



Incentivizing and Supporting Early-Stage Solar Innovation in the United States

Sarah Gomach, Debbie Brodt-Giles, Rebecca Bennett, Alec Schulberg, Noah Kobayashi, Jackie Petre, and Paige Skur

National Renewable Energy Laboratory

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List of Acronyms

DOE	U.S. Department of Energy
JEDI	Justice, Equity, Diversity, and Inclusion
NREL	National Renewable Energy Laboratory
PV	Photovoltaic
SBIR	Small Business Innovation Research
SETO	Solar Energy Technologies Office
TAR	Technical Assistance Request

Executive Summary

In 2018, the U.S. Department of Energy’s Solar Energy Technologies Office and the National Renewable Energy Laboratory set out to develop a repeatable, predictable prize model (the American-Made Challenges) and an entrepreneurial innovation network (the American-Made Network) to support participants along their innovation journeys. This began with the launch of the Solar Prize. Five years and six rounds later, the Solar Prize is the longest-standing competition of the American-Made Challenges. It has awarded \$20.1 million in cash prizes and \$5.5 million in technical support vouchers to 140 teams across all aspects of the solar industry. By sharing the outputs of the prize, the Prize Administrators hope that our lessons learned will help continue to build the clean tech entrepreneurship support ecosystem.

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1 The American-Made Solar Prize

1.1 Background

The American-Made Solar Prize began in 2018 as an opportunity to revitalize American innovation in solar manufacturing in response to the Section 201 tariffs placed on imported solar cells and modules. It responded to Office of Management and Budget guidance M-17-30 around American energy dominance, stating, “development of domestic energy sources should be the basis for a clean energy portfolio composed of fossil, nuclear, and renewable energy sources. Agencies should invest in early stage, innovative technologies that show promise in harnessing American energy resources safely and efficiently. As initiated in the FY2018 budget, federally funded energy R&D [research and development] should continue to reflect an increased reliance on the private sector to fund later-stage research, development, and commercialization of energy technologies.”

The Solar Prize was developed as an open prize competition that inspires entrepreneurial teams to compete, through a series of progressive contests. Open prize competitions are a common tool used in both the public and private sector to solicit new ideas from the public and incentivize solutions toward a proposed challenge, problem, or opportunity. The Solar Prize specifically provides competing teams the opportunity to build and develop (i) new ideas, productions, and solutions that will lead to the creation of new domestic businesses and jobs; (ii) innovative solar solutions and products; (iii) improved manufacturing processes; and (iv) public-private partnerships to accelerate innovation.

The prize utilized the America COMPETES Reauthorization Act of 2010, which amends Section 105 of the Stevenson-Wydler Technology Innovation Act of 1980 by adding Section 24 – Prize Competitions. This new section specifically states, “Each head of an agency, or the heads of multiple agencies in cooperation, may carry out a program to award prizes competitively to stimulate innovation that has the potential to advance the mission of the respective agency.”

1.2 The Prize Mechanism

Prizes are one of several funding mechanisms available to the U.S. Department of Energy (DOE). When designed correctly, prizes offer DOE many benefits and complement other funding mechanisms. In its simplest form, a prize is an award—typically financial—for achieving an objective set by DOE. Funding is given for work already performed (versus other mechanisms where funding is provided for proposed work after it is invoiced and approved for reimbursement). There is no contract or obligations for the winner of a prize, and they can use the funding however they see fit.

Typically, in the prize process, DOE identifies a goal that they want innovators to achieve or a topic area in which they want to incentivize innovation. Working in conjunction with the National Renewable Energy Laboratory (NREL), DOE launches the prize, and innovators work toward the stated goal. At the conclusion of each prize time frame, innovators submit a package detailing the work they completed. With insights from industry experts, DOE reviews all submission packages and makes awards to the winning innovators.

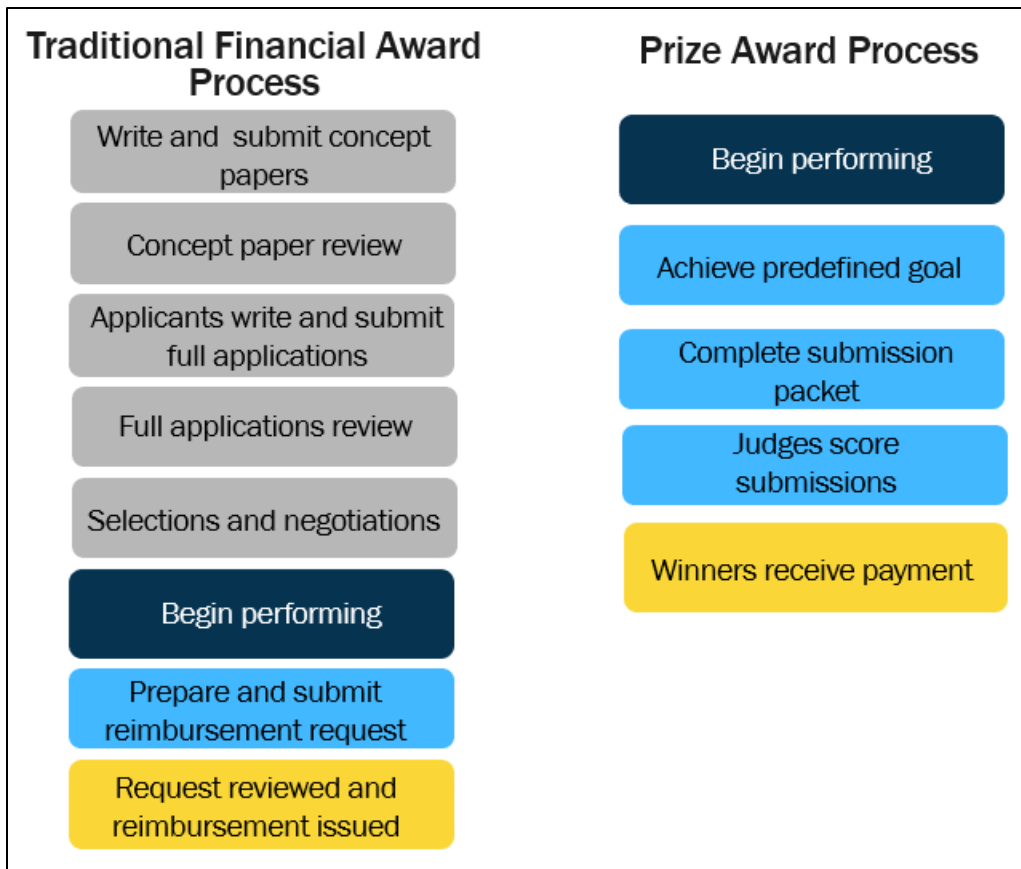


Figure 1. Traditional financial award process versus a prize award process

Prizes offer several benefits to DOE, compared to other funding mechanisms:

Reduces risk. Prizes allow DOE to establish ambitious goals without having to predict which team or approach is most likely to succeed. Instead of funding a plan, like many grants do, prizes fund work that has already been completed. This means that DOE sees results before paying for them. The Solar Prize has a tiered structure, which means that the amount of funding going to a single team in the first phase is relatively low. This gives DOE more latitude to fund new and innovative ideas. Additional Solar Prize phases offer higher funding amounts and the prospect of national laboratory vouchers, enabling DOE to further incentivize high-impact innovations.

Strengthens pipeline. Prizes can reach a new community of stakeholders and partners that have not previously applied for DOE funding, or perhaps have not previously worked in a renewable-energy-related field. Since the Prize Administrators began tracking voluntary applicant data in Round 5, 46% of Solar Prize applicants self-reported that they had not applied to DOE funding in the past. Prizes, by design, typically have fewer and simpler application requirements, reducing some of the barriers that new applicants experience when trying to apply for other DOE funding. DOE offices can use prizes as a feeder into their more established funding programs. Often, the prizes help innovators go from idea to prototype. After seeing this proven, prize teams are in a stronger position to apply for and have success with funding opportunity announcements,

Small Business Innovation Research (SBIR) programs, and other opportunities. From 2020 to 2023, 14 Solar Prize teams went on to receive 18 different SBIR awards.¹

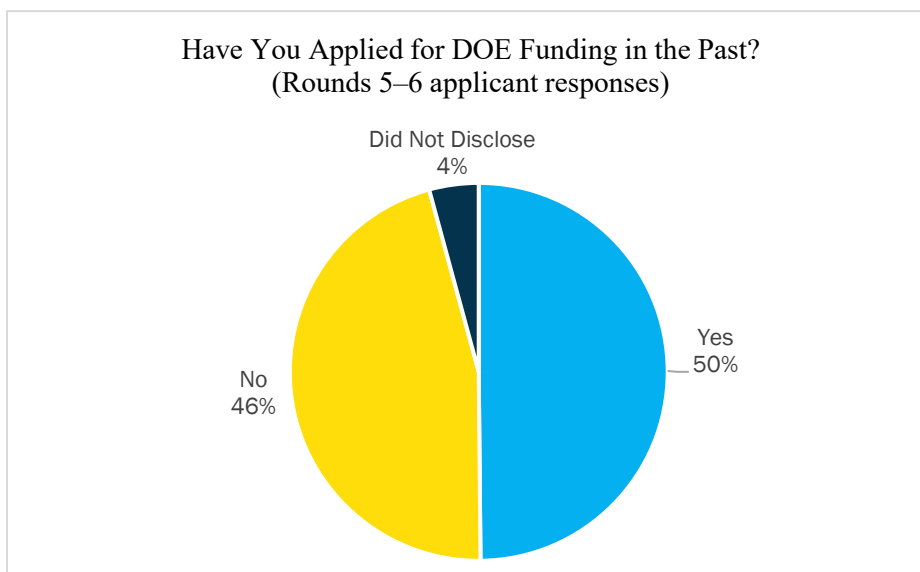


Figure 2. Percent of Solar Prize Rounds 5–6 applicants that have applied to other DOE funding

The Prize Administrators also recognize that prizes have their limitations. Prizes work best when speed and flexibility are prioritized above control and contracts. If a prize is designed correctly, competitors are incentivized to keep working toward the set milestones. However, they are not obligated to do so. Once competitors receive prize funds, they have no further obligations related to how to spend the funds or any reporting. Sometimes, this structure is challenging for prize organizers and funders, particularly for those who want to know what progress teams are making and how funds are being spent. Prizes work best with a balanced approach: Structures should be put in place to support teams, but prize organizers should also trust the prize process to deliver results. Prizes work best when:

The rules are simple. Prizes are often used as a more accessible first entry point to DOE funding. The submission requirements in each phase should match that intention, and the quantity of information should be scaled to the amount of funding awarded.

