U.S. DEPARTMENT OF ENERGY
SOLAR DISTRICT CUP
COLLEGIATE DESIGN COMPETITION

Solar District Cup 2021 Rules

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U.S. DEPARTMENT OF ENERGY | Office of ENERGY EFFICIENCY & RENEWABLE ENERGY
SOLAR ENERGY TECHNOLOGIES OFFICE

NREL Transforming ENERGY

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Acronyms and Abbreviations

DOE	U.S. Department of Energy
DSS	distribution system simulator
IRR	internal rate of return
MACRS	modified accelerated cost recovery system
NPV	net present value
NREL	National Renewable Energy Laboratory
PPA	power purchase agreement
PV	photovoltaic
SAM	System Advisor Model

Summary of Changes for this Edition

1. Added "Battery Storage Challenge" to the listing of data sets included in the Divisions and District Use Cases section.
2. Corrected section numbering in Table 1.
3. Revised Final Deliverable Package—Solar PV Plus Battery Electric Storage System section for the battery challenge.
4. Added the customer savings analysis requirements to the Final Deliverable Package section.
5. Revised the Table 2. Section 4. Financial Analysis Content description.
6. Changed second occurrence of "demonstrating" to "is in" in Table 2 Section 5.A. Development Plan Content.
7. Added the list of district use case partners to the Partners section.
8. Clarified two entries in the Financial Model Baseline Assumptions section of Appendix A. Resources for Model Input Assumptions.
9. Added Customer Savings Analysis Guidance section to Appendix A.
10. Changed page number limit for section 1.A. Project Proposal—Written in Appendix D. Final Deliverable Package Requirements.
11. Deleted "(This page does not count toward the page limit.)" from section 1.A. in Appendix D.
12. Clarified Excel file Format Requirements in section 4. Financial Analysis—Financial Model Format Requirements.
13. Revised the Content Requirements of section 4. Financial Analysis in Appendix D.
14. Added "Annotated list of references or citations" to both sections 5.A and 5.B. in Appendix D.
15. Add district use case partner logos to the back cover.

Summary of Changes for the October 20, 2020 Edition

1. Updated URL link on page 15, Appendix A., Models and Software Tools, HeatSpring Solar Executive MBA Financial Model template.

1. COMPETITION OVERVIEW

Welcome to the U.S. Department of Energy (DOE) Solar District Cup Collegiate Design Competition!

To support DOE's ongoing work addressing structural employment gaps for professionals in the energy industry, the Solar District Cup challenges multidisciplinary collegiate student teams to develop forward-thinking designs for optimized campus or urban district distributed energy systems that inspire students and professionals alike—and then design and model those systems.

The competition engages students across engineering, finance, urban planning, sustainability, and other disciplines or degree programs to reimagine how electric energy is generated, managed, and used in urban areas. Students assume the role of a solar-plus-storage developer to produce a proposal and analyze electric distribution grid interactions for a district use case. For the purposes of this competition, "campus" and "urban district" are distinct areas of developed land containing a group of mixed-use buildings served by a distribution feeder. The competition organizers provide the teams with district use cases—including energy use data for multiple buildings, electrical infrastructure, and the district master plan—to serve as the basis for the solutions the teams develop in the challenge.

Each team competes against other teams in one of multiple divisions. Each division is structured around a single district use case. A division judging panel selects winning teams after the teams submit their final deliverables and present their designs via live video conference. The strongest submissions provide innovative solutions that maximize the district's energy offset and financial savings over the contracted (if PPA or lease) or useful (if cash purchase) life of the system while integrating aesthetic and community considerations.

The Solar District Cup is designed to inspire students to consider new career opportunities, learn new industry-relevant skills, engage with the professional marketplace, and prepare to lead the next generation of distributed solar energy. As competitors, students:

- Gain experience with innovative renewable energy design
- Develop real-world solutions that shape the future of solar energy
- Engage with industry professionals to forge relationships and connections that aid participating students' transition to the solar energy workforce upon graduation
- Compete to earn a trophy and national recognition.

The Solar District Cup invites participation by teams of at least three students enrolled in accredited U.S.-based collegiate institutions. In this case, "collegiate institution" refers to any school of secondary or higher education, including but not limited to community colleges, technical colleges, and traditional four-year and graduate-level universities. There is no cost to register or attend the online Warm-Up Workshop or participate in the final online competition event, and participating team members receive complimentary passes to industry conferences associated with the competition. Following registration, teams receive notification of acceptance on a rolling basis up to the registration deadline.

Competition organizers support student team efforts through educational webinars on system design, modeling, and techno-economic analysis topics free of charge to all student teams. Learn more at www.energy.gov/solardistrictcup.

Register to compete at www.herox.com/solardistrictcup.

Summary Timeline

The Solar District Cup 2021 is a two-semester (or three-academic-quarter) project, starting in fall 2020 and culminating in spring 2021.

- April 30, 2020—Competition announced, and team registration opened
- September 1, 2020—Rules published
- September 10, 2020—Informational webinar held
- September 29, 2020, 5 p.m. ET—Deadline for teams to complete registration
- October 6, 2020—Participating teams announced
- October 8, 2020—Warm-Up Workshop held for participating teams (by video conference)
- November 19, 2020, 5 p.m. ET—Deadline for receipt of Progress Deliverable Package from participating teams
- December 17, 2020—Finalist teams announced, and Progress Deliverable Package feedback provided
- April 15, 2021, 5 p.m. ET—Deadline for receipt of Final Deliverable Package from finalist teams
- April 22, 2021, 5 p.m. ET—Deadline for receipt of final pitch presentation files from finalist teams
- April 24–26, 2021—Finalists present projects by video conference; winners announced. Live video attendance and live presentation by at least one student team member from each finalist team is required. Only students may present to judges at the finalist event.

Background

Rapid advancements in solar electric generation and battery electric storage technologies have resulted in decreasing costs and increasing rates of deployment. At the same time, preparation for professional careers in these technology applications—particularly at the nexus between the two—has limited existing post-secondary curricula.

As indicated in Chapter 5 of DOE's *Quadrennial Energy Review: Transforming the Nation's Electricity System*:

> Workforce retirements are a pressing challenge. Industry hiring managers often report that lack of candidate training, experience, or technical skills are major reasons why replacement personnel can be challenging to find—especially in electric power generation.

Although the solar industry has matured significantly over the last decade, additional opportunities exist to integrate solar-plus-storage solutions at the district scale. With innovation and careful integration, property owners and utilities alike can realize benefits of a more resilient, cost-effective, and sustainable distributed energy source.

DOE has a history of supporting workforce development through competitions focused on project-based learning (e.g., Solar Decathlon, Collegiate Wind Competition, EcoCAR, Cleantech University Prize). Student competitors gain experience solving relevant industry challenges that prepare them for successful careers in solar and related energy fields, benefiting from mentorship, training, collaboration, and networking. The competition supports DOE's ongoing work to help industry address structural employment gaps through comprehensive workforce development activities that simultaneously provide innovative solutions for partner districts' consideration and district-level ideas that inspire industry members.

The Solar District Cup encourages collaboration between academia and industry. The program seeks to establish public-private partnerships and demonstrate corporate and nonprofit industry co-sponsorship.

2. COMPETITION PROCESS

Introduction

The Solar District Cup challenges collegiate student teams to design and model optimized distributed energy systems for a campus or urban district. The strongest teams are often multidisciplinary, including students from mechanical, civil, or electrical engineering; business or finance; urban planning; construction management; communications; or sustainability degree programs. A campus or district is a defined area of developed land containing a mixed-use group of buildings served by a local electrical distribution feeder. The systems proposed by students integrate solar photovoltaic (PV) generation, battery electric storage, and other distributed technologies and capabilities within the district's existing energy sources, uses, and infrastructure.

