design Narrative, and Multimedia Project Pitch will be reviewed by jurors and used to determine preliminary scores prior to the Competition Event.

The submission instructions for the Final Submission deliverables are detailed below.

6.3.1 Project Summary

Teams must submit the Project Summary via the [Project Site](#). The Project Summary should be updated as needed to reflect the final parameters of the design. It must follow the requirements below:

Project Summary Format Requirements

<input type="checkbox"/> Paper size: Standard 8.5 inches (in.) × 11 in. (216 millimeters [mm] × 279 mm), ANSI A
<input type="checkbox"/> Formatting: Single-spaced, 11-point font for body text (diagrams may have smaller fonts)
<input type="checkbox"/> Borders: 0.5-in. (12.7-mm) minimum, except for tables, figures, and images
<input type="checkbox"/> Maximum length: 2 pages
<input type="checkbox"/> File type: Single, bookmarked PDF
<input type="checkbox"/> File size: Less than 10 MB
<input type="checkbox"/> File name: 22DC_[DIVISION]_[SHORT COLLEGIATE INSTITUTION NAME]_SUMMARY_2022-04-05.pdf

Project Summary Content Requirements

Project Summary
<input type="checkbox"/> List the project name, team name, Division, and collegiate institution(s) in the header.
<input type="checkbox"/> Replace the logo in the upper right with the team or collegiate institution's logo.
<input type="checkbox"/> Replace the building image with one or two graphics that best represent the project.
<input type="checkbox"/> Provide a concise description of the project, including a brief identification of the target market.
<input type="checkbox"/> Describe the relevance of the project to the goals of the competition.
<input type="checkbox"/> Summarize the design strategy and relevant key points.
<input type="checkbox"/> List the relevant project data, including cost estimates.
<input type="checkbox"/> Provide technical specifications for the project.
<input type="checkbox"/> Provide project highlights. Briefly explain how the design meets or exceeds the criteria in each of the following Contests: <ol style="list-style-type: none">1. Architecture2. Engineering3. Market Analysis4. Durability and Resilience5. Embodied Environmental Impact6. Integrated Performance7. Occupant Experience8. Comfort and Environmental Quality9. Energy Performance.

6.3.2 Design Narrative

Teams must submit the Design Narrative via the [Project Site](#). This deliverable includes an updated Design Concept as well as construction details and Contest narratives. The Design Narrative is limited to 60 pages, including appendices, and must contain all the information the team deems essential to effectively communicate its competition solution to the Jury. A summary and discussion of analytical results should be provided in the Design Narrative. Supporting information—such as detailed calculations or equipment data sheets—should be relegated to Supplemental Documentation. Citations may be in the team's chosen format, but they should be consistent throughout the submission.

Design Narrative Format Requirements

<input type="checkbox"/> Paper size: Standard 8.5 in. × 11 in. (216 mm × 279 mm), ANSI A
<input type="checkbox"/> Formatting: Single-spaced, 11-point font for body text (diagrams may have smaller fonts)
<input type="checkbox"/> Borders: 0.5-in. (12.7-mm) minimum, except for tables, figures, and images
<input type="checkbox"/> File type: Single, bookmarked PDF
<input type="checkbox"/> Limit content to no more than 60 pages; the cover, back page, and table of contents are not included in this count
<input type="checkbox"/> Number pages; front-matter page numbers can use Roman numerals (e.g., i, ii, iii, etc.)
<input type="checkbox"/> Construction drawings: 11 in. x 17 in. (279 mm x 432 mm), ANSI B
<input type="checkbox"/> File Name: 22DC_[DIVISION]_[SHORT COLLEGIATE INSTITUTION NAME]_NARRATIVE_2022-04-05.pdf

Design Narrative Content Requirements

Front Matter
<input type="checkbox"/> Cover (list collegiate institution, team name, and Division name)
<input type="checkbox"/> Table of Contents
<input type="checkbox"/> List of Tables and/or List of Figures (as applicable)
Section 1: Design Constraints and Goals (up to 4 pages)
<input type="checkbox"/> Design Constraints Description, including timeline, budget, community setting, climate, building science considerations, codes, occupant characteristics, etc. (1–3 pages)
<input type="checkbox"/> Design Goals, including rating systems, energy targets, occupant experience, operational cost, etc. (1 page)
Section 2: Contest narratives, including relevant images and figures (up to 27 pages)
<input type="checkbox"/> 1. Architecture
<input type="checkbox"/> 2. Engineering
<input type="checkbox"/> 3. Market Analysis
<input type="checkbox"/> 4. Durability and Resilience
<input type="checkbox"/> 5. Embodied Environmental Impact
<input type="checkbox"/> 6. Integrated Performance
<input type="checkbox"/> 7. Occupant Experience
<input type="checkbox"/> 8. Comfort and Environmental Quality
<input type="checkbox"/> 9. Energy Performance.