¹ Solar Prize teams as SBIR awardees: 2020: BREK Electronics; 2021: Phase3 Photovoltaics, Asoleyo, Resilient Power Systems, Solar SEED, Taka Solar, TrackerSled; 2022: BREK Electronics, Resilient Power Systems, GismoPower, NanoSpray, Smartville, VesprSolar; 2023: GismoPower, Smartville, HelioVolta, Portable Solar, RCAM Technologies.

They target a phased approach. Our most successful prizes have several phases—the Solar Prize, for example, has three phases. Milestones and deliverables set forth in the initial phases are easier to achieve than later milestones, allowing the prize to keep the barrier to entry low while incentivizing teams to make significant progress over time.

Awards are right-sized to the effort. With too little funding, competitors may not be willing or able to work at-risk to advance their ideas as they are not guaranteed funding after submitting an application. On the other hand, prizes that offer too much funding can result in prize selection officials struggling to select winners, because the funding amount is too high and high-risk to justify distributing to early-stage applicants.

They have deadlines. Our most successful prizes have concrete phase deadlines. Prizes are also used to incentivize quick progress. Phases should be long enough that teams can be successful, but short enough that they encourage rapid development.

Effort is put into recruitment in the first phase. Reaching the right prospective competitors and empowering them to apply in the first phase of the prize is critical to the overall success of a prize. Creating and sharing educational materials that empower potential competitors to apply is critical.

Competitor support is provided. The best prizes have aggressive but achievable deadlines. To achieve the goals within this timeline, competitors need assistance. The Prize Administrators think strategically about the competitors, what assistance they are going to need, and where they will be able to find it. This often involves bringing in external partners who have expertise in the areas in which teams need support.

1.3 The Solar Prize Structure

These considerations for prize design form the foundation for the Solar Prize, which is structured in three progressive phases: Ready!, Set!, and Go!. The Ready! Contest is open to any individual, organization, team, or business in the United States that meets the eligibility requirements.

Ready! Contest – Competitors demonstrate that they have identified and taken action toward developing an impactful idea or solution that addresses a critical need in the solar industry. They also propose a path to develop a proof of concept. Up to 20 teams receive \$50,000 in cash and are eligible to move on to the next phase of the prize.

In the Ready! Contest, competitors must develop a credible solution concept to a real-world problem facing the solar industry and perform substantive due diligence to gather feedback and validate that the proposed solution addresses a real problem and is technically feasible. They are also evaluated on their team’s capabilities and commitment to working on their proposed

“The American-Made Solar [Prize] helped us **accelerate our time** to launch from 3 years to a little over a year and a half. The structure of the program made us **focus on both the product’s development and business plan** at the same time, forcing us to move quickly to compete with the other amazing contestants. In addition, due to the **non-diluting investment**, we will be able to retain ownership of the company, which will help us stay on mission and will contribute significantly to our success. Truly, **there is no downside** to the American-Made Solar Prize, and I recommend it to any budding solar startup with a great idea.”

—Solar Prize Round 5 Competitor

solution. At this stage, the work teams are awarded for is developing the plan and building a team to accomplish the goals proposed.

Set! Contest – The 20 semifinalists work to advance their ideas to proof of concept. They must show that their proof of concept solves an important problem in the solar industry and that it will have significant demand when it enters the market. Up to 10 teams each receive \$100,000 in cash and \$75,000 in technical assistance vouchers and are eligible to move on to the final phase of the prize. To be eligible to win the Set! Contest, a team must be a for-profit entity.

During the Set! Contest, teams’ proofs of concept must demonstrate critical solution functionality. Additionally, teams must perform a rigorous customer discovery process to uncover key insights from the eventual customers or end users of the product.

Go! Contest – The 10 finalists advance their solutions from proof of concept to a refined prototype/product. Additionally, finalists must find a committed partnership that demonstrates the commercial viability of their innovation. This partnership could be a committed pilot partner or secured, credible customers, as evidenced by a legally binding agreement to conduct a pilot test or payment receipts. A Round 2 finalist team told us, “The pilot requirement was the most important part of the whole program. We have a lot more potential orders that we would not have found otherwise.” Two grand prize winners each receive a \$500,000 cash prize and an additional \$75,000 in technical assistance vouchers.

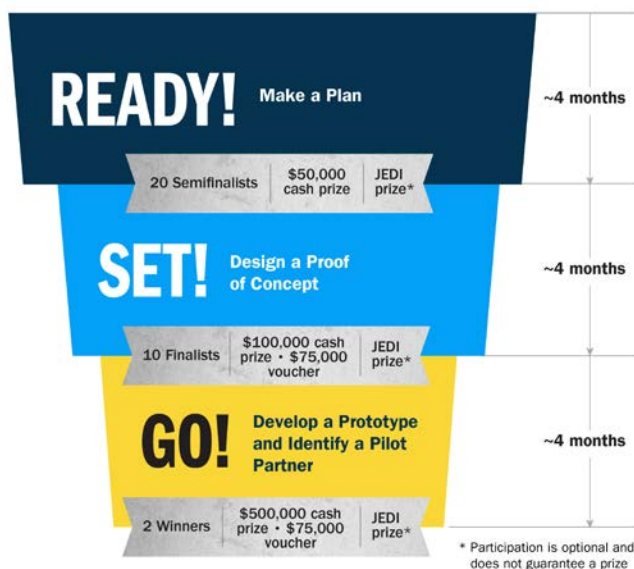


Figure 3. The Solar Prize contests

By design, the phases and milestones of the Solar Prize logically align with the steps a startup would naturally take to pilot and commercialize their technology. Instead of distracting lean startup companies, the prize gives startups a goal that their entire company can rally behind and work toward. The prize phases are also designed to be fast, which accelerates research and development cycles. One Round 2 competitor told us, “While I was in the competition, I was constantly thinking this was not enough time to do what needs to be done. But it was good to have that push and deadline hanging over me. And in hindsight, it was the right amount of time.”

Furthermore, the timeline for the prize is ambitious and asks teams to push themselves in terms of what they can accomplish. Specifically, the requirement for a committed pilot partner at the end of the competition has forced competitors to identify partners earlier than they may have done otherwise. The prize program and this requirement give competitors a framework for partnership conversations that can lead to commitment from pilot partners.

The Solar Prize also has two “Demo Days” as a part of the phase down-selection process—one at the end of the Set! Contest, and one at the end of the Go! Contest. The Set! Contest Demo Day, which occurs virtually, provides an opportunity for the expert reviewer panel to ask clarifying questions after reviewing teams’ submission packages. Go! Demo Day is held in conjunction with a large industry conference, where teams have the opportunity to pitch to a public audience that includes their competition peers, DOE, industry professionals, and others. Even finalist teams that do not win the Go! Contest find this opportunity for public exposure to be a valuable part of participating in the program.

1.4 Iterations Through the Rounds

As the Prize Administrators have learned and gathered feedback from teams, improvements were made to the prize and support structures to best support solar entrepreneurs. Every round has brought incremental changes that lead toward a more impactful program.

In Round 1, all Ready! Contest winners could compete in both the Set! And Go! Contests, even if they did not win the Set! Contest. In Round 2, eligibility was limited for the Go! Contest to only the down-selected finalists. The Prize Administrators found that teams that were awarded after Set! were more motivated by the prize’s timeline and could make more progress with the prize funds and technical support, putting them further ahead of teams that did not receive additional funding at this point. Early rounds of the prize also offered a separate public forum where potential competitors could share ideas and gather feedback ahead of the submission deadline. This was removed in later rounds to reduce confusion and concerns over people “stealing” ideas. During COVID-19, the prize administration team lengthened phase durations to allow competitors time to overcome supply chain and remote working barriers.

In Round 5, two tracks were introduced to the Solar Prize: Hardware and Software. Previously, the Solar Prize required all selected teams to have a hardware component to their solution, as there was a focus on domestic manufacturing. Some software solutions were funded, but they had to be accompanied by a physical device. In Round 5, SETO decided to loosen the submission requirements around this to support software solutions. Working under the assumption that software solutions did not need as much upfront capital investment to go from idea to minimum viable product to functioning platform, the Software Track awarded software teams smaller amounts at each phase of the prize. The two-track format allowed SETO to award more teams with more funding, and reviewers could evaluate software and hardware technologies separately. Although opening the competition to software solutions was beneficial, the Prize Administrators learned that the two-track system was ultimately more time- and resource-intensive than the single-track model. In Round 6, Solar Prize returned to the single-track format, but continued to accept both hardware and software solutions.

With the Round 5 Software Track, the Justice, Equity, Diversity, and Inclusion (JEDI) Contest was introduced, which encouraged competitors to consider and incorporate JEDI principles into

their solutions. While any software submission was eligible for the base prize, solutions that specifically addressed solar market barriers faced by underserved communities could win additional prize money on top of the base prize. This was only available to Software Track competitors in Round 5 but is now part of the single-track Solar Prize model, meaning that anyone who applies to the prize is eligible to win additional funding for solutions that address JEDI principles.

1.5 Funded Teams

Through six rounds, the Solar Prize has provided \$20.1 million in cash prizes and \$5.5 million in technical support vouchers to 140 teams across all aspects of the solar industry.