The winning teams in each division of the Solar District Cup 2021 receive a trophy and national recognition. Additionally, one team is identified by a public audience of peers and industry professionals as the project pitch winner. All student competitors gain valuable experience with real-life examples of innovative renewable energy design. Competitors learn leading industry software, present to nationally respected judges, and engage with industry mentors.

For the purpose of this competition, the organizers present the teams with district use cases based on existing campuses or urban areas and assign a district use case to each division. Each team develops a solution for its assigned district use case, which enables students to work on a real-world project of actual energy load, utility rate, and site data while developing distributed-energy solutions. These use cases are developed using input from district partners to provide real-world constraints and considerations. The solutions the teams develop provide insights that could inform the partner districts for future development of distributed energy resources.

The competition organizers host an online informational webinar and Warm-Up Workshop that provides information and clarity about the competition rules, deliverables, and judging criteria to help all teams succeed. Competition organizers also support student team efforts through educational webinars on solar and battery system design, modeling, and techno-economic analysis topics. Additionally, through a partnership with Solar Power Events, registered team members receive access to the educational, poster, and trade show sessions of the Solar Power International conference, part of North America Smart Energy Week. At the conclusion of the competition, student teams present their solutions to industry leaders and judges on a video conference, where winners are also announced.

Goal

The goal for each team is to design a solar-plus-storage system for a campus or district that maximizes energy offset and financial savings over the contracted (if PPA or lease) or useful (if cash purchase) life of the system. Competition teams analyze electric distribution grid interactions and assume the role of renewable energy systems developers to produce a power purchase agreement (PPA), lease, and/or cash purchase proposal for their division's district.

How to Enter

1. Go to the Challenge page at www.herox.com/solardistrictcup.
2. Create a HeroX account if you don't already have one, or sign in and then choose "Solve this Challenge." This indicates your interest in competing; it is not a commitment.
3. By the registration deadline, one person from each team must click "Begin Entry" and then submit a "Register" entry on HeroX to complete registration. This step is when you identify

your collegiate institution and expected team makeup. There is no cost to submit a Register entry.

4. Registration entries received by the deadline are deemed participating teams. All teams who successfully complete a Register entry and meet eligibility are accepted.
5. Divisions are assigned by the competition organizers following receipt of a complete Register entry and by the date on which participating teams are announced. Assignments ensure an equal number of teams in each division.
6. Multiple teams from a single school may submit a Register entry, but only one team may compete per division. Three divisions are expected.
7. Only one person per team may submit a Register entry. Other members join that registered team via HeroX. Team members may be added or removed from a team at any time. Once you have registered a team, you can invite additional members using HeroX.

How to Win

A team competes against other teams in a division, and each division has a single district use case. Competition organizers assign teams to divisions upon registration. Each team designs its own solution for the assigned division's district use case. The strongest team concepts are those that maximize the district's energy offset and financial savings over the system's contracted (if PPA or lease) or useful (if cash purchase) lifetime while integrating aesthetic and community considerations. A team wins based on its average score as determined by a panel of three to five judges who evaluate the competition entries through review of deliverable packages and presentations. The first-place winners of each division compete against each other to determine a project pitch winner.

Divisions and District Use Cases

The Solar District Cup has multiple divisions. Each division has at least six teams competing against each other.

Each division is assigned a use case of an existing mixed-use urban district or campus in need of increased distributed energy development. The competition organizers provide each team with the details of their division's district use case.

A district use case is a defined area served by one or more electrical distribution feeders with a collection of spaces potentially available for PV installation, including but not limited to: building rooftops, open land, parking, and other infrastructure. The use case for each district includes the following data sets, at a minimum:

- Sustainability goals of the district use case
- A map designating the boundaries of the campus or district in which student teams are confined to designing their systems
- Twelve consecutive months of interval load (energy consumption) data (in intervals ranging from 15 minutes to hourly) for several of the buildings that are within the district and connected to the feeder
- Electric utility rate schedule
- Base-case OpenDSS model
- A development master plan, land ownership status, local zoning codes, and permitting requirements for land use.
- Battery storage challenge (included at the Final Deliverable Package phase)

The district use cases might have select details simulated or otherwise changed by the organizers for the purposes of the competition. Information provided to teams is intended to be used only by the team members. The data provided is not for redistribution to the public or for use outside of the competition.

What to Submit

Teams submit two deliverables: a Progress Deliverable Package and a Final Deliverable Package. These packages are summarized in Table 1 and Table 2 and are described in greater detail in the appendices. Competition deliverables are submitted via HeroX.

Deliverable packages are considered to be on time if they are received by the respective due date and time as indicated on HeroX. Late submissions may be considered on a case-by-case basis, but are marked as such when distributed to the reviewers or judges.

Progress Deliverable Package—Solar PV System

A complete submission for the progress deliverable is a design and techno-economic analysis of interconnected solar PV systems that maximize energy offset and savings over the system's contracted (if PPA or lease) or useful (if cash purchase) lifetime for the division district use case.

The competition organizers evaluate the Progress Deliverable Package using the evaluation statements in Table 1. Organizer staff reviewers evaluate the degree to which they "agree" or "disagree" with the individual evaluation statements. Teams advance as finalists if the reviewers agree (on average) with the evaluation statements more than they disagree with the statements. Teams do not compete against each other to become finalists. Written feedback regarding rules compliance is provided to all teams who submit a Progress Deliverable Package.

Table 1 comprises the content requirement summaries and corresponding evaluation statements for the Progress Deliverable Package. The required file format of each component of the Progress Deliverable Package is indicated in brackets. Each deliverable must use the information provided in the district use case and the assumptions and resources cited in Appendix A. Additional details on the required components of the deliverable package are provided in Appendices B and C. Additionally, the submission form on the HeroX platform asks teams to answer a few short questions about team makeup, approach to work done to date, and planned work for winning the competition in the next stage. These additional questions are not judged, but they are used to enable continuous program improvement by the organizers.

Table 1. Progress Deliverable Package Content and Evaluation Statements

Content	Evaluation Statement
1. Executive Project Summary	
A project overview, including PV system sizing; distribution system impact summary; PPA, lease, and/or purchase price with financial performance; and development plan highlights [PDF].	The team communicates its solution clearly, concisely, effectively, and professionally with proper spelling and grammar.
2. Conceptual System Design	
A. Layout and specifications for the PV systems proposed on one or more rooftops, parking lots, or ground areas within the district [PDF]. B. Average hourly energy production output for each system over annual period [Excel spreadsheet].	A. Conceptual system design is complete and reasonable for PV system location and specifications. B. Energy output is complete, based on reasonable yield factor accounting for climatic variables, and clearly conveyed.
3. Distribution System Impact Analysis	
A. Descriptive approach to power flow model and distribution system impact risk [PDF], including: - Irradiance profiles for the proposed PV systems - Load profile characterization - Maximum PV system capacity limit given distribution system constraints - Control settings for the PV systems, capacitor banks, and voltage regulators.	A. Description of approach includes explanation of model input choices and any distribution system impact risks.
B. Power flow model [OpenDSS input and output]: - Demonstrating all network elements satisfy loading and voltage constraints - Demonstrating active elements have realistic settings, responses, and dead times.	B. Power flow model runs correctly, and voltage analysis shows operation within expected bandwidth and with reasonable inputs.
4. Financial Analysis	
A project financial model that uses the production data, PPA or lease price, and other inputs to calculate investor internal rate of return (IRR) at a net present value (NPV) of $0 [Excel spreadsheet].	Financial model has a complete set of reasonable inputs, models cash flows competently, has a PPA or lease price that is reasonable by market standards, and a rate of return that would be acceptable to investors.
5. Development Plan	
A. Building and site plan for conceptual system design, including applicable local ordinances [PDF].	A. Building and site plan demonstrates compliance with district master plan, zoning, and other land use or building restrictions.
B. Construction plan to procure necessary permits and comply with local codes [PDF].	B. Construction plan includes a timeline and demonstrates compliance with permitting and relevant codes.