Appendices	
<input type="checkbox"/>	A. Design renderings (up to 5 pages)
<input type="checkbox"/>	B. Construction documentation highlights (up to 20 pages)
<input type="checkbox"/>	a. Site plan
<input type="checkbox"/>	b. Representative floor plan(s) with dimensions
<input type="checkbox"/>	c. Building elevations
<input type="checkbox"/>	d. Building sections, including building science control layers
<input type="checkbox"/>	e. Interior details, including a rendered floor plan showing typical furniture layout and option details on finishes, cabinetry, and other fixtures
<input type="checkbox"/>	f. Wall, window, door, floor, and roof details, including building science control layers, schedule, and specifications
<input type="checkbox"/>	g. Mechanical plans and schedules, ⁸ indicating equipment locations and specifications as well as heating and cooling system capacity diagrams (Btu/hr·ft ² , tons/ft ² , or kilowatt/m ²)
<input type="checkbox"/>	h. Plumbing plans and schedules, ⁸ including fixture locations, piping system layout and design, and equipment location and specifications
<input type="checkbox"/>	i. Electrical and lighting plans and schedules, ⁹ including installed lighting (watt/ft ² or watt/m ²) levels, control systems, and renewable systems
<input type="checkbox"/>	C. Energy performance (HERS Index rating and/or EUI target) (up to 4 pages)
<input type="checkbox"/>	HERS Index Rating Documentation Summary
<input type="checkbox"/>	1. Include the house size adjustment factor calculations as required for homes exceeding the area specified in the size adjustment factor table.
<input type="checkbox"/>	2. Perform a HERS Index analysis to include the home with and without the renewable energy system.
<input type="checkbox"/>	EUI Target Documentation Summary
<input type="checkbox"/>	1. Summarize major inputs for the energy model, including envelope characteristics, lighting power densities, plug load densities, HVAC sizing capacities, HVAC system efficiencies, and overview equipment schedules.
<input type="checkbox"/>	2. Demonstrate compliance with the Division definition. EUI should be provided in both site and source metrics. Show summary calculations of the potential for on-site or off-site renewable energy to offset the annual energy consumption of the building on a source basis.

⁸ Teams should indicate system type, size, and quantity; however, full system layout and specifications are not required.

⁹ Teams should indicate system type, size, and quantity; however, full system layout and specifications are not required.

6.3.3 Supplemental Documentation

Teams submit Supplemental Documentation via the [Project Site](#). Supplemental Documentation is optional and may not be more than 100 pages. This document includes additional documentation to support the team’s design goals and submission, such as energy analysis reports, financial analysis details, equipment specifications, quantity takeoffs, supplemental construction details, or supporting design calculations. Jurors have a limited amount of time to review the entire submission. They might not read the Supplemental Documentation in detail or at all, and they are not expected to open any hyperlinks in this material.

Supplemental Documentation Format Requirements

<input type="checkbox"/> Paper size: Standard 8.5 in. × 11 in. (216 mm × 279 mm), ANSI A
<input type="checkbox"/> Formatting: Single-spaced, 11-point font for body text (diagrams may have smaller fonts)
<input type="checkbox"/> Borders: 0.5-in. (12.7-mm) minimum, except for tables, figures, and images
<input type="checkbox"/> File type: Single, bookmarked PDF
<input type="checkbox"/> Limit content to no more than 100 pages
<input type="checkbox"/> Number pages
<input type="checkbox"/> File name: 22DC_[DIVISION]_[SHORT COLLEGIATE INSTITUTION NAME] SUP 2022-04-05.pdf

6.3.4 Multimedia Project Pitch

Each team must submit a 90 second Multimedia Project Pitch via the [Project Site](#). This deliverable provides the opportunity to highlight key design aspects in a short amount of time. Teams may be creative in how they chose to develop their Multimedia Project Pitch.

Each team’s Multimedia Project Pitch will be reviewed by jurors prior to the Competition Event as part of the Final Submission. Content from the winning teams will be shared via Solar Decathlon social media following the Competition Event. Unlike the live 8-minute presentation to Juries, there is no limit on the maximum number of team members who can participate in the Multimedia Project Pitch.

Multimedia Project Pitch Format Requirements

<input type="checkbox"/> Length: 90 seconds or less
<input type="checkbox"/> File type: .mov or .mp4
<input type="checkbox"/> File name: 22DC_[DIVISION]_[SHORT COLLEGIATE INSTITUTION NAME] PITCH 2022-04-05.pdf

6.3.5 Project Images

Each team must submit 3 project images: 2 images that best represent the project, such as renderings, drawings, photographs of scale models, or other team-generated content, and at least one image of your team. These images must be submitted via the [Project Site](#). Organizers use images to recognize individual team performance, to integrate into event materials, or for outreach, as appropriate.