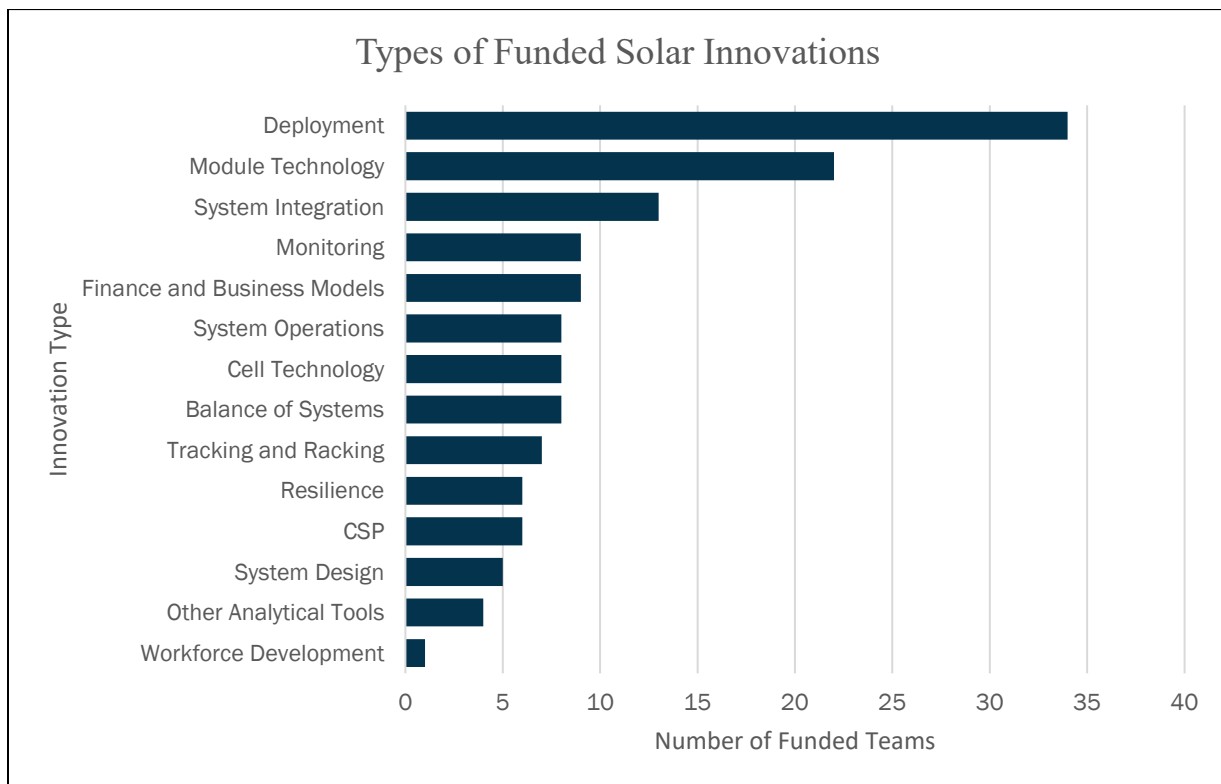


Figure 4. Funded Solar Prize teams

In the Ready! Contest, individuals, private entities (for-profits and nonprofits), nonfederal government entities, and academic institutions are eligible to compete. However, to win the Set! Contest, teams must be a for-profit entity. This means that teams that did not compete as a for-profit entity in the Ready! Contest must incorporate or find a for-profit partner during the Set! Contest. This balances the Solar Prize’s goal of soliciting ideas from as wide of an audience as possible with the ultimate aim of growing the commercial U.S. solar industry. Of the 140 semifinalists, 16 were individuals and 8 were academic institutions. Competing in the Set! Contest required these 24 teams to incorporate, driving an increase in the number of small businesses working in the solar industry.

Although Solar Prize received submissions from all fifty states, Washington D.C., and Puerto Rico, there are larger clusters of semifinalists in areas with strong local support networks for

start-ups and strong solar utilization. There are also clusters of semifinalists around some of the stronger network nodes as well.

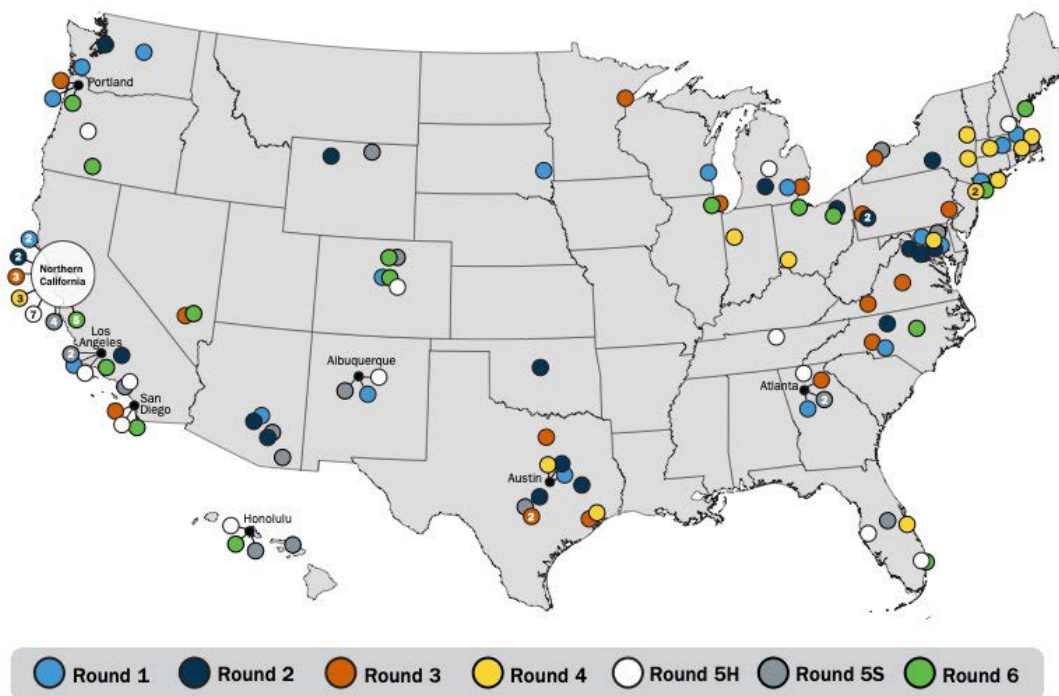


Figure 5. Geographic distribution of funded Solar Prize teams

1.5.1 Go! Contest Grand Prize Winners

Over six rounds of the prize, 15 teams have become Go! Contest winners. In rounds 1 through 4, two teams were each selected as winners. In Round 5, two teams were selected for each track (Hardware and Software) with one additional team winning the JEDI Contest. In Round 6, two Go! winners were selected, with one of the winners also winning the JEDI Contest.

Round 1

Breakthrough Photovoltaic (PV) Cell & Module Architecture, *Solar Inventions*

This team created a new PV cell design that can help produce a more stable and reliable solar module. This team effectively divided the cell into multiple sections without physically breaking it. This prevents hot spots and improves efficiency and safety.

Factory Installed Solar for Manufactured Homes, *Phase3 Photovoltaics*

This team developed a solution that integrates solar into factory-built homes. By incorporating solar cells in the manufacturing process, they are able to provide their solar home solution at a substantially lower cost per watt compared to traditional installation.

Round 2

Back-Contacted Silicon Modules at the Cost of PERC,² *SunFlex Solar*

This team is replacing the high-cost copper backsheets on standard back-contacted silicon solar cells with aluminum, which costs less. They will use a high-speed laser to weld the aluminum backsheet to the silicon wafer. The team has secured a path to manufacturing this technology domestically to produce high-efficiency, cost-competitive solar modules.

>15-kV Power Router (SST)³ DC Coupled Solar + Storage, *Resilient Power Systems*

This team developed a hybrid inverter that enables interconnection between solar, storage, and other energy resources using a novel wide-bandgap technology platform. Their power router enables direct connection of these resources to the medium-voltage distribution grid, integrating transformers and inverters into a single unit. The integrated design provides a clear pathway for domestic manufacturing.

Round 3

Evergrid: Keep Solar Power Flowing When the Grid is Down, *Maxout Renewables*

This team developed the Evergrid, an appliance powered by a flywheel that can turn a residential solar installation into a microgrid that keeps delivering power during a grid outage while the sun is shining. The Evergrid also stabilizes the home microgrid by providing power balancing capacity when appliances like refrigerators cycle on and off.

Wattch – The OS for Modern Energy Companies, *Wattch*

This team developed cost-effective hardware and combined it with secure, scalable software to make a solar monitoring platform to help commercial and industrial PV plants increase operational efficiency. The platform can provide predictive maintenance schedules to decrease downtime, and it has a universal dashboard that lets PV fleet owners and operators observe the performance of all their systems, improve remote and automated diagnostics, and better model a plant's lifetime energy yield.

Round 4

Aerogel Insulated Solar Collector for Process Heat, *AeroShield Materials*

This team developed a flat-plate solar-thermal energy collector system that operates at more than 120°C with efficiencies greater than 45%. Transparent aerogel insulation enables this performance, minimizes heat loss, allows for simpler receiver design, and reduces cost. Aerogel lets light pass through but doesn't let heat escape.

Roofing for the Sol, *the r&d lab*

This team designed a metal residential roofing product to make solar roofs more aesthetically pleasing. It will match the color of the roof to the solar panels, increase the speed of installation, and match the lifespans of the solar and roof components. This innovation has the potential to increase solar adoption among consumers.

² PERC = passivated emitter and rear contact

³ SST = solid-state transformer

Round 5 Hardware

Solvair SR, The All-in-One Residential Solar Panel, *TECSI Solar Inc.*

This team developed a residential solar module that simplifies the ordering and installation process by combining the racking, flashing, hardware, and power electronics into a single product. TECSI's all-in-one solar module eliminates the aluminum frame, reducing the greenhouse gas emissions of the installation.

Roll-Formed Steel Frames for PV Modules, *Origami Solar*

This team developed steel PV module frames leveraging U.S.-made and formed steel. Compared to current frames made from imported aluminum, these frames lower the carbon emissions associated with making the frames and reduce PV system costs while also supporting a U.S.-based supply chain.

Round 5 Software

Elevated Asset Care, *SolarGrade*

This team built a management platform to facilitate the inspection, operations, and maintenance of PV systems, leveraging field technician inputs and data analytics.

Illuminate Field Work for Distributed Solar, *illu*

This team built a mobile and desktop tool for operations and maintenance workflow management that will assist field technicians and simplify distributed solar maintenance.

Voluntary Carbon Reduction Through Rooftop Solar, *Midday Tech*

This team, which won the JEDI Contest, built a platform to connect consumers who purchase voluntary carbon offsets with high-impact rooftop solar projects in underserved communities.

Round 6

From Hazardous Waste to Solar Storage, *ReJoule*

This team, which won the JEDI Contest, developed a fast, new method for testing the health of decommissioned electric vehicle batteries and using these batteries to develop an integrated solution for storing solar power and dispatching it at peak hours. This allows for fast screening of used batteries and certification for use in grid-scale storage of solar energy.

Grid-Flexible Solar Control Software, *Latimer Controls*

This team developed an intelligent control software that enables utility-scale PV to provide power reliably and on demand. This will replace grid reliance on fossil fuels, drive higher profitability for PV operators, and generate revenue increases for solar asset owners with low capital cost.

1.6 Long-Term Tracking

The Solar Prize alone is not intended to provide sufficient financial resources for teams to commercialize their technology. Rather, it incentivizes innovators to take the next step with their technology. In some cases, this could be providing a garage entrepreneur their first funding to move an idea past the hobby stage. For others, it could be the funding needed to cross a commercialization “valley of death.” The Solar Prize is intended to give the funding and support

needed to jumpstart and accelerate technology development in the hope that teams will continue to find the resources and partnerships they need after the prize concludes.

1.6.1 Self-Reported Long Term Tracking

The Prize Administrators have started to follow up annually with Solar Prize teams to track their progress in bringing their innovations to market. In our most recent follow-up, 73 of 120 semifinalists from Rounds 1–5 responded with updates. Of those 73 teams, 70 are still actively working on their Solar Prize innovations. Before competing in the Solar Prize, 34 of the teams reported that they had raised funds totaling \$32.1 million for their innovations. During and after the Solar Prize, 35 teams reported raising additional funds; after competing in the Solar Prize, these funds totaled \$64.3 million. Thirteen of these 35 teams had not previously raised any money.