See Appendices B and C for Progress Deliverable Package content and formatting requirements.

Final Deliverable Package—Solar PV Plus Battery Electric Storage System

The Final Deliverable Package includes a complete conceptual design and techno-economic analysis of a proposed **interconnected solar PV plus battery electric storage system that maximizes energy offset and savings over the system's contracted (if PPA or lease) or useful (if cash purchase) lifetime for the division district,** given its use case parameters and conditions.

The competition organizers will provide teams with a battery challenge at the beginning of the Final Deliverable Package phase, for which they must design a battery optimization strategy. Teams are *required* to integrate their own input assumptions in the financial model provided on HeatSpring and submit the completed spreadsheet in the deliverable packages. Student teams must perform a customer savings analysis in the Final Deliverable Package in addition to the project financial model. Student teams must perform a customer savings analysis for the solar-plus-battery storage system, as well as each of the PV systems they've proposed in their district. The Final Deliverable Package requires student teams to update their Progress Deliverable Package and to present their optimized solution.

Table 2 provides a content requirement summary of the Final Deliverable Package. The required file type for each component of the final deliverable is indicated in brackets. Additional details on the required content and formatting of the deliverable package sections are provided in Appendices B and D.

Table 2. Final Deliverable Package Content and Judging Statements

Content	Judging Statements for Evaluation
1. Project Proposal	
A. Proposal document that encapsulates and summarizes deliverable sections 2–5. The proposal should make the case as to why the proposed solar system and developer team are the best choice for the district [PDF]. B. Presentation that demonstrates the team's approach to the system design, operation, optimization, and innovation [PowerPoint and live presentations].	The proposal presents a clear and concise summary of the project. Both the proposal and the presentation make a compelling case as to why the proposed solution is the best choice for the district given its needs, constraints, and goals.
2. Conceptual System Design	
A. Layout and specifications for PV system(s) with battery electric storage system(s) added, including summary description of results and underlying assumptions used in the analysis [PDF]. B. Average hourly energy production output over annual period, including battery charge and discharge cycles [Excel spreadsheet].	Conceptual system design proposes creative and innovative solution that demonstrates excellent analysis, system design, and optimal battery use strategy.

Table 2. Final Deliverable Package Content and Judging Statements (cont.)	
Content	**Judging Statements for Evaluation**
3. Distribution System Impact Analysis	
A. Descriptive approach to power flow modeling [PDF], with a summary of analysis, underlying assumptions, and results as well as the rationale for sizing and siting the battery, including: - Selection of operating mode (e.g., peak shaving, self-consumption, capacity firming) and corresponding input settings for the battery system - Assumptions made to model the battery, including round-trip efficiency parameters - Justification for any changes to the distribution system infrastructure either needed or avoided as a result of adding the PV and battery systems. B. Power flow model demonstrating the proposed solar PV plus battery systems can operate without voltage violations [OpenDSS input and output].	Power flow modeling approach demonstrates sophisticated strategy to integrate a reliable solution into the distribution system while operating within voltage and loading restrictions.
4. Financial Analysis	
Financial models [Excel spreadsheet or spreadsheets] comprised of: - Two project financial models: one for the solar systems (HeatSpring model) and one for the solar-plus-storage system (battery analysis software). The solar system model outputs an IRR and the solar-plus-storage model should output a contract price (e.g., $/kWh, $/month) - Customer savings model that calculates annual cash flows for system offtaker (i.e., the district) and provides an NPV of savings over the contractual (if PPA or lease) or useful (if cash purchase) life of the system.	Financial analyses communicate a strong grasp of renewable energy project finance. Input assumptions are justifiable, calculations are correct, battery-operation strategy delivers maximum economic benefits, and pricing and rate of return are attractive to the market.
5. Development Plan	
A. Building and site plan demonstrating conceptual system design, including any proposed rezoning, is in alignment with the campus master plan [PDF]. B. A construction schedule and development plan to implement the design [PDF], including: - Necessary construction and land use permits - Compliance with applicable local codes - Potential risks to successful deployment - Approach to address potential concerns and questions of district decision makers and surrounding community members.	Proposed building, site, construction, and development plans with any rezoning adds significant value in a comprehensive, actionable, and feasible approach for the district and surrounding community.

See Appendices B and D for Final Deliverable Package content and formatting requirements.

How Entries Are Scored

A qualified panel of three to five judges—comprising subject-matter experts and representatives from the partner district use cases selected by the competition organizers—score finalist submissions according to the extent to which they agree that the content and formatting requirements were met and with the solution aligns with the judging statements listed in Table 2. Judges evaluate the Final Deliverable Package sections using a scale from 1 to 6 for disagreement or agreement with the evaluation statements, as shown in Table 3.

Table 3. Scoring Scale

1	2	3	4	5	6
Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree

Judges are assigned deliverable sections and evaluation statements based on their areas of expertise as shown in Table 4. All judges evaluate the Project Proposal.

Table 4. Judging Panel Makeup and Assignments

Content	System Design Judge	Utility Judge	Financial Analysis Judge	District Use Case Judge
Project Proposal	X	X	X	X
Conceptual System Design	X			
Distribution System Impact Analysis		X		
Financial Analysis			X	
Development Plan				X

The following is a list of steps and actions the judges take to ensure each finalist entry receives fair and equal consideration.

1. Judges review their assigned content of the Final Deliverable Packages submitted by each team.
2. Each statement listed in the "Judging Statements for Evaluation" receives a preliminary score between 1, "strongly disagree," and 6, "strongly agree" (on the scoring scale shown in Table 3), based on the subjective determination of each judge.
3. The evaluation statements form the basis of each judge's score, so it is critical that teams successfully complete each component of the deliverable package while maintaining a comprehensive and innovative optimization strategy overall.
4. The scores from each judge are collected to determine the team's preliminary score. The summed score from each judge is averaged across the judging panel as the preliminary average score each team.
5. The preliminary scores for all teams in the division yield a preliminary ranking of teams.

6. The judges witness a 15-minute live presentation by each team. Each division presents in parallel. Ten minutes are provided for judges to ask questions of each team. A maximum of five students per team may present, and up to ten students per team may answer questions from the judges.
7. The judging panel convenes following the live video conference presentations to review preliminary scores, discuss and agree upon final evaluation of each statement, and determine the winners of the competition.
8. First-, second-, and third-place winners and optional honorable mentions are identified and announced. Individual scores for each team are not released. No ranking is completed beyond third place. The judges' feedback is provided to each team individually.
9. The first-place winner of each division presents an 8-minute project proposal pitch at the final event. Final event attendees select a Proposal Pitch winner from among the presenting teams. The presentations are open to the public and promoted to industry, increasing the recognition of the top teams. The division and competition process is illustrated in Figure 1.