Project Images Format Requirements

<input type="checkbox"/> Ensure all images have a minimum resolution of 1920 x 1080 pixels.
<input type="checkbox"/> Ensure the images have an aspect ratio of 16:9.
<input type="checkbox"/> Submit the images as files such as .jpg, .tiff, or .png.
<input type="checkbox"/> File names:
<input type="checkbox"/> 22DC_[DIVISION]_[SHORT COLLEGIATE INSTITUTION NAME]_TEAMPHOTO_2022-04-05.EXTENSION]
<input type="checkbox"/> 22DC_[DIVISION]_[SHORT COLLEGIATE INSTITUTION NAME]_PHOTO1_2022-04-05.EXTENSION]
<input type="checkbox"/> 22DC_[DIVISION]_[SHORT COLLEGIATE INSTITUTION NAME]_PHOTO2_2022-04-05.EXTENSION]

6.3.6 Presentation Slides

Teams develop one set of slides for the Competition Event, to be used for Division presentations, and Grand Jury presentations if the team is selected as a first-place Division winner. The Presentation Slides are submitted via a Box link provided on the [Project Site](#).

Presentation Slides Format Requirements

<input type="checkbox"/> File type: PDF and/or PPTX (Presentation Slides must have an aspect ratio of 16:9.)
<input type="checkbox"/> To ensure that all electronically submitted materials work with the organizers' presentation computers, teams should embed all videos in the team submission.
<input type="checkbox"/> Maximum file size: <ul style="list-style-type: none"><input type="checkbox"/> 100 MB
<input type="checkbox"/> File name: <ul style="list-style-type: none"><input type="checkbox"/> 22DC_[DIVISION]_[SHORT COLLEGIATE INSTITUTION NAME]_PRESDIV_2022-04-05.EXTENSION]

6.4 Faculty Report Submission Instructions

The Faculty Report should reflect the results of the team's Design Challenge project. It will be used by the organizers to improve future events and identify lessons learned. Faculty may submit one report per collegiate institution. Faculty Reports should be submitted via email to SDdesign@nrel.gov.

Faculty Report Format Requirements

<input type="checkbox"/> File type: Single PDF
<input type="checkbox"/> Length: Up to 20 pages
<input type="checkbox"/> File name: 22DC_[DIVISION]_[SHORT COLLEGIATE INSTITUTION NAME]_FACULTY_2022-05-24.PDF

Faculty Report Content Requirements

<input type="checkbox"/> Summarize how the Design Challenge was integrated into coursework.
<input type="checkbox"/> Summarize the team perspective on the effectiveness of the organizers' communications efforts with both the teams and the public.
<input type="checkbox"/> Describe next steps for the team project, if applicable.
<input type="checkbox"/> Provide a short description of team members' future plans for employment, continued study, or other endeavors.
<input type="checkbox"/> Include suggested competition improvements.
<input type="checkbox"/> Include any other information that would be helpful to the organizers or future teams.
<input type="checkbox"/> Include a contact list of all team members who worked on the project, including permanent (noncollegiate institution) email addresses.

Glossary

Attached Housing

Multiple dwelling units within a single building

Challenge

Either of two avenues for team participation in the Solar Decathlon competition: the Design Challenge and/or the Build Challenge

Competition

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

Competition Event

The period when Finalist Teams are presenting to juries and related activities

Contest

Like the Olympic decathlon, the Contests evaluate the building for creativity, overall integration of systems, and ability to deliver outstanding aesthetics, efficiency, and functionality

Design Challenge

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

Design Challenge Manager

The head Rules Official responsible for writing and enforcing the Rules and conducting the Design Challenge

Design Narrative

A 60-page maximum Design Challenge deliverable that is part of the final deliverable submission; the Design Narrative provides a complete submission to be reviewed by jurors in advance of the competition

Design Partner

An organization or client that has a planned construction, major retrofit project, or new construction project in their building portfolio and works with a collegiate team to develop a zero energy design option for the project

Director

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

Division

A category based on building type in which a team competes

Division Jury

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

Dwelling unit

A dwelling unit 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. See the [2018 International Energy Conservation Code](#) for more information.

Education Building

An educational facility for students that includes permanent provisions for food service, recreation, offices, classrooms, and other support functions, such as mechanical spaces, circulation, and restrooms

Exhibition Team

Participant Teams that are not selected as Finalists but submit a final design submission and are invited to participate virtually in the final Competition Event; Exhibition Teams cannot be selected as winners but will gain feedback and participate in competition activities

Faculty Advisor

A faculty member who advises the team and represents a competing collegiate institution

Faculty Lead

A Faculty Advisor who serves as a primary contact for a team; responsible for communicating competition details from organizers to team members, as well as overseeing and closely engaging with the team

Faculty Report

A 20-page maximum Design Challenge deliverable that summarizes the results of a team's Design Challenge project

Finalist Teams

Participant Teams that are selected to present their final design to Division Jurors at the Competition Event

Floor Area

The sum of the floor areas of the spaces within the building, including basements¹⁰; the floor area is measured from the exterior faces of the exterior walls or from the centerline of walls separating buildings. For more information, see [ANSI Z765-2003](#) and [ASHRAE 90.1-2019](#).

Finished Area

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

¹⁰ Floor area is sometimes referred to as the finished floor area or gross floor area.