Table 1. Funds Raised by Solar Prize Teams

When	Total \$	# Teams	Range per Team	Median per Team
Before	\$32.1M	34	\$1K–\$7M	\$50K
During & After	\$64.3M	35	\$20K–\$10.9M	\$200K
Total	\$96.5M	51	\$1K–\$10.9M	\$505K

Funding raised came from multiple sources, including Seed/Series A, other federal grants, state grants, venture debt, other grants and competitions, and friends and family.

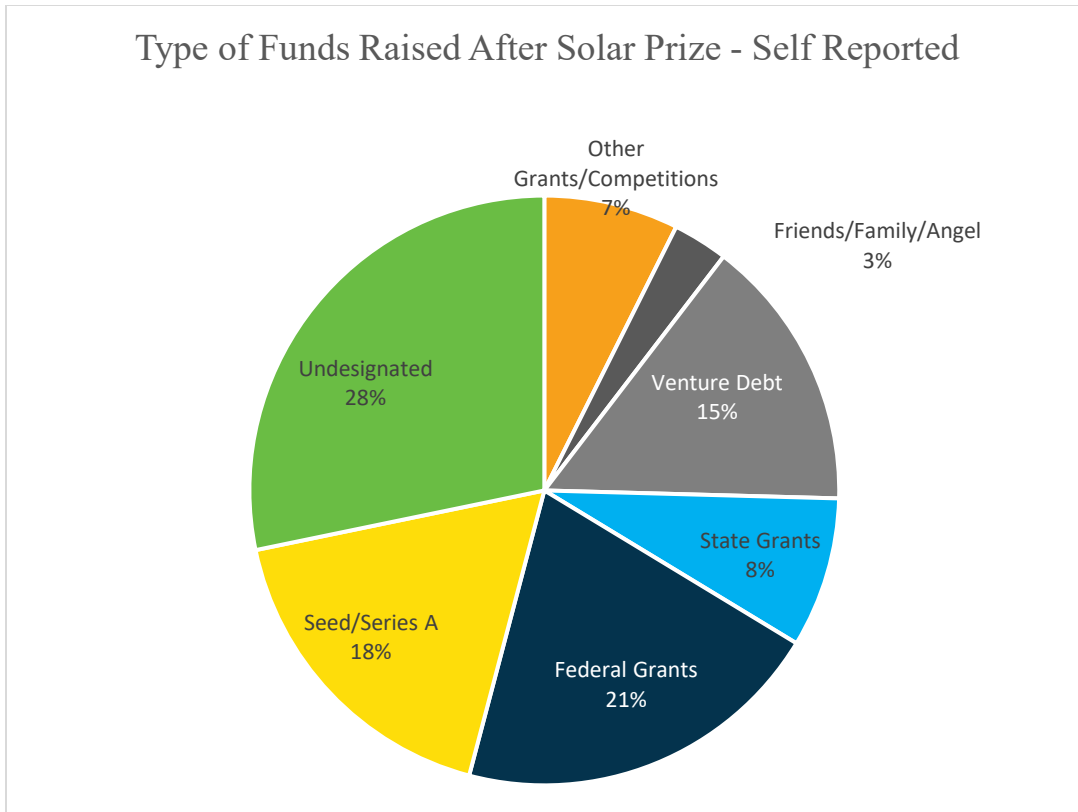


Figure 6. Types of funds raised during and after the Solar Prize – Self Reported

Additionally, 17 teams have secured revenue from bringing their Solar Prize innovations to market, totaling \$5.9M. These 17 teams represent rounds 1 through 5 of the Solar Prize. Annual revenue per company ranges from \$7,000 to \$2,500,000, with a median revenue of \$100,000.

NREL’s long-term tracking also looks into the growth of Solar Prize teams. Before competing in the Solar Prize, teams reported a total employee count of 171.5. After competing, these teams reported adding a total of 91.5 employees, resulting in a grand total of 263 employees. Of these 263 employees, 58.5 identify as women and an additional 99 self-identify as representing a diverse group.

Along with tracking the teams’ progress in terms of funding amounts, funding types, revenue, and employee growth related to their Solar Prize innovation, the Prize Administrators also aim to understand the partnerships that Solar Prize contestants develop, both inside and outside of the American-Made Network. Among the 55 teams who provided their partnership information, there were nearly 200 active partnerships, with an average of 3.5 organizations partnering with each team.

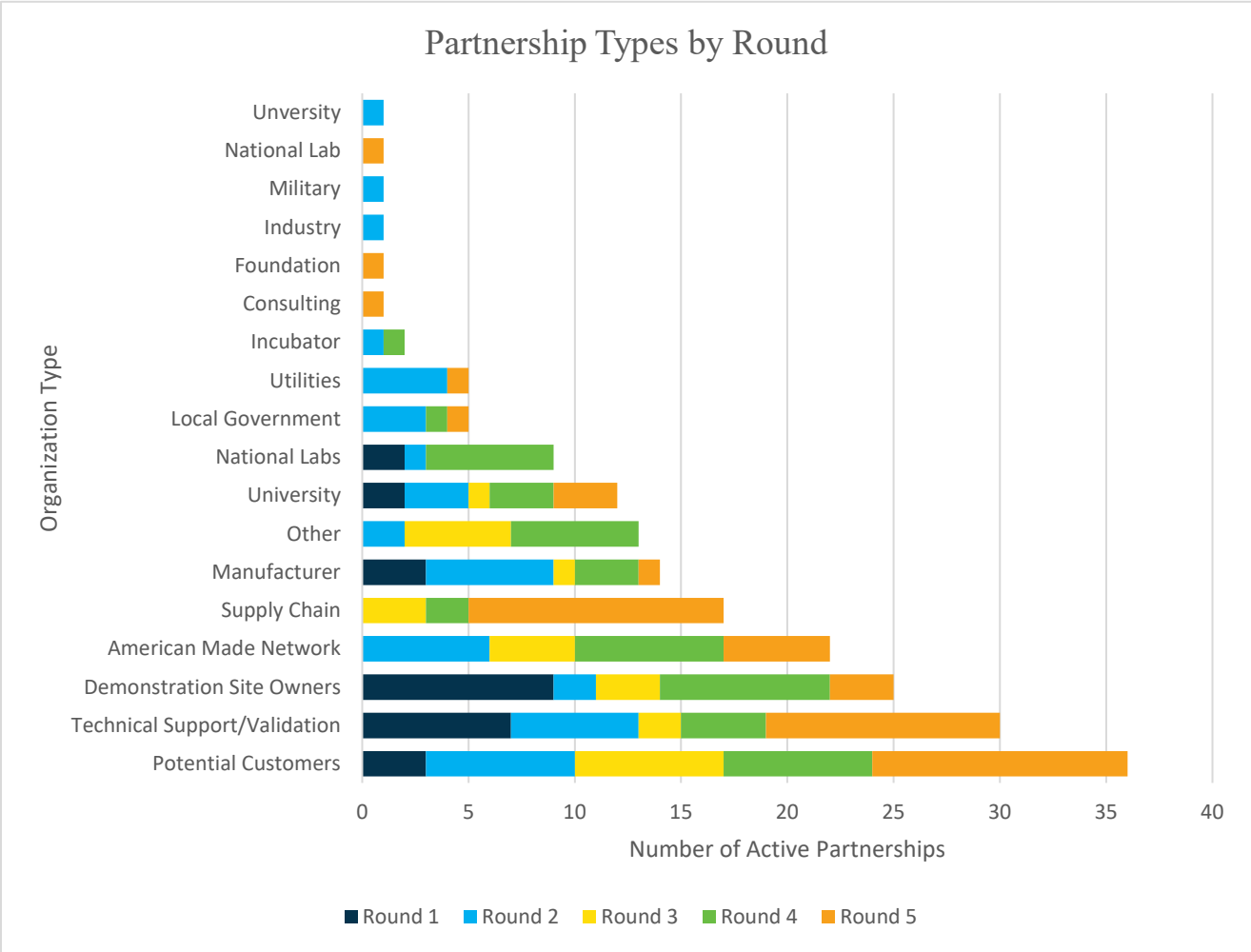


Figure 7. Solar Prize active partnerships after competing in the prize

1.6.2 Public Database Tracking

A second way the Prize Administrators track the long-term progress of past Solar Prize teams is through publicly available data on company size and funding raised. the Prize Administrators matched 37 companies in an online database to Solar Prize teams across the six rounds.

Table 2. Companies Identified in Public Database

Solar Prize Round	# Companies Identified
Round 1	5
Round 2	8
Round 3	3
Round 4	9
Round 5 Hardware	6
Round 5 Software	2
Round 6	4

Collectively, these teams won \$5.74 million in cash awards through the Solar Prize. Prior to competing in Solar Prize, 33 of these companies had raised \$177 million in funding. However, through this dataset, the Prize Administrators are unable to determine whether or not those funds were raised specifically for a team’s Solar Prize innovation. After competing in Solar Prize, 25 of these teams went on to raise an additional \$130 million in funding for their companies. The largest amount raised for a single company was \$31.5 million, the smallest was \$80,000, and there was a mean additional funding raise of \$1.5 million. This funding was combination of Seed Round/Series A raises, Later stage venture capital, grants, angel investment, incubator and accelerator funding, and crowdfunded equity.

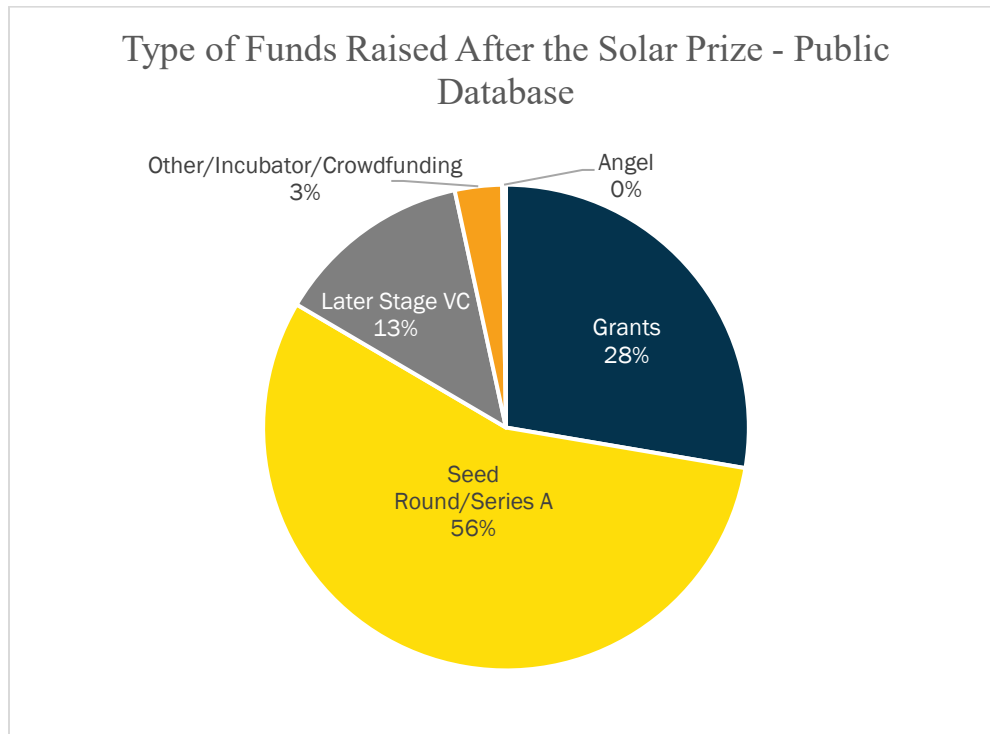


Figure 8. Types of funds raised during and after the Solar Prize – Public Database

Looking across the two data collection methods – self reporting and public database – and removing duplicate entries, 49 teams that competed in Solar Prize have gone onto raise at least \$169 million in additional funding.