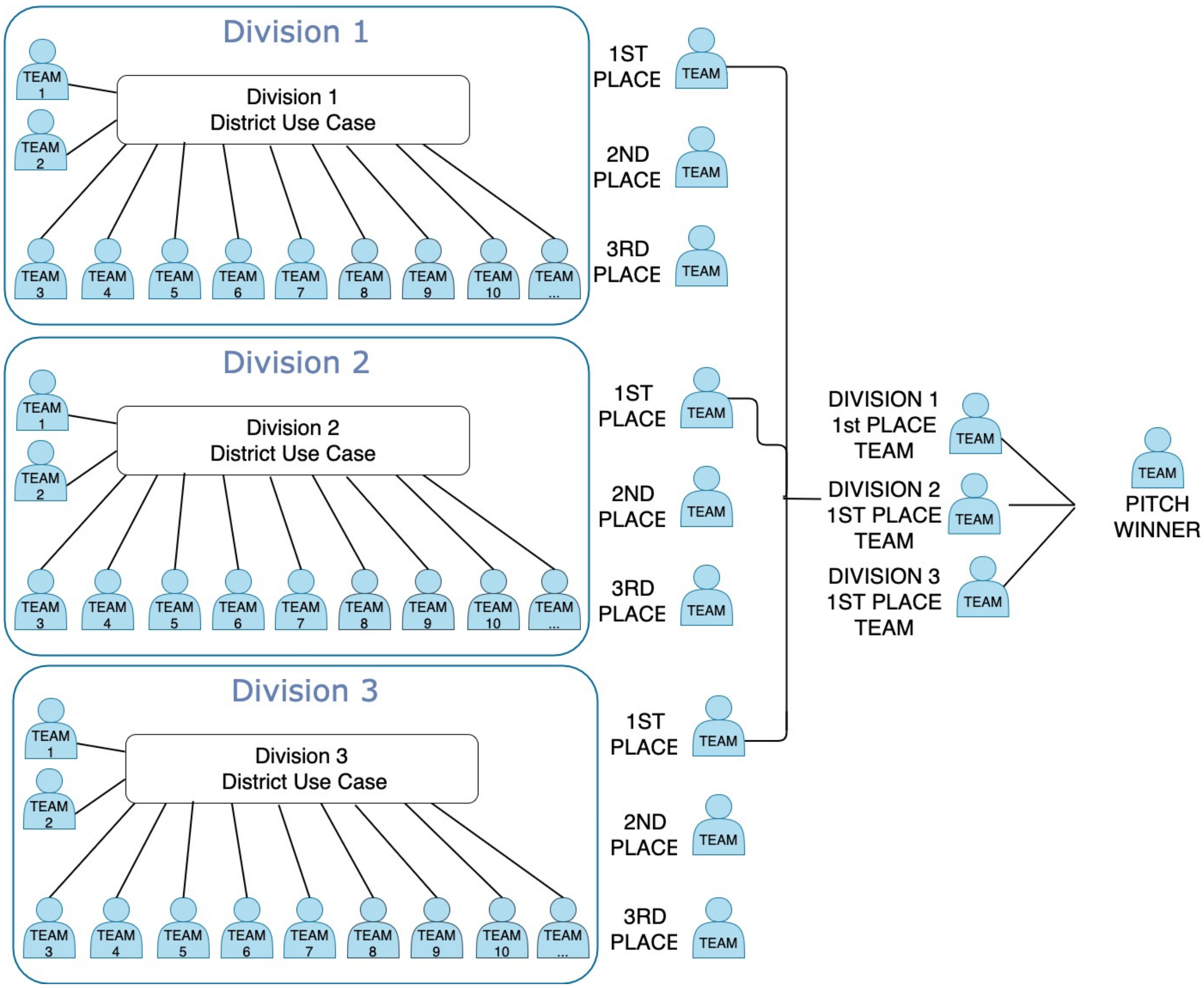


Figure 1. Division and competition process

Who Can Enter

The Solar District Cup invites participation of teams composed of at least three students enrolled in accredited U.S.-based collegiate institutions. Students must be enrolled in at least one class and be pursuing a degree for the duration of the competition. Students and faculty advisors are not required to be U.S. citizens at the time of the competition. Members of the judging panels, competition organizer staff, and DOE and national laboratory employees are ineligible to compete.

Although any level of collegiate student is eligible to compete, the challenge scope is intended for multidisciplinary teams of upper-level undergraduate students. Student participation may be integrated into senior design or capstone work, count as elective or independent study course credit, be added to the curriculum of existing classes, or be considered an extracurricular student activity.

Each team is encouraged to have at least one faculty advisor, but this is not required for participation. If a team of students needs assistance in identifying a faculty advisor or mentor, they can contact the competition organizers for help.

By uploading a deliverable package, a team certifies that it is in compliance with the eligibility requirements. If the organizers become aware that a team or individual is not eligible, that team may be disqualified from competition.

Competition Events

Warm-Up Workshop

The competition organizers host an all-team Warm-Up Workshop (see Summary Timeline). At this workshop, teams engage with each other, learn from industry leaders, and receive training from the competition organizers. The Warm-Up Workshop is free to team members.

Solar Power International (optional)

The competition organizers provide access to the educational and poster sessions of the online Solar Power International conference, starting in September and concluding with a virtual trade show on October 21–22, 2020. By attending this conference, team members have an opportunity to engage with and learn from industry leaders. Conference registration is free to participating students who are listed as team members via HeroX.

Final Competition Event via Video Conference

The competition organizers conduct the final competition event as a video conference. At this event, teams present their projects live to industry judges, and the winners of each division are announced. The first-place winners of each division present to video conference attendees, who then select a project pitch winner. Live video conference attendance and presentation by at least one student team member from each finalist team is required. Up to five team members can present live.

Curriculum Support

Team efforts are supported by a series of optional online educational webinars presented by the competition organizers on competition and techno-economic analysis topics. The webinar topics relate specifically to the required elements of the deliverable packages. Faculty advisors or mentors are expected to provide guidance to teams toward successful completion and, where feasible, may integrate competition activities into coursework, academic credits, or related curriculum.

Instructive videos are provided to all registered team member students and faculty on HeatSpring, a platform that enables knowledge leaders to better reach knowledge seekers. Content is be added throughout the competition period and includes topics such as:

- Conceptual System Design
- Distribution System Impact Analysis
- Solar Project Finance
- Development Planning
- Using Aurora Solar for Conceptual System Design
- Using OpenDSS for Distribution System Modeling
- Excerpts from the "Solar Executive MBA" focusing on Development Plans, Sizing a Distributed Generation System and Economic Modeling Basics, Risk Management and Budgeting, and Request for Proposal and Financing Strategies.

Additionally, throughout the competition period, the organizers host a series of webinars and optional "office hours" to provide guidance or to answer student questions.

Student teams are encouraged to engage with faculty advisors and/or mentors for support, guidance, and consultation. Mentors may be teachers, staff, or other industry professionals, such as collegiate alumni, local chapters of professional societies or associations, local electric utilities, emeritus professors, adjunct instructors, or faculty from other departments.

3. COMPETITION AUTHORITY AND ADMINISTRATION

The Solar District Cup is organized by DOE and the National Renewable Energy Laboratory (NREL), which is managed and operated by the Alliance for Sustainable Energy, LLC, for DOE. Funding is provided by DOE's Office of Energy Efficiency and Renewable Energy Solar Energy Technologies Office. The views expressed herein do not necessarily represent the views of DOE or the U.S. government.

The Solar District Cup 2021 is governed and adjudicated by this rules document, which is intended to establish fair contest rules and requirements. The competition is designed and administered by a team of competition organizers consisting primarily of DOE and NREL staff. In the case of a discrepancy with other competition materials or communication, this document takes precedence. The latest release of these rules takes precedence over any prior release. The organizers reserve the right to change contest criteria, rules, and outcomes as needed. Additionally, competitors are encouraged to bring to the organizers' attention rules that are unclear, misguided, or in need of improvement. For the purposes of competition evaluation, a violation of the intent of a rule will be considered a violation of the rule itself. Questions on these rules or the program overall can be directed to solardistrictcup@nrel.gov.