Grand Jury

A group of Jurors evaluating the first-place Division Winners of the Design Challenge

Industry Partner

Industry professionals who offer expertise and experience to the project

Juror

An organizer selected by the appropriate Challenge Manager to participate as a member of a specific Division Jury

Multifamily Building

A blend of residential and commercial building area

Multidisciplinary Team

An educationally diverse team that includes students from more than one field of study, including but not limited to engineering, architecture, graphic design, construction, and interior design

New Housing

A residential new construction for one to two dwelling units

Office Building

A complete commercial facility with full fit and finish for a defined client(s), including support functions such as mechanical and electrical spaces, circulation, vertical transportation, and restrooms

Organizer

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

Participant Team

A team participating in the Solar Decathlon Design Challenge

Project Site

An online site that includes official competition communications and guidelines; accessible by all teams and organizers

Project Summary

A two-page, high-level description of the project with key takeaways and introductions of the team and collegiate institution; a preliminary Project Summary is submitted early in the competition and is updated in later deliverables.

Resilience

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

Retrofit Housing

Renovation of an existing building for one to two dwelling units to zero energy construction through upgrades to systems, such as plumbing, electrical, mechanical, and envelope. This includes adaptive reuse

Rules

All principles or regulations governing conduct, action, procedure, arrangement, etc., for the duration of the project; this document is the “Rules document.”

Rules Official

An organizer authorized to interpret the Rules and officiate one or more of the Contests

Sponsor

A business or organization that provides funds for the competition

Staff

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

Team

The combination of team members representing a single entry to a Solar Decathlon Challenge

Team member

An enrolled student, faculty member, or other person who is affiliated with one of the participating collegiate institutions and is integrally involved with a team’s project activities

U.S. Department of Energy Solar Decathlon®

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

Appendix A: Resources

This appendix lists key resources. Additional resources and software are available on the [Project Site](#).

[U.S. Department of Energy](#)

The mission of DOE is to ensure America's security and prosperity by addressing its energy, environmental, and nuclear challenges through transformative science and technology solutions. Energy Department resources include:

- [Building America Solution Center](#)
The Building America Solution Center provides access to expert information on hundreds of high-performance construction topics, including air sealing and insulation, HVAC components, windows, indoor air quality, and more.
- [Home Performance with Energy Star](#)
The Home Performance with ENERGY STAR (HPwES) program connects homeowners with experienced and trusted contractors who can help them understand their home's energy use and identify home improvements that increase energy performance, improve comfort and health, and lower utility bills.
- [Zero Energy Ready Home Program Guidelines](#)
DOE Zero Energy Ready Homes are verified by a qualified third-party and are at least 40%–50% more energy efficient than a typical new home. This generally corresponds to a Home Energy Rating System (HERS) Index Score in the low- to mid-50s, depending on the size of the home and region in which it is built.
- [DOE Zero Energy Ready Home](#)
This website provides a virtual tour of Zero Energy Ready Homes and a map of builders.
- [Zero Energy Ready Home Recommended Quality Management Provisions](#)
This website provides a quality management checklist.
- [Environmental Justice](#)
This website details DOE's commitment to environmental justice and related activities and resources.

[National Renewable Energy Laboratory](#)

NREL specializes in the research and development of renewable energy, energy efficiency, energy systems integration, and sustainable transportation. NREL resources include:

- [PVWatts](#)
This tool estimates the energy production and cost of energy of grid-connected photovoltaic (PV) energy systems throughout the world. It allows homeowners, small building owners, installers, and manufacturers to easily develop estimates of the performance of potential PV installations.

[ASHRAE](#)

ASHRAE is dedicated to advancing the arts and sciences of HVAC and refrigeration to serve humanity and promote a sustainable world. ASHRAE resources include:

- [ASHRAE Advanced and Zero Energy Design Guides](#)
The Design Guides offer designers and contractors the tools needed to achieve significant energy savings compared to buildings that meet the minimum requirements of Standard 90.1-2004.

[National Institute of Building Sciences](#)

The National Institute of Building Sciences created the Whole Building Design Guide to share information across industry, academic, and federal partners to advance high-performing facilities. National Institute of Building Sciences resources include:

- [Whole Building Design Guide](#)
The Guide presents the philosophy of the integrated design approach and design objectives for whole building design, and includes guides for building envelope design.

[PHIUS+](#)

PHIUS is a non-profit organization dedicated to making high-performance passive buildings the mainstream standard. PHIUS provides training and certification programs for building professionals, conducts high-performance building research, and certifies passive buildings. PHIUS offers [software and resources](#), including the [WUFI® Passive](#) energy modeling software available for download at no charge.

[Smart Home America](#)

Smart Home America provides information on how to build stronger, sustainable, and more resilient communities. Smart Home America resources include:

- [FORTIFIED](#)
FORTIFIED provides standards for coastal and inland construction. FORTIFIED Home helps strengthen new and existing homes through system-specific building upgrades to minimum building code requirements that can reduce damage from specific natural hazards. FORTIFIED Commercial is a voluntary construction standard and designation program to help strengthen new commercial buildings during severe weather.