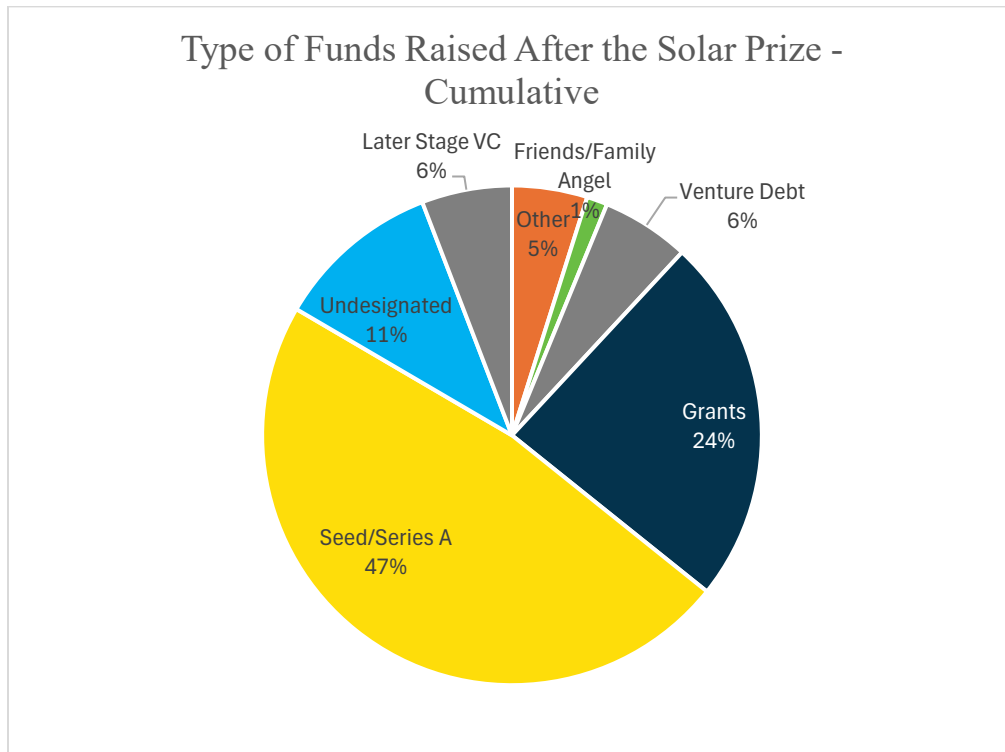


Figure 9. Types of funds raised during and after the Solar Prize - Cumulative

The goals of the Solar Prize extend far beyond the results of the 1-year, three-phase prize. Ultimately, the Prize Administrators hope that the program makes it faster and easier for our nation to accelerate innovative research ideas to the benefit of U.S. solar competitiveness. Although the Prize Administrators cannot directly correlate teams’ future progress to their participation in the Solar Prize, the Prize Administrators can track their progress over time to see if the teams supported through this program are indeed continuing on a trajectory to have an impact on the industry. Teams from Round 1 of the Solar Prize completed the program 5 years ago, whereas teams from Round 5 completed the program only 1 year ago. To provide a greater picture of the Solar Prize’s impact, the Prize Administrators intend to continue to track the teams and their progress over time.

2 Support for Solar Entrepreneurs

2.1 The American-Made Network

The success of the Solar Prize relies on a two-part system—the prize mechanism and the support network. The American-Made Network has been a critical part of the program design from the beginning. While cash is critical to entrepreneurs’ success, so is access to mentors, potential customers and partners, testing facilities, and other assistance. The American-Made Network provides this support in three different ways. First, the Network is open to any organization across the United States that has the skills, expertise, and interest to support innovators in the clean energy transition. Over the past 5 years, more than 400 organizations have joined the Network in this capacity. The second piece of the Network is a subset of these organizations called Power Connectors. Power Connectors receive a contract directly from NREL to provide tailored support to the prize program and competitors. In the case of the Solar Prize, this tailored support is provided via outreach and recruitment efforts during the Ready! Contest, support and mentoring for the teams during the Set! and Go! Contests, and event assistance. Finally, the Network includes access to DOE’s 17 national laboratories, which teams can engage with through the technical support vouchers offered as a part of the Set! and Go! Contest prizes.

2.2 Network Utilization during the Ready! Contest

In every round, Network members help promote the prize to their networks and help potential competitors vet their ideas and prepare their submissions. As the Network grows, there are more Network members assisting competitors in the first phase of the competition.

The following chart shows the number of Network members that assisted teams during the Ready! Contest in each round. Many Network members support multiple teams. In Round 7, for example, 46 different Network members were listed on 69 submissions. One Network member assisted 33 different teams.

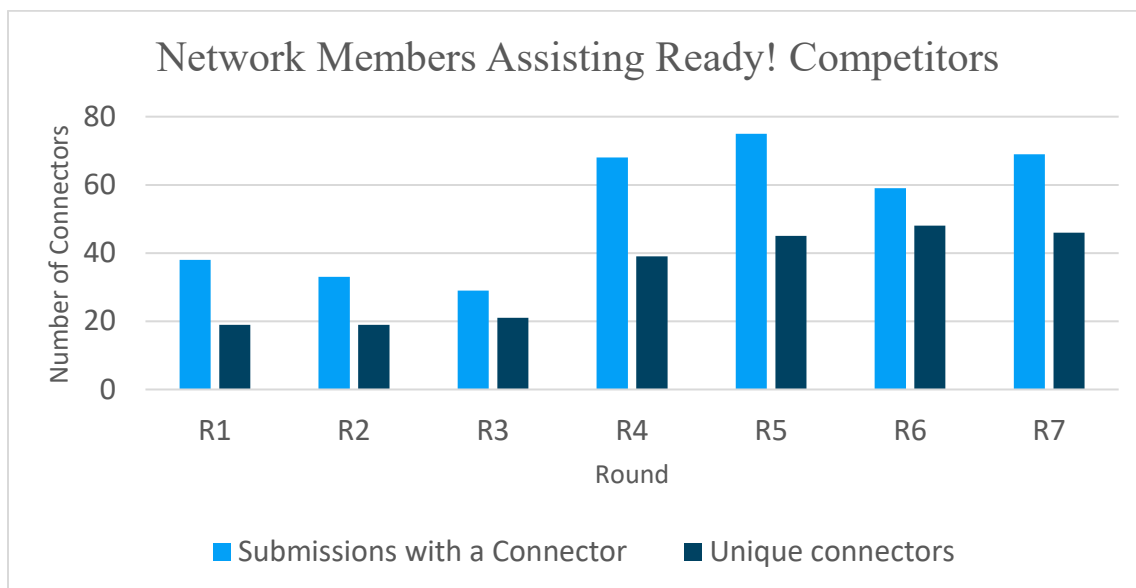


Figure 10. Number of network members – “Connectors” who assisted teams in the Ready! Contest

Network members receive a small monetary award if they provided support to a team that won the Ready! Contest. From Rounds 1-6, 57 different organizations received a total of \$295,000 for providing this assistance.

2.3 Technical Assistance Requests

Each round of the Solar Prize has asked competitors to submit a Technical Assistance Request (TAR). In the TAR, teams outline the skills, expertise, or assistance they need to be successful. These TARs are publicly available so that members of the American-Made Network and other support groups can connect with Solar Prize competitors to provide relevant assistance.

In Solar Prize Rounds 1–4, the TAR was submitted as a two-page open-response document. For Rounds 5 and 6, the TAR was generated through the American-Made Network matching tool, a matchmaking tool that connects entrepreneurs and innovators to the right resources at the right times. The matching tool contained a list of 18 preidentified categories of support. Competitors were asked to rate their need for each area on a scale of 0 to 5, with 5 indicating the highest level of need. Generating the TARs in the matching tool provides the Prize Administrators with valuable data from all applicants on the highest areas of need for early-stage solar entrepreneurs. For both the Solar Prize and other programs looking to support early-stage entrepreneurs, this aggregate information indicates where programs should focus their technical assistance offerings.