Judges may not have personal or financial interests in; be an employee, officer, coordinator, or agent of any entity that is a registered participant in; or have a familial or financial relationship with an individual who is a registered competitor in this contest.

The Solar District Cup is a collegiate design competition. There is no expectation that any of the submitted entries will be built or implemented by the students or partner districts.

4. PARTNERS

The Solar District Cup depends on partnerships to be successful. We would like to thank the following organizations for their support of the competition and the student teams:

Aurora Solar

This software company has created a one-stop, cloud-based solution to streamline the solar design and sales process. It provides all competing teams free accounts and access to its solar software, offering customized training, and staffing "office hours" sessions throughout the competition.

HeatSpring LLC

This technology firm has developed a platform that helps knowledge leaders better reach knowledge seekers. It offers online courses led by industry experts for professionals in renewable energy industries, including solar and green building. HeatSpring provides a training platform and solar industry training content for all competing students as well as staff "office hours" with solar business experts Keith Cronin and Chris Lord.

Solar Power Events

This group is behind North America's largest solar and storage events and is owned by the Solar Energy Industry Association and Smart Electric Power Alliance. The organization provided space, promotion, and amenities for the Solar District Cup at Solar Power International 2019 and helps the competition participants engage with solar industry professionals throughout the 2021 competition.

District Use Cases

The Solar District Cup 2021 has multiple divisions to which teams are assigned. Each division centers on a distinct use case of a real-world mixed-use urban district or campus interested in pursuing distributed energy solutions.

The Solar District Cup would not be able to provide these district and campus use cases without the collaboration of our Solar District Cup 2021 use case partners and their willingness share valuable data with the student teams:

- City of Denver / Auraria Higher Education Center
- University of Central Florida
- University of Nebraska Lincoln

These organizations have generously given their time and data to ensure that their districts were accurately represented and provided the student teams with robust challenges to drive competition.

"Our university benefitted tremendously by serving as a use case in this inaugural competition. The professionalism of presentations by the interdisciplinary academic teams showing the strategic breadth and technical depth of final recommendations will indeed inform our next steps as we work to achieve our 2030 climate goals."

Robert Koester
Solar District Cup 2020 District Use Case Representative from Ball State University

"The Solar District Cup was an immersive and technically challenging event that allowed our future innovators to work with actual region-specific utility data. Allowing students to navigate real world engineering, financial and social challenges associated with renewable technologies is educationally invaluable. The positive takeaway was the opportunity to view things from the mind of today's students and has ultimately inspired me to take serious consideration of the many solutions I observed."

Patrick Chavez
Solar District Cup 2020 District Use Case Representative from New Mexico State University

Appendix A. Resources for Model Input Assumptions

A series of assumptions and resources are provided to serve as a baseline for all teams' design and analysis. NREL and other organizations regularly publish cost benchmarks and industry-analysis documentation that estimate the cost for system technologies and components, the prevailing cost of capital for financial inputs, market-appropriate PPA prices, and other related figures. Teams are encouraged to conduct their own research, and several staring resources are provided here. Assumptions should be cited where appropriate, and, if deemed necessary by the team, justified in the project proposal. Although teams are encouraged to discuss the competition and their proposed solution with industry professionals, costs or assumptions not publicly available to all teams are not to be used in calculations. Unless qualified alternates are used following the previously described process, all teams should use the input values listed under the "Financial Assumption" section below.

Note that in addition to providing system production output, NREL's System Advisor Model (SAM) also includes default assumptions for many of the input values required to run the financial model. The NREL SAM tool and materials specified below can be used as a baseline for successful analysis. The link for SAM is provided (users are required to register when using SAM for the first time, but registration is free).

Students may use any resources or tools desired to derive their financial modeling inputs, study modeling mechanics, or validate their results. Teams are ***required*** to integrate their own input assumptions in the financial model provided on HeatSpring and submit the completed spreadsheet in the deliverable packages.

Financial Model Baseline Assumptions

- Property tax: Assume $0 over the course of the PPA or lease.
- Sales tax: Assume all sales tax already is expressed in the total system cost.
- Corporate tax rate: Assume 27% for state plus federal total rate.
- Developer margin: 10% (this is a different figure from the developer's cost of capital or rate of return).
- Construction timeline: approximately eight months.
- PV lifetime is 30 years (e.g., if your PV system has a 20-year PPA, there are 10 years of "residual value" on the system).
- PPA or lease contract term is 20 years.
- System degradation is 0.5% per year.
- Inflation is 2% per year.

Written Resources

- NREL PV System Cost Benchmark provides data points for PV system and component costs. Additional unitized balance of system costs are available in the "Financial Model Assumptions" section.
- NREL Financing Terms and Trends provides data points for PV cost of capital (debt, tax equity, and partner equity inputs).
- Emerging Opportunities and Challenges in Financing Solar provides general information on how PV projects are financed using tax incentives in the United States.
- Norton Rose Fulbright's cost of capital updates have information on tax equity and debt rates for the 2020 fiscal year.
- Best Practices for Operation and Maintenance of Photovoltaic and Energy Storage Systems (3rd Edition) provides cost figures for operations and maintenance.

- Database of State Incentives for Renewables and Efficiency provides information on state and local incentives for PV and PV-plus-storage systems.
- Solar District Cup Training Course on HeatSpring provides free videos and written resources relating specifically to the required activities of the Solar District Cup.
- Examples of real-world project proposals from SunPower and Borrego Solar have been provided in the data room for reference.

Models and Software Tools

- Aurora Solar—Can be used to create 3D site layouts, design PV systems, perform shading analysis, and estimate PV system performance.
- SAM—Can be used for PV systems production modeling and financial model validation.
- REopt™ Lite—Can be used for battery operations analysis.
- OpenDSS—An electric power distribution system simulator (DSS) for supporting distributed resource integration and grid modernization. It is available free of charge at http://smartgrid.epri.com/SimulationTool.aspx. It can be used for distribution system voltage analysis.
- Cost of Renewable Energy Spreadsheet Tool—Can be used as a reference or instructive tool in designing Excel-based renewable energy financial models.
- NREL Annual Technology Baseline and levelized cost of energy calculator—Can be used to source data points and validate the inputs/outputs of other models.
- ArcGIS Online—Can provide parcel, zoning, and other information for plan development.
- HeatSpring Solar Executive MBA Financial Model template—Required for use as a template financial model for the system(s) proposed by competing teams. Note: must be logged in to the free HeatSpring course to access.

Customer Savings Analysis Guidance

The customer savings analysis is an evaluation of the economics for the *offtaker* of the solar-plus-storage system, while the financial analysis is an evaluation of the economics for the *investors* in the solar-plus-storage system. Several tools are available to perform the customer savings analyses, including the load analysis model and the financial model in the HeatSpring platform, SAM, and REopt Lite.

Additionally, students can perform this evaluation manually in an Excel spreadsheet by matching the building load with hourly solar production and pricing both according to the avoided cost (utility rate at that interval of time) and PPA or lease respectively. A demand charge analysis can also be performed this way by determining the maximum usage in each month. **Note:** the models in the HeatSpring platform can only perform customer savings analyses on the solar system alone. When adding the battery to the savings analysis, student teams must use another tool, such as SAM or REopt Lite, or a tool of their choice.

Charts displaying annual and cumulative customer savings (or losses) over the contract lifetime period should be included in the proposal document, as well as a table displaying total system characteristics, such as the example in Table 5 below. A breakout of each system's individual savings can also help the customer determine which systems may be more economical and therefore more likely to be chosen for installation.