[U.S. Environmental Protection Agency](#)

The mission of the U.S. Environmental Protection Agency (EPA) is to protect human health and the environment, ensuring clean air, land, and water, and promoting environmental stewardship. EPA resources include:

- [Environmental Justice Screening and Mapping Tool](#) (EJSCREEN)
EJSCREEN is an environmental justice mapping and screening tool that provides a nationally consistent dataset and approach for combining environmental and demographic indicators.



U.S. DEPARTMENT OF ENERGY
SOLAR DECATHLON

2023 Build Challenge Rules

March 2022

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 ₂	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 From the July 2021 Release

The following is a summary of the changes and updates to this 2023 Build Challenge Rules document since its initial release in July 2021:

- The requirement for a Proposal as part of the Build Challenge application process was removed.
- The release date for the Solar Decathlon Build Challenge Building Code has been adjusted to March 2022.
- A “Decisions on the Rules” document will be provided on the [Project Site](#) if needed.
- 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.
- For both the 2022 and 2023 Competition Events, if held as in-person events, participating teams may send up to five (5) student decathletes and up to two (2) faculty advisors to represent the team at the event and present to juries. Only student decathletes are permitted to present to juries.
- Details for various measured Contests have been updated to provide clarification.
- Summaries of each deliverable are found in this document. However, exact and final formatting and content requirements for each deliverable can be found in the *Deliverable Requirements* document on the [Project Site](#).
- The D5: Permit Set Documentation date in the Design Deliverables table has been changed to match the Summary of Important Dates in Section 1.

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](#).

Table of Contents

1	Summary of Important Dates	1
2	Build Challenge Structure	3
2.1	Challenge Phases	4
2.2	Required Tasks	5
2.3	Team Structure	5
2.4	Student Decathlete Qualifications	6
2.5	Faculty Lead Role	6
2.6	Application	7
2.7	Building Code	7
2.8	Units of Measurement	7
3	Build Challenge Requirements	8
3.1	Authority	8
3.2	Administration	8
3.3	Participation	11
3.4	Build Challenge House Requirements	14
3.5	Energy	14
3.6	Build Challenge Events	16
3.7	Build Challenge Activities	17
4	Build Challenge Contests	19
4.1	Architecture	20
4.2	Engineering	20
4.3	Market Analysis	21
4.4	Durability and Resilience	22
4.5	Embodied Environmental Impact	22
4.6	Integrated Performance (measured)	23
4.7	Occupant Experience (measured)	25
4.8	Comfort and Environmental Quality (measured)	28
4.9	Energy Performance (measured)	29
4.10	Presentation	31
5	Build Challenge Juried Contest Evaluation Process	32
5.1	Juror Process	32
5.2	Team Process	32
6	Build Challenge Deliverables	34
6.1	D1: Project Introduction	36
6.2	D2: Project Management Plan	36
6.3	D3: Construction Documentation	36
6.4	D4: Design Presentation	36
6.5	D5: Permit Set Documentation	36
6.6	D6: Construction Progress	37
6.7	D7: Construction Completion	37
6.8	D8: Project Story	37
6.9	D9: Final Jury Presentation Files	37
6.10	D10: Post-Event Project Report	37

Authors: NREL's Joe Simon, Michael Young, Taylor Ryan, Marlana Praprost, Jes Stershic, 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 12, 2022:** Updated 2023 Build Challenge Rules Released
 - Minimal revisions expected, primarily focused on clarifying intent or adding definition to dates or schedules.
- **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.

- **February 14, 2023, 5 p.m. EST: D7—Construction Completion Deliverable Deadline**
 - Teams must have: (1) received a Certificate of Occupancy from their local Authority Having Jurisdiction (AHJ), (2) installed all Organizer Instrumentation Equipment, and (3) demonstrated an accessible tour route through their house to organizers.
- **February 17–March 17, 2023: Measured Contest Evaluation Period**
 - All homes are to be evaluated independently of each other.
 - Point penalties of 1 point per day of delay will be assessed to teams not ready to begin measured contest evaluations on February 17, 2023.
- **March 28, 2023, 5 p.m. EST: 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.
- **March 29–April 18, 2023: Local Exhibition Period**
 - While teams may exhibit their as-built houses earlier, such as alongside the Measured Contest activities, all homes should be open to the public during this period.
- **April 19, 2023, 5 p.m. EDT: Final Presentation Deliverable Deadline**
- **April 21–24, 2023: Solar Decathlon Competition Event**
 - All teams will present to juries on the National Renewable Energy Laboratory (NREL) campus in Golden, Colorado, USA.
 - All 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 ft² and 3,000 ft². 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 at the Competition Events occurring on the NREL campus in Golden, Colorado. The organizers do not plan to provide financial assistance for lodging or travel expenses.

Teams that compete in the Solar Decathlon Build Challenge design fully functional houses compliant with Challenge guidelines and then build/remodel, exhibit, and operate houses in their own communities. Each house is extensively measured to evaluate its performance, and teams present to multiple juries in competition with all other teams. For the Build Challenge, each of the 10 Contests are scored independently, and the team with the most points at the end of the competition wins.

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 at least one student, or 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 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 20 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, though it is possible not all teams who receive an Approval to Proceed will receive Prize funding.