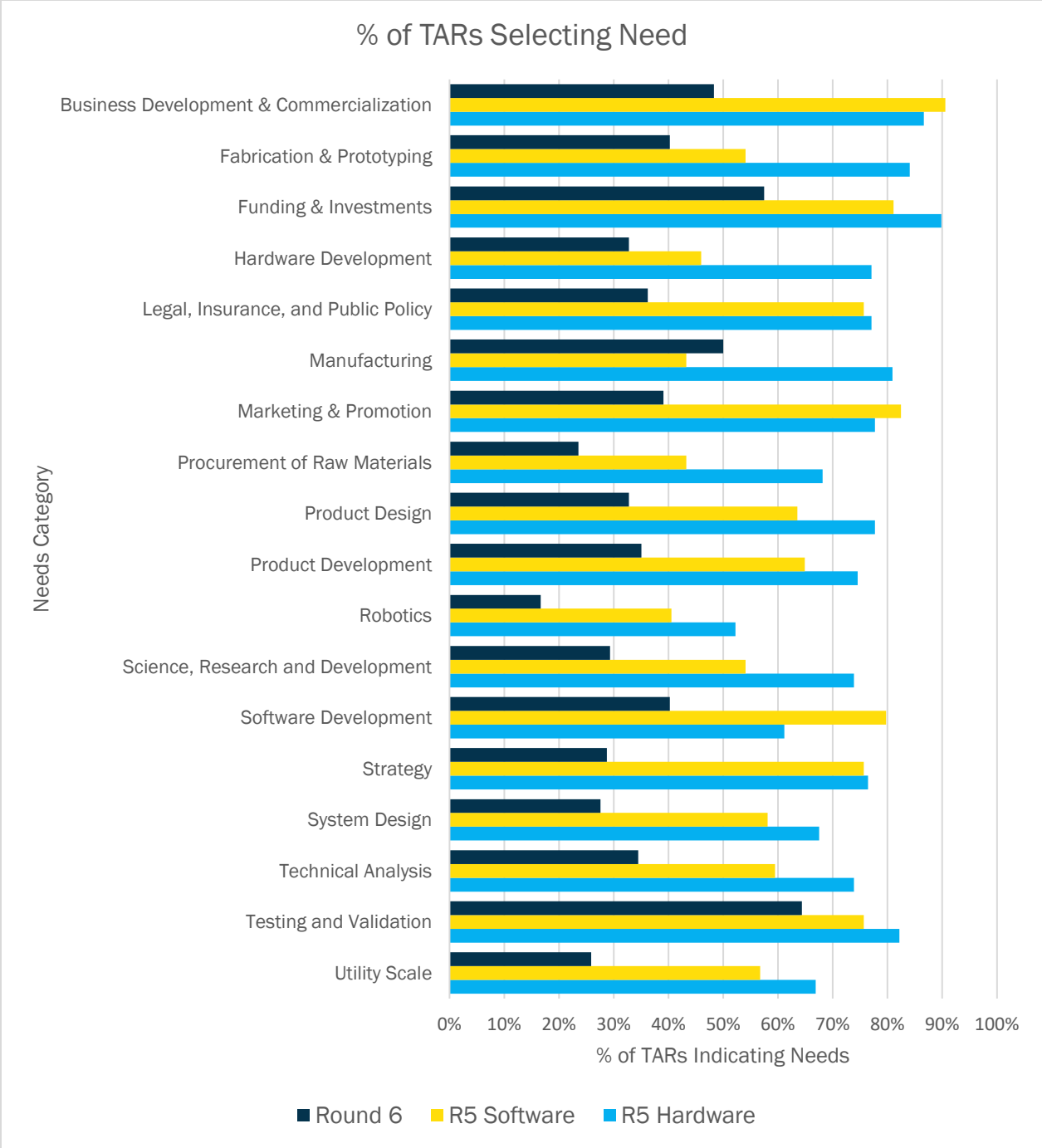


Figure 11. Percentage of TARs and needs selected

2.3.1 Solar Prize Round 5

In the Solar Prize Round 5 Hardware Track, 157 TARs, indicating 2,116 needs with a total weighted score of 6,402, were generated in the matching tool. Competitors selected an average of 13.4 different needs per TAR with an average total weight of 40.8. The top three needs by number of selections were Funding & Investments (141), Business Development & Commercialization (136), and Fabrication & Prototyping (132). These three needs were listed on

90%, 87%, and 84% of TARs, respectively. Both Testing & Validation (129) and Manufacturing (127) were also listed on more than 80% of TARs.

When these needs were ranked by overall weighted total, Funding & Investments still topped the list, with a total weighted selection of 560 and an average weight of 3.97. Business Development & Commercialization and Testing & Validation both received a total weight of 465. The average weight for Testing & Validation was slightly higher at 3.6 versus 3.42 for Business Development & Commercialization. While Marketing & Promotion ranked fourth in weighted total (431), it ranked third in average weight at 3.53.

Table 3. Comparing Round 5 Hardware Versus Software – Basic Metrics

	Round 5 Hardware	Round 5 Software
Number of TARs	157	74
Total Needs (total weighted score)	2,116 (6,402)	847 (2,577)
Average Number of Needs (average total weight)	13.4 (40.8)	11.4 (34.8)

Solar Prize Round 5 provides additional insights, as it is the only round where software and hardware solutions were routed to different tracks. This means that the generated TARs were also separated by track, allowing the Prize Administrators to compare differences in needs between hardware and software innovators.

In the Software Track, 74 TARs were generated in the tool, indicating a total of 847 needs with a total weighted score of 2,577. Competitors selected an average of 11.4 needs per TAR, with an average weight of 34.8 across TARs. The top three needs by number of selections were Business Development & Commercialization (67), Marketing & Promotion (61), and Funding & Investments (60). Only Business Development & Commercialization appeared on more than 90% of TARs. Marketing & Promotion and Funding & Investments appeared on 82% and 81% of TARs, respectively.

When ranked by weighted total, Marketing & Promotion was identified as the largest need, with a score of 232. Business Development & Commercialization and Funding & Investments also received weighted scores above 200. When ranked by average weight, Marketing & Promotion still held the top spot, with a weight of 3.8. However, Utility Scale jumped to second place, with an average weight of 3.52. Although Utility Scale was listed as a need on only 57% of TARs, competitors that needed assistance in this category ranked is as a high need.

Table 4. Comparing Top Three Needs – Hardware Versus Software

	Round 5 - Hardware	Round 5 - Software
Number of Selections	<ul style="list-style-type: none"> • Funding & Investments (141) • Business Development & Commercialization (136) • Fabrication & Prototyping (132) 	<ul style="list-style-type: none"> • Business Development & Commercialization (67) • Marketing & Promotion (61) • Funding & Investments (60)
TAR Percentage	<ul style="list-style-type: none"> • Funding & Investments (90%) • Business Development & Commercialization (87%) • Fabrication & Prototyping (84%) 	<ul style="list-style-type: none"> • Business Development & Commercialization (90%) • Marketing & Promotion (82%) • Funding & Investments (81%)
Total Weight	<ul style="list-style-type: none"> • Funding & Investments (560) • Business Development & Commercialization (465) • Testing & Validation (465) 	<ul style="list-style-type: none"> • Marketing & Promotion (232) • Business Development & Commercialization (220) • Funding & Investments (210)
Average Weight	<ul style="list-style-type: none"> • Funding & Investments (3.97) • Testing & Validation (3.6) • Business Development & Commercialization (3.42) 	<ul style="list-style-type: none"> • Marketing & Promotion (3.8) • Utility Scale (3.52) • Testing & Validation (3.45)

As anticipated with software solutions, needs in Robotics, Procurement of Raw Materials, Manufacturing, and Hardware Development were ranked lowest from all three perspectives (number of times selected, weighted total, and average weight).

2.3.2 Solar Prize Round 6

In the Solar Prize Round 6, software and hardware solutions were submitted to the same track, so the Prize Administrators were unable to distinguish needs between the two. A total of 174 TARs were generated in the matching tool with 1,153 total needs selected and a total weighted score of 4,124. Each competitor selected an average of 6.6 needs, with an average total weight of 23.7. In Round 6, the highest need by number of times selected was Testing & Validation (112), followed by Funding & Investments (100) and Manufacturing (87). Overall, these needs were selected by a much smaller percentage of competitors—64%, 57%, and 50%, respectively—and represent the only three needs listed on more than 50% of the TARs. The weighted total rankings match the same order as the number of times selected, with 432 for Testing & Validation, 404 for Funding & Investments, and 323 for Manufacturing. When ranked by average weight, the needs

shift slightly. Funding & Investments takes the top spot with an average weight of 4.04. Fabrication & Prototyping follows with 3.89, and Testing & Validation follows with an average weight of 3.86.

2.3.3 Cumulative View

The 463 analyzed TARs were generated by 361 different users. The difference in TARs can be attributed to the same user(s) applying to both Round 5 and Round 6 or user(s) generating a new TAR in a different phase of the prize. Across the 463 TARs, 4,116 needs were selected with a weighted total of 13,103. Regardless of how needs are ranked, Funding & Investments, Testing & Validation, Business Development & Commercialization, and Marketing & Promotion remain in the top four (though with slightly different rankings).

Regardless of round or ranking order, Robotics is the least needed area of assistance, with only 30% of competitors noting any need in the category and an average weight of 2.12. This indicates that it is not a significant need for those competitors.