Table 5: Sample Solar-plus-Storage Summary Table

System	Aggregate Size	All Inclusive PPA Price	PV Only Price	Year 1 Generation	Total 20 yr Savings
PV System	3.3 MW	$0.11/kWh	$0.07/kWh	3,960,000 MWh	$1,200,000
Battery Storage System	1 MW / 2 MWh			Based on demand charge mgmt. strategy	$1,800,000 (with PV system)

Note: these numbers above not based on a real system; in fact adding a battery may create negative savings (which student teams may choose to characterize as the value of resilience[1] or some other non-monetary benefit). Further examples of how student teams can display customer savings and system specs can be found in the proposal documents in the data room.

The customer savings analysis will depend on the agreement structure under which the battery is contracted: i.e., power purchase agreement (PPA), lease, or some other arrangement (e.g., tolling agreement, shared savings agreement). Student teams should determine which contracting mechanism is best given their battery discharge strategy and state regulatory environment and include the rationale behind their choice in the proposal documents.

Student teams may find that the economics of a battery system are not as compelling as standalone PV. If this is the case, teams may make this statement in their proposal and focus on the system configuration that offers the district the best value (e.g., standalone PV installed on select rooftops). However, teams will still be required to provide the summary results of their battery evaluation and provide a rationale for either including or excluding it in their system proposal.

[1] For more on the value of resilience, see: https://www.nrel.gov/docs/fy20osti/74241.pdf

Appendix B. Deliverable Package Submission Requirements

File Name Requirements

Submitted deliverable package files must be named as follows:

- [DistrictUseCaseAbbreviation]_[SchoolShortName]_[DeliverableSection].[extension]
    - [DistrictUseCaseAbbreviation] provided within the district use case profile
    - [SchoolShortName] is your collegiate institution commonly recognized and distinct short name, abbreviation, or acronym
    - [DeliverableSection] is given in the Appendix C and D format requirements
    - [extension] is PDF, XLSX, ZIP, or PPTX.

Appendix C. Progress Deliverable Package Requirements

1. Executive Summary

Format Requirements

☐	File type: single, bookmarked PDF with all fonts embedded and 300 dpi minimum resolution
☐	Up to 6 pages total; any additional pages submitted are not reviewed
☐	ANSI A (8.5" x 11") paper size must be used
☐	Minimum font size of 11 points, minimum ½" margin on all sides
☐	Written in complete, grammatically correct, and spell-checked English
☐	File name: [DistrictUseCaseAbbreviation]_[SchoolShortName]_ExecutiveSummary.PDF

Content Requirements

☐	Title page that includes names of school, team, district use case, and deliverable section. (This page does not count toward the page limit.)
☐	Brief narrative of system design (e.g., locations, rationale, total system size, total production), distribution system voltage impacts, financial information including PPA or lease price with the project IRR and NPV for the systems under PPA or lease, savings for the district, and development considerations (e.g. zoning, permitting, conformity with district master plan)
☐	Summary tables of system sizes, total annual production, and associated PPA, lease, or cash purchase prices (if systems have individual associated prices; if one price for all systems, indicate this)
☐	Summary graphics (e.g., overhead graphic of district-wide solar solution, flow chart depicting team collaboration process, charts from financial analysis)

2.A. Conceptual System Design—Layout and Specifications

Format Requirements

☐	File type: single, bookmarked PDF with all fonts embedded and 300 dpi minimum resolution
☐	Up to 30 pages total; any additional pages submitted are not reviewed
☐	ANSI A (8.5" x 11") paper size must be used
☐	Minimum font size of 11 points, minimum ½" margin on all sides
☐	Written in complete, grammatically correct, and spell-checked English
☐	File name: [DistrictUseCaseAbbreviation]_[SchoolShortName]_ConceptualDesign.PDF

Content Requirements

☐	Heading or title block with names of school, team, district use case, and deliverable section
☐	System design summary of approach and solution (maximum 2 pages)
☐	Listing of equipment selection and specifications (maximum 2 pages)
☐	Site plan(s) showing layout of all proposed installations
☐	Individual system plans showing panels and location of associated equipment
☐	Shading model image for each proposed installation

2.B. Conceptual System Design—Energy Production

Format Requirements

☐	Packaged into a single Excel file, multiple tabs allowed
☐	Include column labels and relevant units
☐	Include all formulas used to calculate results
☐	Explain any macros or associated internal scripts
☐	Indicate where cells are using an input assumption versus a calculated result
☐	Generate natively if possible; exports from other programs should be carefully reviewed
☐	File name: [DistrictUseCaseAbbreviation]_[SchoolShortName]_EnergyProduction.XLSX

Content Requirements

☐	Hourly generation profile for each proposed solar installation over a year
☐	Details of inputs and process used to calculate the hourly generation profile
☐	Source of irradiance model used

3.A. Distribution System Impact Analysis—Approach to Power Flow Model

Format Requirements

☐	File type: single, bookmarked PDF with all fonts embedded and 300 dpi minimum resolution
☐	Up to 10 pages total; any additional pages submitted are not reviewed
☐	ANSI A (8.5" x 11") paper size must be used
☐	Minimum font size of 11 points, minimum ½" margin on all sides
☐	Written in complete, grammatically correct, and spell-checked English
☐	File name: [DistrictUseCaseAbbreviation]_[SchoolShortName]_DistributionApproach.PDF

Content Requirements

☐	Heading or title block with names of school, team, district use case, and deliverable section
☐	Summary of the simulation methodology applied for analyzing the distribution system impact of the PV sizes and interconnection locations
☐	Irradiance profile(s) and load profile characterization
☐	Maximum PV system capacity limit given distribution system constraints and without upgrades
☐	Summary of the impact of PV system interconnection on the distribution system, incorporating voltage/distance plots or voltage and loading heat maps
☐	Summary of factors that impact PV system hosting capacity on the distribution system and the impact of using smart inverter control modes
☐	Summary of systems operation, detailing configurable settings for the PV system, capacitor banks, and voltage regulators used for the simulation study
☐	Summary of the methodology used for any system upgrade detailing any component that was upgraded

3.B. Distribution System Impact Analysis—Power Flow Model

Format Requirements

☐	File type: ZIP archive of OpenDSS files and profiles
☐	File name: [DistrictUseCaseAbbreviation]_[SchoolShortName]_PowerFlowModel.ZIP

Content Requirements

☐	Complete power flow model, demonstrating that network elements satisfy loading and voltage constraints with realistic settings, responses, and dead times
☐	Simulation study carried out for at least one year at minimum 15-minute temporal resolution
☐	All dependencies (e.g., the profiles used to run the time series analysis)

4. Financial Analysis

Format Requirements

☐	Packaged into a single Excel file, multiple tabs allowed
☐	Include column labels and relevant units
☐	Include all formulas used to calculate results
☐	Explain any macros or associated internal scripts
☐	Indicate where cells are using an input assumption versus a calculated result
☐	Generate natively if possible; exports from other programs should be documented. (Links to external spreadsheets are prohibited.)
☐	File name: [DistrictUseCaseAbbreviation]_[SchoolShortName]_Financial.XLSX

Content Requirements

☐	The Excel-based financial model provided in the HeatSpring course materials is *required* for the project financial analysis
☐	Calculate a reasonable project IRR and an investor NPV of $0 given a certain PPA or lease price and other input assumptions