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 for at least two weekends between March 29 and April 18, 2023.

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 18–24, 2023.

2.2 Required Tasks

- Attend monthly all-team conference calls for project updates and important information from the organizers about Build Challenge requirements, as outlined in Section 2.
- 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 submit a Foreign National Data Card.

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	The 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.

2.4 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.

2.5 Faculty Lead Role

The Faculty Lead, or leads, 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; and
- Ensure the team builds the house as designed and exhibits to the public.

2.6 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.

2.7 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.

2.8 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 Build Challenge Director has the final decision-making authority in all aspects of the Challenge. NREL is responsible for the execution of the Challenge.

Build Challenge Manager

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

Rules Officials

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

- a) The official version of the rules shall be the rules on the [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 goal 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. The overall Solar Decathlon Competition email is solardecathlon@nrel.gov. Should a team need to contact DOE's Solar Decathlon Director directly, the email is 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 conference calls with the organizers. Additionally, teams are expected to participate in webinars intended to educate and prepare the teams for successful participation in the Challenge.
- 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 20 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 20 teams that successfully complete their house design and complete construction will earn a financial award, likely \$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 Build Challenge Director is solely authorized to disqualify a team from the competition. Disqualification from the competition requires prior notice to the team and an opportunity for the team to make an oral or written statement on its behalf.
- c) The Build Challenge Manager shall notify all teams via the [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 Saturday, April 22, 2023.
 - o Exception: The results of one or more juried contests are announced on the final day of the Competition Event and cannot be protested.
- d) The protest shall be submitted by emailing the Build Challenge Manager at 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:
 - o The Build Challenge Manager convenes the Protest Resolution Committee.
 - o 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.
 - o 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.
 - o 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.
 - o The committee considers the protest and notifies the director and Build Challenge Manager of its recommendation in writing. The committee shall indicate the reason for the decision, any adjustment to a team’s measurement or score, and how many points shall be assessed as a filing fee, if any.
 - o 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.
 - o 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 ft² (37.16 square meters [m²]) and less than 3,000 ft² (278.71 m²).

- 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 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 collected/generated onsite must be offset with site-collected/generated renewable energy.

- a) Fireplaces, firepits, candles, and other devices using nonsolar fuels are not permitted in the designs.
- b) Gas-fired 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 (nonrechargeable) batteries (no larger than 9-volt) is limited to smoke detectors, remote controls, thermostats, alarm clock backups, and other small devices that typically use small primary batteries. These batteries do not need to end the competition with a full charge.
- c) The use of the factory-installed battery within a team’s electric vehicle is permitted. Vehicle-to-grid power flow capabilities within the competition prototype is only permitted if vehicle-to-grid power flow and associated equipment are approved by the vehicle’s manufacturer.
- d) Plug-in (nonhardwired) devices with small secondary (rechargeable) batteries that are designed to be recharged by the house’s electrical system (e.g., a laptop computer) shall be connected, or plugged into, the house’s electrical system whenever the devices are present at the competition house.

- 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 Competition Event on April 21–24, 2022, at NREL in Golden, Colorado; the Community Exhibition activities, which occur primarily in early 2023, and the Competition Event in April 2023, which will also take place at NREL.

3.6.1 Registration and Attendance

All Solar Decathlon Build Challenge 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 send up to five (5) student decathletes and up to two (2) faculty advisors to represent the team at the event and present to juries. Note that only student decathletes are permitted to present to juries; non-decathletes (e.g., faculty advisors) are strictly prohibited from interacting with their student decathletes and jurors during jury presentation activities.

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) Teams are required to use the Solar Decathlon logo, the DOE word mark, and the NREL logo on all communication materials used. The Solar Decathlon logo must be at least three times the size of all other logos.
- b) The Solar Decathlon logo, the DOE word mark, and the NREL logo are the only required graphic elements teams must use.
- c) Team uniforms are exempt.

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 ft² (1.858 m²) 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.
- d) Each team is responsible for making its own reservations and arrangements, and for covering all necessary costs.

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 for 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 2.4, are permitted to operate the house and participate in the contests.

- a) All competition-related communications during the Build Challenge Events shall be between the organizers and decathletes. Non-decathlete team members and crew, including faculty, are not permitted to participate in or listen to competition-related communications.

- 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 project assembled 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 Public Exhibit

- a) Teams are required to provide an accessible route to all areas of the house or exhibit that are available to the public during exhibit hours.
- b) Teams are permitted to produce and distribute up to one informational brochure or handout at the 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.

3.7.5 Team Uniforms

- a) During all Build Challenge Events and special events specified by the organizers, all team members present shall 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
				Energy Balance	30
				Energy Value	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

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

- a) Reduced points are earned for an average draw between 2 (0.473 L) and 20 (4.73 L) cups. Reduced point values are scaled linearly. If more than 20 (4.73 L) cups of water, on average, 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

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 Event 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 300 lx and 100 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). 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

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 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.