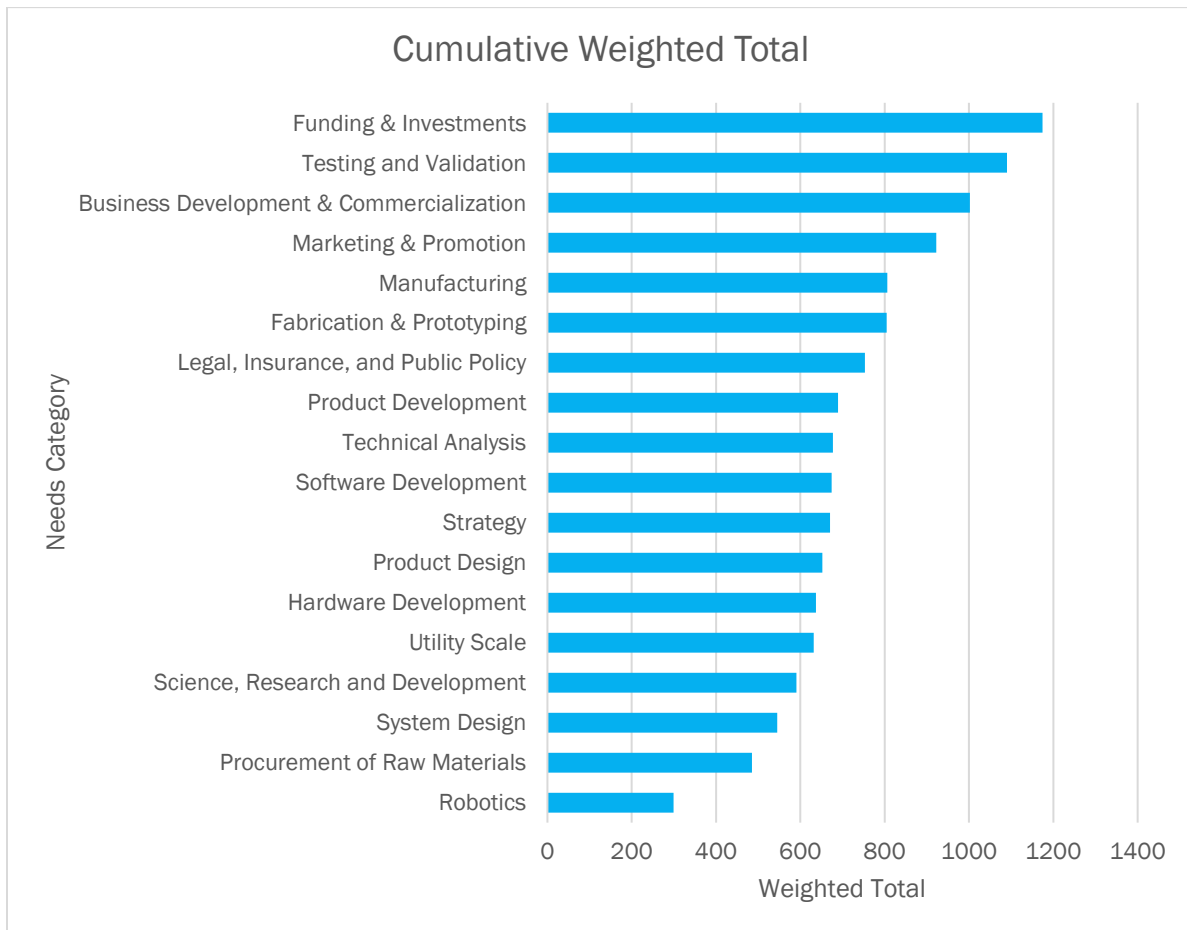


Figure 12. Cumulative weighted total of needs

Need Category	# Times Selected				Weighted Total				Average Weight			
	R5H	R5S	R6	Cumulative	R5H	R5S	R6	Cumulative	R5H	R5S	R6	Cumulative
Funding & Investments	141	60	100	301	560	210	404	1174	3.97	3.50	4.04	3.90
Testing and Validation	129	56	112	297	465	193	432	1090	3.60	3.45	3.86	3.67
Business Development & Commercialization	136	67	84	287	465	220	317	1002	3.42	3.28	3.77	3.49
Marketing & Promotion	122	61	68	251	431	232	259	922	3.53	3.80	3.81	3.67
Manufacturing	127	32	87	246	413	70	323	806	3.25	2.19	3.71	3.28
Fabrication & Prototyping	132	40	70	242	422	111	272	805	3.20	2.78	3.89	3.33
Legal, Insurance, and Public Policy	121	56	63	240	363	177	213	753	3.00	3.16	3.38	3.14
Product Development	117	48	61	226	331	141	217	689	2.83	2.94	3.56	3.05
Strategy	120	56	50	226	341	169	160	670	2.84	3.02	3.20	2.96
Product Design	122	47	57	226	331	130	191	652	2.71	2.77	3.35	2.88
Software Development	96	59	70	225	235	197	242	674	2.45	3.34	3.46	3.00
Technical Analysis	116	44	60	220	332	136	209	677	2.86	3.09	3.48	3.08
Hardware Development	121	34	57	212	366	77	194	637	3.02	2.26	3.40	3.00
Science, Research and Development	116	40	51	207	294	124	173	591	2.53	3.10	3.39	2.86
System Design	106	43	48	197	267	124	154	545	2.52	2.88	3.21	2.77
Utility Scale	105	42	45	192	326	148	158	632	3.10	3.52	3.51	3.29
Procurement of Raw Materials	107	32	41	180	287	66	132	485	2.68	2.06	3.22	2.69
Robotics	82	30	29	141	173	52	74	299	2.11	1.73	2.55	2.12
Grand Total	2,116	847	1,153	4,116	6,402	2,577	4,124	13,103	3.03	3.04	3.58	3.18

Figure 13. TAR needs rankings

Values in the table were formatted as a 3-color scale with gradient. Dark green values indicate highest values, yellow indicates midpoint values, and red indicates lowest values.

2.4 Finding Support in the American-Made Network

The American-Made Network matching tool also allows Network members to enter their capabilities. To date, over 400 organizations in the Network have entered capabilities into the tool. These organizations include incubators, accelerators, universities, prototyping facilities, testing centers, consultants, prize alumni, and others who have the desire and expertise to support energy innovators and entrepreneurs.

In the tool, while rounds 5 and 6 were active, Network members selected categories they could provide assistance in, using the same list that innovators selected from. Network members gave each selected category a weight indicating their ability to provide support in this area, from 1 (weaker in this capability) to 5 (strong in this capability). Currently, 441 Network members have selected an average of 8.6 assistance categories each. By the number of organizations offering support, the top four capabilities are Business Development & Commercialization, Strategy, Product Development, and Science, Research, & Development. These same four also have the highest total weighted score and highest average weight (though Strategy's average weight of 4.03 is higher than Business Development & Commercialization at 3.98). Robotics, Procurement of Raw Materials, Utility Scale, and Legal, Insurance, & Public Policy are the bottom four offerings in terms of number of organizations, weighted total, and average weight (though with different ordering).

Assistance Category	# of Organizations Offering	Weighted Total	Average Weight
Business Development & Commercialization	291	1159	3.98
Strategy	257	1036	4.03
Product Development	248	932	3.76
Science, Research & Development	248	926	3.73
Manufacturing	237	780	3.29
Marketing & Promotion	229	809	3.53
Funding & Investments	223	764	3.43
Technical Analysis	222	804	3.62
Product Design	212	725	3.42
Testing & Validation	210	713	3.40
System Design	205	664	3.24
Fabrication & Prototyping	201	669	3.33
Hardware Development	196	644	3.29
Software Development	184	515	2.80
Legal, Insurance, & Public Policy	173	432	2.50
Utility Scale	172	460	2.67
Procurement of Raw Materials	164	421	2.57
Robotics	157	365	2.32
Grand Total	3,829	12,818	3.35

Figure 14. Network members' assistance offerings

Values in the table were formatted as a 3-color scale with gradient. Dark green values indicate highest values, yellow indicates midpoint values, and red indicates lowest values.

2.4.1 Alignment of Offerings and Needs

Of the top four needs identified by Solar Prize applicants and the assistance categories offered by Network members, only one area overlaps: Business Development & Commercialization. This indicates that, while American-Made offers a robust network of support, there is a lack of assistance within the Network to solar entrepreneurs in areas such as Funding & Investments, Testing & Validation, and Marketing & Promotion. There is also a significant misalignment between Legal, Insurance, and Public Policy needs and offerings in this category in our network. In part, some misalignment may be caused by the American-Made Network's support of energy entrepreneurs across technology areas; the Network is not tailored specifically for solar industry expertise and support.

Figure 12 contains a graphical representation of the assistance gaps in the Network. The average weighted scores for innovator needs are indicated with blue marks, and the average weighted assistance offered by the Network is indicated with orange marks. The greatest needs are where there is a significant gap between the two indicators, especially for higher-ranking categories overall. Where the orange indicator is significantly above the blue indicator, there is a lot of expertise in the Network, but it is not an area of expertise requested by innovators.

In this data, the Prize Administrators see a large opportunity to focus the next stage of growth within the Network on expertise and support in Funding & Investments.

The data from the Network matching tool offers a broad view of the needs of solar innovators in general. Once semifinalists (winners of the Ready! Contest) are selected, they are provided with additional support during the remainder of the prize.

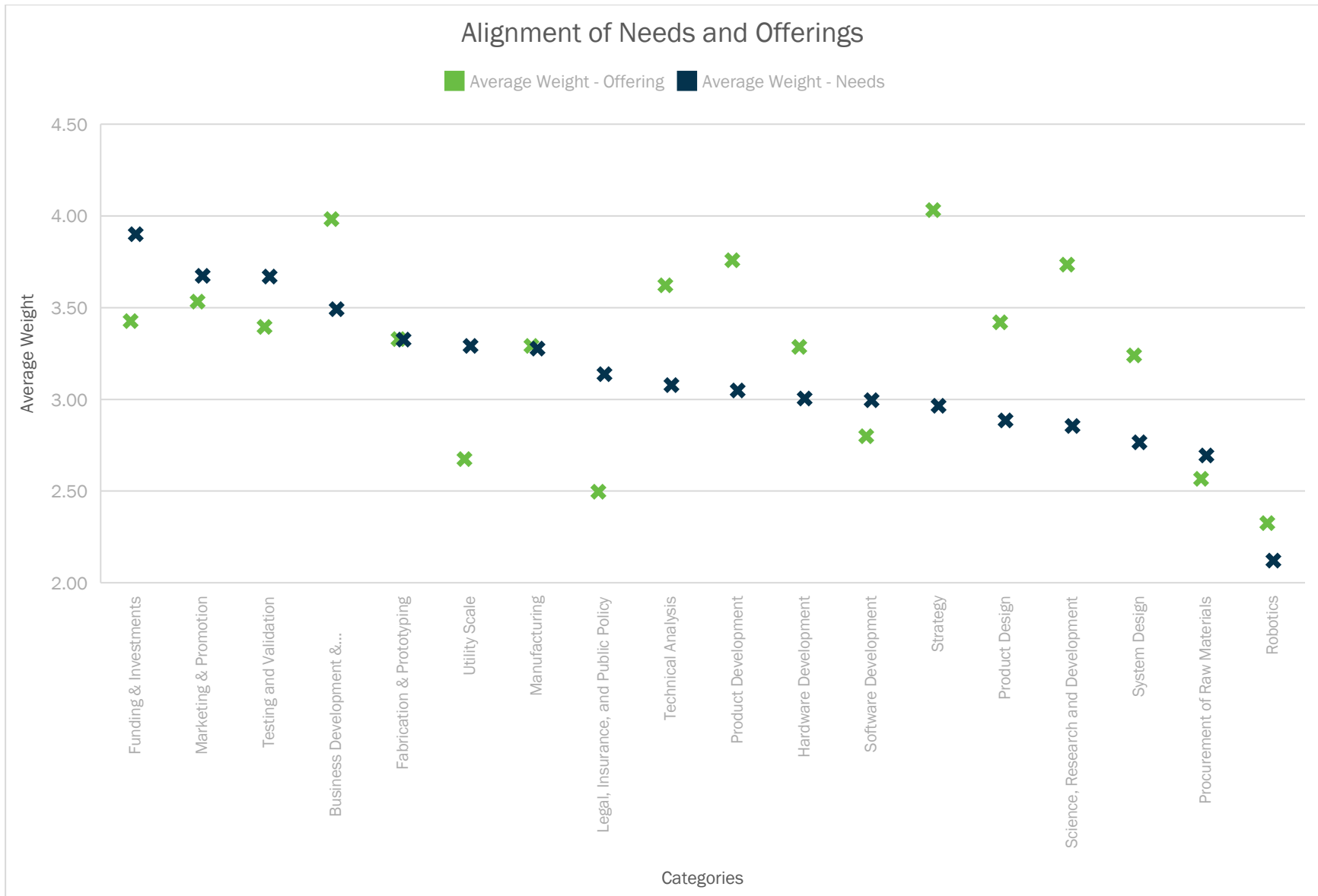


Figure 15. Alignment of needs and Network offerings

2.5 Semifinalist Needs Assessments

For each round of the Solar Prize, the Prize Administrators contract with Power Connectors to provide support to the teams that have been selected to move onto the Set! and Go! Contests. The exact level of the Power Connectors' support has varied through the rounds as the Prize Administrators and Power Connectors have learned better ways to support solar entrepreneurs. In more recent rounds, two Power Connectors have been contracted. In Rounds 4, 5, and 6, the Power Connector support started with a needs assessment and a kickoff phone call with each team to understand the teams' needs. Then, each team was assigned one of the Power Connectors as their primary Power Connector. This Power Connector was responsible for individual mentoring sessions throughout the course of the prize.