5.A. Development Plan—Building and Site Plan

Format Requirements

☐	File type: single, bookmarked PDF with all fonts embedded and 300 dpi minimum resolution
☐	Up to 7 pages total; any additional pages submitted are not reviewed
☐	ANSI A (8.5" x 11") paper size must be used
☐	Minimum font size of 11 points, minimum ½" margin on all sides
☐	Written in complete, grammatically correct, and spell-checked English
☐	File name: [DistrictUseCaseAbbreviation]_[SchoolShortName]_BuildingSitePlan.PDF

Content Requirements

☐	Heading or title block with names of school, team, district use case, and deliverable section
☐	Identification of applicable land use and zoning ordinances and analysis of compliance
☐	Demonstration of compliance with district use case master plan
☐	Demonstration of compliance with other land-use or building restrictions or regulations

5.B. Development Plan—Construction Plan

Format Requirements

☐	File type: single, bookmarked PDF with all fonts embedded and 300 dpi minimum resolution
☐	Up to 5 pages total; any additional pages submitted are not reviewed
☐	ANSI A (8.5" x 11") paper size must be used
☐	Minimum font size of 11 points, minimum ½" margin on all sides
☐	Written in complete, grammatically correct, and spell-checked English
☐	File name: [DistrictUseCaseAbbreviation]_[SchoolShortName]_ConstructionPlan.PDF

Content Requirements

☐	Heading or title block with names of school, team, district use case, and deliverable section
☐	Identify applicable local permitting and codes
☐	Approach to procure necessary permits and comply with local codes
☐	Proposed timeline for permitting, construction, and interconnection

Appendix D. Final Deliverable Package Requirements

1.A. Project Proposal—Written

Format Requirements

☐	File type: single, bookmarked PDF with all fonts embedded and 300 dpi minimum resolution
☐	Up to 18 pages total; any additional pages submitted are not reviewed
☐	ANSI A (8.5" x 11") paper size must be used
☐	Minimum font size of 11 points, minimum ½" margin on all sides
☐	Written in complete, grammatically correct, and spell-checked English
☐	File name: [DistrictUseCaseAbbreviation]_[SchoolShortName]_ProjectProposal.PDF

Content Requirements

☐	Title page that includes names of school, team, district use case, and deliverable section.
☐	Executive summary of the project including the proposed PV systems, battery system, pricing, and how the proposed solution is uniquely tailored to serve the district's needs, constraints, and goals (1–2 pages)
☐	Introduction of the team, including student team member field of study and work performed on proposal, and advisors, including both faculty and external mentors (1–2 pages)
☐	Project overview with charts, tables, and summary graphics, including narratives describing the following: (up to 12 pages)
	System sizing and design rationale with a table of location, size, and annual production (1–3 pages)
	The solar and storage system's impacts on the local distribution system, and proposed solutions for any forced voltage violations (1–3 pages)
	Proposed PPA, lease, and/or purchase price; price justification; sources for model inputs; expected savings for the district over the contract lifetime; and the economic benefits of the system for investors. This section should also include a summary of the applicable state and local policies and regulations (e.g., net metering, state incentives) and how these have influenced the system economics. (1–3 pages)
	Development plan highlights and how the proposed solar and storage solution conforms to the district master plan (1–3 pages)
☐	Conclusion recapping project pitch and benefits to the district (1 page)

1.B. Project Proposal—Pitch Presentations

Format Requirements

☐	File type: PowerPoint, with all fonts and images embedded without external file references and no embedded video or audio
☐	16:9 aspect ratio
☐	Written in complete, grammatically correct, and spell-checked English
☐	Duration of 15 minutes for division presentation and 8 minutes for pitch presentation
☐	File name: [DistrictUseCaseAbbreviation]_[SchoolShortName]_DivisionPresentation.PPTX
☐	Optional: a second, shorter presentation. File name: [DistrictUseCaseAbbreviation]_[SchoolShortName]_PitchPresentation.PPTX

Content Requirements

☐	Title slide including names of school, team, and district use case.
☐	Summary of team's solar-plus-storage solution, as well as its approach to: • Competition, including team structure and work effort • Solar-plus-storage design • Expected operation • Distribution system risks • Financial performance • Development plans.
☐	Innovation as it relates to: • Analysis methods • Optimized technology selection, system design, and operation • Financial result.
☐	Pitch how this project proposal helps achieve the district goals
☐	Pitch why your team should win

2.A. Conceptual System Design—Layout and Specifications

Format Requirements

☐	File type: single, bookmarked PDF with all fonts embedded and 300 dpi minimum resolution
☐	Up to 40 pages total; any additional pages submitted are not reviewed
☐	ANSI A (8.5" x 11") paper size must be used
☐	Minimum font size of 11 points, minimum ½" margin on all sides
☐	Written in complete, grammatically correct, and spell-checked English
☐	File name: [DistrictUseCaseAbbreviation]_[SchoolShortName]_ConceptualDesign.PDF

Content Requirements

☐	Heading or title block with names of school, team, district use case, and deliverable section
☐	System design approach and description of final solution (maximum 2 pages)
☐	Description of equipment selection and specifications, including total DC size of each system, total project size, and battery details, including process for optimization (maximum 2 pages)
☐	Diagram showing location of all proposed PV and battery systems within the district
☐	Individual PV system plans showing panels and location of associated equipment
☐	One-line diagrams for each system and wiring required between systems
☐	Shading model image for each PV installation

2.B. Conceptual System Design—Energy Production and Battery Cycles

Format Requirements

☐	Packaged into a single Excel file, multiple tabs allowed
☐	Include column labels and relevant units
☐	Include all formulas used to calculate results
☐	Explain any macros or associated internal scripts
☐	Indicate where cells are using an input assumption versus a calculated result
☐	Generate natively if possible; exports from other programs should be carefully reviewed
☐	Proofread document for spelling, grammar, legibility, and formatting
☐	File name: [DistrictUseCaseAbbreviation]_[SchoolShortName]_EnergyProduction.XLSX

Content Requirements

☐	Hourly generation profile for each solar system over a year
☐	Details of inputs and process used to calculate the hourly generation profile
☐	Source of irradiance model used
☐	Inputs for the battery charge/discharge strategy

3.A. Distribution System Impact Analysis—Approach to Power Flow Model

Format Requirements

☐	File type: single, bookmarked PDF with all fonts embedded and 300 dpi minimum resolution
☐	Up to 12 pages total; any additional pages submitted are not reviewed
☐	ANSI A (8.5" x 11") paper size must be used
☐	Minimum font size of 11 points, minimum ½" margin on all sides
☐	Written in complete, grammatically correct, and spell-checked English
☐	File name: [DistrictUseCaseAbbreviation]_[SchoolShortName]_DistributionAnalysis.PDF

Content Requirements

☐	Heading or title block with names of school, team, district use case, and deliverable section
☐	The methodology, assumptions, and results for sizing of PV systems
☐	The impact of PV system interconnection on the distribution system incorporating voltage/distance plots or voltage and loading heat maps
☐	Sensitivity analysis for factors that impact PV system hosting capacity on the distribution system, including use of smart inverter control modes
☐	The methodology and assumptions for sizing and siting battery storage systems, including round-trip efficiency parameters
☐	Battery systems operation mode and settings used for the simulation study
☐	The methodology used for any system upgrade either needed or avoided, detailing any component that was upgraded
☐	If the REopt Lite profile is used, the profile should also be provided

3.B. Distribution System Impact Analysis—Power Flow Model

Format Requirements

☐	File types: ZIP archive of OpenDSS files and profiles, or other model inputs and outputs.
☐	File name: [DistrictUseCaseAbbreviation]_[SchoolShortName]_DistributionModel.ZIP