Air Tightness Subcontest

All available points are earned for a measured air tightness of less than or equal to 0.05 cfm 50/ft². 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 cfm 50/ft² and 0.25 cfm 50/ft². Reduced point values are scaled linearly. No points are earned for measurements above 0.25 cfm 50/ft².
- 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

Teams are evaluated on their home's ability to sufficiently retain its interior comfort for occupants without the use of energy-intensive electrically controlled thermodynamic cycles over a 3-day period. All available points are earned for maintaining a time-averaged interior dry-bulb temperature that is at least 20% closer to the upper or lower bound of the target temperature range defined in the Temperature Control Subcontest than the time-averaged exterior dry-bulb temperature during the 3-day measurement period.

- a) Reduced points are earned if time-averaged interior dry-bulb temperature is 10% to 20% closer to the target temperature range compared to the exterior dry-bulb temperature. Reduced point values are scaled linearly. No points are given for 0 to 10%.
- b) The organizers will identify at least two zones in each house and measure the temperature of each zone. The zone deviating farthest from the target is the zone temperature of record.

For example, if the time-averaged exterior temperature is 100°F (38°C) and the house maintains a time-averaged interior temperature of 80°F (27°C), the difference between the exterior and interior temperatures is 20°F (11°C), which is 77% of the difference between 100°F (38°C) and the upper end of the target range of 74°F (23°C). This would earn full points. If, however, the time-averaged interior temperature was 98°F (37°C), it would only be 8% closer to the target range ($2/26 = 8\%$) and would earn 0 points.

4.7 Occupant Experience (measured)

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

Kitchen Appliances Subcontest

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

- a) **Refrigerator:** All available points are earned for maintaining time-averaged interior temperature of a refrigerator between 34°F (1.111°C) and 40°F (4.444°C) during the scored periods.
 - Reduced points are earned if the time-averaged interior refrigerator temperature is between 32°F (0°C) and 34°F (1.111°C) or between 40°F (4.444°C) and 42°F (5.556°C). Reduced point values are scaled linearly. No points are earned for a time-averaged interior refrigerator temperature below 32°F (0°C) or above 42°F (5.556°C).
 - The refrigerator volume published in the manufacturer's specifications shall be a minimum of 4.5 cubic feet (ft³) (0.127 m³).
 - The refrigerator may only be used to store food and beverages.
- b) **Freezer:** All available points are earned for maintaining a time-averaged interior temperature of a freezer between -20°F (-28.889°C) and 5°F (-15°C) during the scored periods.
 - Reduced points are earned if the time-averaged interior freezer temperature is between -30°F (-34.444°C) and -20°F (-28.889°C) or between 5°F (-15°C) and 15°F (-9.444°C). Reduced point values are scaled linearly.
 - The freezer volume published in the manufacturer's specifications shall be a minimum of 2 ft³ (0.0566 m³).
 - The freezer may be used to store food and only enough ice to fill the freezer's ice bin (or equivalent).
- c) **Oven:** All available points are earned for maintaining a time-averaged interior temperature of an oven between 400°F (204.444°C) and 450°F (232.222°C) during scored periods.
 - 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 ft³ (0.0566 m³).
 - The oven may not contain any food or beverages during the measurement period.
 - Teams are provided two attempts to meet this requirement, with each attempt separated by at least 8 hours of time.
- d) **Cooktop:** All available points are earned for bringing at least 8 cups (1.892 L) of water in a pot to a rolling boil during a scored period.

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

Clothes Washing Subcontest

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

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

Clothes Drying Subcontest

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 single contiguous 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

All available points are earned for successfully operating smart home electronics, including a television, a computer, a smart outlet, and energy monitoring circuits. Teams may choose when to target earning points. 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. Points are earned for demonstrating that each can be powered and operated successfully.

- b) Each home shall have at least one smart outlet or light that can be controlled remotely and set to a schedule. Points are earned for demonstrating successful operation of the outlet or light.
- c) Each home shall have the ability for the homeowner to monitor circuit-level energy use. Points are earned for demonstrating complete and successful circuit-level energy monitoring to the organizers.

House Occupancy Subcontest

Each team shall host at least six members of its community for at least 2 hours. The House Occupancy Subcontest will feature at least six individuals in addition to two decathletes operating the house. The goal of this Subcontest is to validate a fully functional house with visitors and to enable a successful evaluation of the house for the Comfort & Environmental Quality Contest. To earn full points for the House Occupancy Subcontest, teams shall:

- a) Host at least six guests, including at least one organizer-invited observer.
- b) Serve a complete meal with an adequate amount of food for all guests at appropriate serving temperatures and in a timely manner.
- c) Prepare and cook all food and beverages in the house during a scheduled period of time.
- d) Serve and have guests eat the meal in the finished square footage.
- e) Comply with the following safety requirements:
 - Do not use any flames, including candle flames.
 - Do not serve or use any alcoholic beverages.
 - Use only drinking water purchased in sealed containers.
 - Wash and rinse all dishes and cookware before use.
 - Store all food and beverages properly.
 - Do not use coolers to store food, beverages, or ice.