The needs assessment categories focused on areas where Power Connectors had expertise or connections to help. They also focused on activities that would help teams be successful in the Solar Prize, including connecting with relevant stakeholders for customer discovery, identifying the required pilot partner for the Go! submission, refining their video pitch, and reviewing the technical narrative submission. Teams were asked to rate each of the needs as a Priority 1 – Critical Need; Priority 2 – Important, but Not Urgent; Priority 3 – Need Support Here Eventually; or No Support Required. Teams were asked to only categorize up to three needs as Priority 1, though some teams selected more.

Table 5. Semifinalist Needs Assessment Results – Rounds 4–6

Needs Category	Priority 1 (Critical Need)	Priority 2 (Important but Not Urgent)	Priority 3 (Need Support Here Eventually)	No Support Required Here
Customer Discovery	47%	32%	15%	6%
Connections to Investors/Funders	38%	23%	32%	8%
Pilot Test Partner	35%	39%	12%	14%
Business Development Support	33%	33%	27%	6%
Submission Review	30%	42%	24%	3%
Assistance With Engineering/Industrial Design	25%	19%	33%	23%
Manufacturing Support	25%	17%	33%	25%
Access to Coding Support (R5 Software Only)	21%	14%	36%	29%

Across 66 completed needs assessments, making connections to relevant customers to complete the customer discovery process was largely identified as the most pressing need for Solar Prize teams. This needs assessment was conducted at the beginning of the Set! Contest, and a major activity during the Set! Contest is for teams to do customer discovery. This demonstrates that teams are looking to the Power Connectors to help with immediate prize-related needs.

2.6 Leveraging National Laboratory Capabilities

The final piece of the Solar Prize is technical assistance vouchers. Winners of the Set! and Go! Contests are awarded a \$75,000 voucher that must be redeemed (in part) at one of DOE's 17 national laboratories. These vouchers pair teams with a national laboratory researcher who can work with them, through a standard lab cooperative research and development agreement, to further develop their innovation through research and development, test and validate their technologies, and/or provide additional research and insights.

All semifinalist teams submit voucher work slides as a part of their Set! submission packages. These slides outline, at a broad level, the support a team would use if they won a voucher at the end of the Set! Contest. At least two-thirds of each voucher must be redeemed at a national lab. The remaining one-third can be redeemed with a member of the American-Made Network. If a team wants to split their voucher between multiple locations, a separate voucher work slide was submitted for each location. Similar to the TARs for the Network, analyzing the full set of voucher work slides delivers insight into what the teams are most frequently requesting from the national labs.

The voucher work slides allow for free-form responses, so the Prize Administrators cataloged the slides and categorized the focus areas of the requests. Across Rounds 1–6, the Prize Administrators looked at 134 slides.⁴ Although teams provided different slides for different facilities, they often indicated multiple voucher objectives on a single slide. The Prize Administrators identified 221 objectives across these 134 slides for 105 different teams.

Voucher requests can be separated into three main categories, with sub-needs in each category: testing, research, and design.

⁴ Due to the format of the Round 5 Software Track, voucher request slides were not included as a part of the Set! submission and are not included here.

Table 6. Voucher Request Slides Summary

Values in the table were formatted as a 3-color scale with gradient. Dark green values indicate highest values, yellow indicates midpoint values, and red indicates lowest values.

Request Category	# of Requests	% of Teams
Testing		
Life cycle	8	8%
Certification and compliance	16	15%
Performance	64	61%
Efficiency and durability	21	20%
Special equipment/software	23	22%
Research		
Analysis	6	6%
Create simulation	20	19%
General further research	15	14%
Real-world applications	17	16%
Design		
Create prototype	16	15%
Improve prototype	11	10%
Other		
Other	4	4%

The most frequent request, by far, was for performance testing, with 61% of all teams citing this as a critical need. The next four requested needs—though almost 40% less requested than performance testing—were special equipment/software (22%), efficiency/durability testing (20%), creating simulations/modeling (19%), and consultation on real-world applications (16%).

Only half of the teams that submit a voucher work slide go on to win the Set! Contest and receive a voucher. Through Rounds 1–5, the Solar Prize placed 60+ vouchers at various national laboratories and external facilities. In total, the Solar Prize has supported more than \$300,000 in vouchers for 14 external facilities, with an average of nearly \$25,000 to each facility, and \$3.5 million in national laboratory vouchers across five national laboratories.⁵

Similar to the analysis of the voucher work slides, the majority of the redeemed vouchers focused on testing and validation. Testing and validation accounted for 58% of all redeemed vouchers. This was followed by research and development (15%), modeling (12%), and environmental testing (8%).

⁵ NREL – 32 vouchers; Sandia – 20 vouchers; PNNL – 3 vouchers; LBNL – 2 vouchers; ANL – 1 voucher.

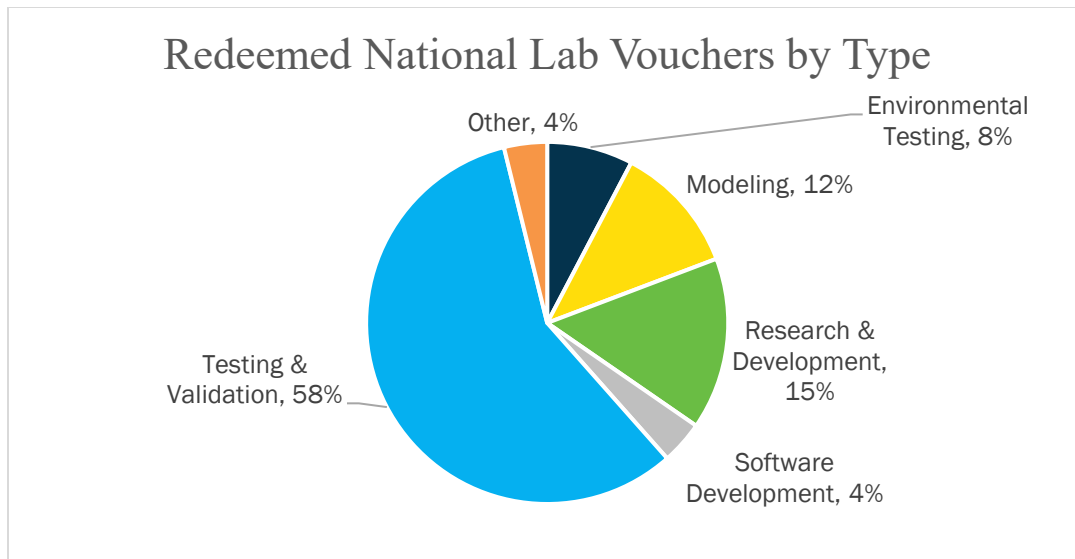


Figure 16. Vouchers redeemed at national labs

Our findings indicate that across the three segments of the American-Made Network—Network members, Power Connectors, and national laboratories—each segment fulfills a different need for early-stage solar entrepreneurs. Solar Prize applicants are turning to the Network for support with Funding & Investments, Testing & Validation, Business Development & Commercialization, and Marketing & Promotion. Power Connectors are often leveraged to support the next steps teams need to take to be successful in the prize, including customer discovery, connections to funding/investments, and identifying a pilot partner. Finally, national labs are uniquely positioned to offer testing, particularly around technology performance.

3 Conclusion

Five years, six rounds, 160 funded innovators, and more than 400 Network members later, the Solar Prize continues to support early-stage U.S. solar innovation. Now in its seventh round, the Solar Prize has become an embedded part of the Solar Energy Technologies Office's (SETO's) funding mechanisms. Family businesses, college students, and industry veterans have all made advances in solar innovation through this prize. After the prize concludes, many teams have asked the same thing: How can we pay it forward and help others in this program? More than 20 alumni teams have joined the American-Made Network and mentored future prize participants. The Prize Administrators hope that this platform—including the prize, the support services, and the community of peers—continues to accelerate early-stage solar innovation. As NREL and DOE continue to build out the program, track the long-term progress of teams, and refine the technical assistance offerings, the Prize Administrators also hope to build stronger partnerships with other organizations supporting solar innovation to more thoroughly build out the funding value chain from concept to commercialization and scale up.

The Solar Prize was the first and flagship prize in the American-Made prize portfolio. To date, American-Made has launched over 70 prizes with 20 different DOE offices and offered more than \$260 million in prizes. The Prize Administrators continue to iterate on the prize mechanism to incentivize innovation in a variety of different fields, and hope that American-Made will continue to help establish the United States' leadership in the clean energy transition.

For more information on the American-Made Solar Prize, please visit <https://americanmadechallenges.org/challenges/solarprize>

Appendix A. The Prize Mechanism and American-Made Program

Prizes, authorized under the America COMPETES Act, are one tool that the U.S. Department of Energy is utilizing to incentivize innovation and provide financial awards for successful initiatives. Prizes are awards for work already completed. This means that DOE can set a goal to be achieved, and competitors work toward that goal. At the end of each prize phase, competitors complete a submission outlining the work done and progress made. Competitors who have accomplished the most high-quality work are awarded a cash prize, which they can use however they see fit.



The American-Made program is a U.S. Department of Energy (DOE) research and development ecosystem focused on accelerating clean energy innovation and prizes are a cornerstone of their mission. This unique model combines prizes with a cleantech network and technical voucher funding to incentivize rapid advances in technologies and applications, entrepreneurship, capacity and community building, and workforce development, forging new connections among the nation's entrepreneurs, private sector, and DOE's national laboratories. These three program pillars work together to effectively speed new projects toward their commercial and implementation-ready potential: cash prizes incentivize new ideas and engage new participants; a network of expertise and resources supports their success; and voucher funding provides access to state-of-the-art laboratory facilities and researchers.

Prize competitions in general are a rapidly growing mechanism to fund innovative ideas and concepts. When compared with other funding available to entrepreneurs and communities, prizes hold undeniable appeal: they typically have a low barrier to entry, more progress on shorter timelines, and faster funding distribution, making it relatively easy for anyone with ideas, knowledge, and skills to compete. While prizes are a relatively small part of the larger funding environment, their scope and reach have increased substantially over the past two decades. As the breadth of prizes has grown, their complexity, diversity, and innovative nature has also widened significantly.

With the American-Made Program, DOE has expanded its reach into the prize ecosystem. American-Made is an organized, multifaceted, dynamic approach to government prize funding. It is a fast-paced, engaging way for entrepreneurs, innovators, and communities to earn government funding to fuel their concepts. To date, the program has awarded more than \$260 million in cash prizes and support across more than 70 prizes and competitions. Multiple new prizes and competitions are announced each year by DOE offices seeking to advance a concept or solicit ideas from entrepreneurs and other communities. The American-Made program's prizes and competitions, vouchers, and network are managed and administered by the National Renewable Energy Laboratory (NREL).