Content Requirements

☐	Complete power flow model, demonstrating network elements satisfy loading and voltage constraints with realistic settings, responses, and dead times
☐	Simulation study carried out for at least one year at minimum 15-minute temporal resolution
☐	All dependencies (e.g., the profiles used to run the time series analysis)

4. Financial Analysis—Financial Model

Format Requirements

☐	Excel file with multiple tabs or multiple Excel files
☐	Include column labels and relevant units
☐	Include all formulas used to calculate results
☐	Explain any macros or associated internal scripts
☐	Indicate where cells are using an input assumption versus a calculated result
☐	Generate natively if possible; exports from other programs should be documented. (Links to external spreadsheets are prohibited.)
☐	File name: [DistrictUseCaseAbbreviation]_[SchoolShortName]_FinancialModel.XLSX

Content Requirements

☐	The Excel-based financial model provided in the HeatSpring course materials is *required* for the solar portion of the project financial analysis. This model allows for calculations of both investor economics and savings to the district. For the solar-plus-storage analysis, student teams may use SAM or REopt Lite or another tool of their choice. The relevant outputs of this analysis—e.g., summary of inputs and outputs, cash flows, charts, and others—can be pasted in a tab or multiple tabs in the HeatSpring model Excel spreadsheet, or documented in a separate spreadsheet
☐	Calculate a reasonable project IRR and an investor NPV of $0 given a certain PPA or lease price and other input assumptions
☐	Possible purchase-option to the district (depending on instructions in use case profile)
☐	Customer savings analysis included as a separate tab in the HeatSpring model or as a separate spreadsheet. This analysis should calculate annual cash flows for system offtaker (i.e., the district) and provide an NPV of savings over the contractual (if PPA or lease) or useful (if cash purchase) life of the system. Customer savings analyses inputs include the district's utility rate, their annual kWh consumption, the price of solar energy, and others.

5.A. Development Plan—Building and Site Plans

Format Requirements

☐	File type: single, bookmarked PDF with all fonts embedded and 300 dpi minimum resolution
☐	Up to 15 pages total; any additional pages submitted are not reviewed
☐	ANSI A (8.5" x 11") paper size must be used
☐	Minimum font size of 11 points, minimum ½" margin on all sides
☐	Written in complete, grammatically correct, and spell-checked English
☐	File name: [DistrictUseCaseAbbreviation]_[SchoolShortName]_BuildingSitePlan.PDF

Content Requirements

☐	Heading or title block with names of school, team, district use case, and deliverable section
☐	Identification of applicable land use and zoning ordinances, analysis of compliance, and any proposed rezoning
☐	Analysis of aesthetic appearance in surrounding viewshed
☐	Demonstration of compliance with or fulfillment of district master plan
☐	Demonstration of compliance with other land use or building restrictions or regulations
☐	Annotated list of references or citations

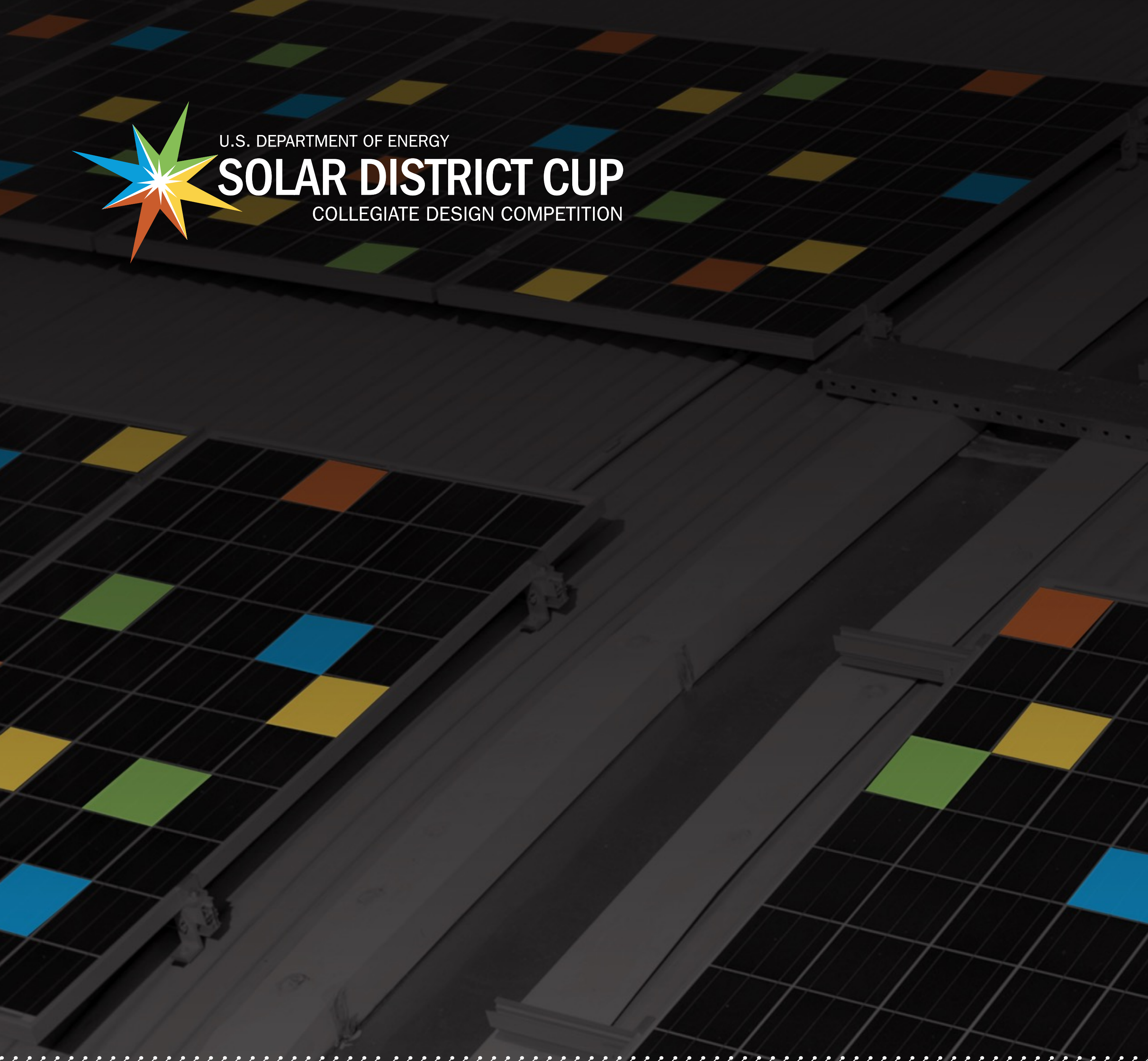
5.B. Development Plan—Construction Plan

Format Requirements

☐	File type: single, bookmarked PDF with all fonts embedded and 300 dpi minimum resolution
☐	Up to 10 pages total; any additional pages submitted are not reviewed
☐	ANSI A (8.5" x 11") paper size must be used
☐	Minimum font size of 11 points, minimum ½" margin on all sides
☐	Written in complete, grammatically correct, and spell-checked English
☐	File name: [DistrictUseCaseAbbreviation]_[SchoolShortName]_ConstructionPlan.PDF

Content Requirements

☐	Heading or title block with names of school, team, district use case, and deliverable section
☐	Identify applicable local permitting and codes
☐	Approach to procure necessary permits and comply with local codes
☐	Proposed timeline for permitting, construction, and interconnection
☐	Construction staging approach
☐	Identification of risks to successful project development and deployment
☐	Strategy to engage community members and achieve buy-in for project
☐	Annotated list of references or citations



U.S. DEPARTMENT OF ENERGY

SOLAR DISTRICT CUP

COLLEGIATE DESIGN COMPETITION

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