Electric Vehicle Charging Subcontest

All available points are earned for charging an electric vehicle from a battery state below 40% to at least 75% within a specified time period. 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 prototype house must include the infrastructure required to charge the vehicle.
- c) Any vehicle used must be a model commercially available at the beginning of the 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

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

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

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

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.

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

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

- a) Reduced points are earned if the time-averaged interior relative humidity is between 25% and 35% or between 50% and 70%. Reduced point values are scaled linearly. No points are earned for a time-averaged interior relative humidity below 25% or above 70%.
- b) The organizers will identify at least 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 using mechanical means or demonstrate that the climate zone of the target market does not require humidity control.

Indoor Air Quality Subcontest

All available points are earned at the conclusion of each scored period by keeping the time-averaged interior carbon dioxide (CO₂) level below 1,000 parts per million (PPM) following occupancy of six individuals for 1 h. The CO₂ levels are measured when the house is occupied as part of the House Occupancy Subcontest.

- a) Reduced points are earned for time-averaged interior CO₂ levels between 1,000 PPM and 2,000 PPM. Reduced point values are scaled linearly. No points are earned for time-averaged interior CO₂ levels above 2,000 PPM.
- b) The organizers will identify at least two zone in each house and measure the CO₂ level of each zone. If more than one measurement is collected, the CO₂ level deviating farthest from the target CO₂ level is the CO₂ level of record.

Comfort Gradient

All available points are earned at the conclusion of each 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.

Exterior Noise Infiltration Subcontest

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 kilohertz. 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.¹

- 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.

¹ <http://www.usgbc.org/node/4631859?return=/credits>

Energy Efficiency Subcontest

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

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

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

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

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 greater than 2,000 kWh.

Solar Energy Utilization Subcontest

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. 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

Δt = 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, including written, verbal, multi-media, 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:

- **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.
- **Implementation**, 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.
- **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 contest shall have a jury panel made up of three to five jurors who will assess the team projects. All 6 juries will review each team. The juries will review the assigned deliverables associated with all competing teams and will evaluate the presentations from each Division. The juries will then assign a percentage integer value according to this process for every team, awarding a 1st through nth place for all teams in each Division. Ties are not permitted.

5.1 Juror Process

Each jury shall follow the following steps:

Step 1: Deliverables Review

Each juror will spend approximately 1–2 hours reviewing 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 six decathletes may be present during the presentations to the juries. No other team members may be present.
- 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) Initially, each team will have 10 minutes to present their project to all juries and competition event attendees.
- d) Following the initial presentations, each jury will be provided 15 minutes to meet with each team privately, followed by a 5-minute deliberation period. During the 15 minutes with each

team, the entire time is allocated for team members to lead the jury through the contest-specific aspects of the design and answer any questions the jury may have.

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

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

Deliverable Name	Required Content	Due Date
D1: Project Introduction	<ul style="list-style-type: none"> • Team Short Description • Conceptual Design • Initial Conceptual Design Renderings 	November 30, 2021
D2: Project Management Plan	<ul style="list-style-type: none"> • Initial Project Report, including Project Management Plan • Schematic Design Drawings • Construction Partner Details • Construction Site Details 	February 15, 2022
D3: Construction Documentation	<ul style="list-style-type: none"> • 75%+ Complete Construction Documentation • Public Project Renderings • Construction Schedule 	March 29, 2022
D4: Design Presentation	<ul style="list-style-type: none"> • 20-Minute Design Presentation • Public Project Renderings • Optional Poster 	April 12, 2022
D5: Permit Set Documentation	<ul style="list-style-type: none"> • Updated Project Report, including Project Management Plan • Permit Set – Construction Documentation • Updated Public Project Renderings 	August 2, 2022
D6: Construction Progress	<ul style="list-style-type: none"> • Copy of Construction Permit from AHJ • Construction Progress Photos • Updated Construction Documentation 	October 18, 2022
D7: Construction Completion	<ul style="list-style-type: none"> • Copy of Certificate of Occupancy from AHJ • Organizer Instrumentation Equipment Installation Report • Demonstration of ADA-Compliant Accessible Tour Route 	February 14, 2023
D8: Project Story	<ul style="list-style-type: none"> • Final Project Report, including Project Management Plan, Public Project Summary, Summary of Online and Public Exhibit Success, Completed Form of Key Features, and Team Roster • Jury Documentation • As-Built Construction Documentation • House Photography • 3-Minute Audiovisual Presentation • Video of Public Tour & Team Story B-Roll 	March 28, 2023
D9: Final Presentation Deliverable	<ul style="list-style-type: none"> • Final Jury Presentation Files 	April 19, 2023
D10: Final Report	<ul style="list-style-type: none"> • Post-Event Project Report 	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 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.

6.6 D6: Construction Progress

The Construct Progress deliverable is reviewed by organizers, and feedback is provided. 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](#).

6.7 D7: Construction Completion

The Construction Completion deliverable is reviewed by organizers, and feedback is provided. 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](#).

6.8 D8: Project Story

The Project Story is reviewed by organizers, and feedback is provided. 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](#).

6.9 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 & 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.

6.10 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.

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For more information, visit: energy.gov/eere

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