IEEE EMPOWER A BILLION LIVES

COMPETITION GUIDE

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OVERVIEW

The Challenge: To Accelerate Scale in Energy Access

IEEE Empower a Billion Lives (EBL) is a biennial global competition, which challenges teams from around the world to develop innovative solutions that can bring cost-effective energy, and its life transforming impact, to billions of unserved and underserved people. The competition encourages a holistic approach by evaluating technology, social impact, and business models of competing solutions. Winning teams will demonstrate success through field-testing and a path to rapid scaling of their solutions. For more information, visit: www.empowerabillionlives.org.

Need for the Competition

Grand Challenge:

Three billion people around the world live in severe energy poverty, including 770 million who live without electricity access. Providing affordable energy access to them can dramatically impact their living standard, health, education, productivity and ability to be a part of modern society. Many programs and initiatives have been doing stellar work in tackling energy poverty, but much remains to be done. The centralized electricity grid is not the optimal choice for remote and rural applications, due to environmental impact, cost, mismatch to user needs and challenges around financial feasibility. Decentralized solutions, such as solar home systems and microgrids, have emerged as a response to shortcomings of the centralized grid approach, but

affordability, scalability, interoperability and societal and technical sustainability remain a key challenge. Such decentralized scalable plug-n-play solutions that can be rapidly deployed also impact energy poverty and energy equity in the more developed nations, as well as energy resiliency for communities that are impacted by climate change or major societal disruptions and displacement. Solving energy poverty using mature and proven 20th century solutions, an obvious path forward, could result in an additional 3.8 gigatons per year of carbon emissions - an environmental catastrophe! New solutions that can scale are clearly needed!

Our Approach:

IEEE Empower a Billion Lives (EBL) is a recurring global competition organized by the IEEE Power Electronics Society[1], to crowdsource regionally relevant innovation to accelerate deployment of energy access solutions in the affected areas.

It is anticipated that fast moving 21st century technologies with rapidly declining prices[2] can allow a holistic approach to the design of energy solutions to address the needs of families and communities living completely off-grid or suffering from energy poverty in the broadest sense. Effective solutions should be economically viable today, and should be able to provide continuing value to the families and communities as they improve their lives.

A primary focus for EBL is to help develop new energy-access, energy-equity, and energy-resiliency solutions with reduced technology and market risk. Another is to prove out new business models which show impact and scale can be achieved with economically viable and environmentally sustainable solutions.

EBL-I was a great success by all measures and the visibility it received globally was beyond our expectations. It attracted 470 teams from 70 countries, which through a process involving five regional competitions and field testing conducted across four continents, resulted in 23 teams participating in the global finals in Baltimore, Maryland, US, in 2019. Over $500K was given to the selected teams in support and awards. The EBL-I competition has attracted more than a hundred articles, an active presence on social media, thousands of blog postings, and press releases with over 30,000 views of the EBL website,and 500,000 impressions. EBL also won the prestigious Summit Humanitarian Award in 2019 presented by the American Society of Account Executives. Please visit www.empowerabillionlives.org for more details on the competition, the winning teams, and their continued impact.

The EBL-II Competition:

Competing teams will develop and demonstrate in target communities, technically innovative solutions to address the needs of the rapidly growing global energy access market of 3 billion people. These solutions also need to demonstrate business viability and the potential for rapid scaling. The competition consists of two online rounds, followed by a regional field-testing round, and concluding with a global final round.

- **Round 1 - Concept Paper Submission:** Teams will submit Concept papers online. Teams meeting the requirements, as noted by judges, will be invited to submit full proposals of their solution for the Second Round.
- **Round 2 - Full Proposal Submission:** Teams will be invited to submit their full proposals. Teams meeting the requirements, as noted by judges, will be invited to field-test their solution. In case of teams participating in the 'Student Team' category, demonstration of solution capabilities in an equivalent laboratory setting may be acceptable.
- **Regional Field-testing**: Accepted teams will field-test their solutions and will utilize a provided data-logger for verification. Successful teams will be invited to the EBL II Global Final at the discretion of the EBL Judges where they will show the results of their field testing, including an interview with the solution end-user and the field-testing data. At the discretion of the judges and EBL, the top few student teams may also be invited to the Global Final.
- **Global Final**: All succeeding teams will compete in the Global Final. The total anticipated prize purse is in excess of $300,000.

Impact:

Ongoing competition cycles will drive a continuous learning process leveraging past learnings and rapid technology advances to deliver tremendously impactful solutions. EBL believes that rapidly changing technologies offer a unique opportunity to crowdsource innovation globally with cross-disciplinary teams, to spark creativity that can generate unexpected outcomes – the heart of the competition is this WOW! factor. Teams offering affordable and innovative solutions to energy access can win recognition on a global stage and also see financial success.

The impact of affordable energy access on families and communities can be profound, providing positive outcomes in areas of health, food security and resilience, access to water, education, increased productivity, digital and financial inclusion, and livelihood and lifestyle changes.

1-Institute of Electrical and Electronics Engineers (IEEE) is the world's largest technical organization with over 420,000 volunteers in 160 countries**. 2**-'Exponential' technologies may include PV solar, energy storage, power electronics, internet of things, decentralized control, communications, edge computing, pay-as-you-go, mobile wallets, block-chain, data analytics, etc.

IEEE EMPOWER A BILLION LIVES COMPETITION

Accelerating Scale in Energy Access

COMPETITION PARTICIPATION GUIDELINES & METRICS

EBL II – COMPETITION SCHEDULE:

Empower a Billion Lives Competition (EBL II) will consist of two competition rounds in three stages – Online Round, Field Evaluation, and a Global Final Round. Field testing will be carried out between the online round and final competition. The EBL final round for EBL II will be held in Detroit, Michigan, US in 2022. The EBL competition will operate on a two-year cycle, with online rounds in the first year, followed by field tests and a global final in the second year.

COMMON REQUIREMENTS:

The Empower a Billion Lives competition invites teams to submit proposals addressing key challenges in the scaling of energy access solutions. A key EBL objective for energy impoverished families and communities is to facilitate their digital and financial inclusion in society and to stimulate productive uses of energy to support assimilation into the global economy.

From a technical viewpoint, proposed solutions are likely to address key issues such as real-time control and operation of the system, load management and system optimization, and should meet both current and future customer needs. However, EBL is really seeking innovative (WOW!) ideas that fulfill the basic energy access needs of the families and communities, possibly in a completely different manner. In all cases, solutions do need to address business issues such as capital and operating costs and show a business model that is economically viable. Solutions should provide at least the equivalent of ESMAP Tier 2 access in terms of functionality enabled, which is a minimum of 50W (for 30 minutes), and more than 200Wh per day.

COMPETITION TRACKS:

EBL specifically targets two groups as consumers of energy access solutions – the single family and the community. The typical family earns less than $1500 per year and lives in a low population density rural community, which has 20-1000 homes (see Appendix I for more details). Successful EBL solutions will solve energy access problems for both groups – some in a decentralized bottom-up manner, and some in a centralized top-down manner. The traditional approach has been through electricity generation and delivery, but there may be other solutions that take a completely different approach, and still achieve the desired objectives. EBL would like to encourage teams to focus on the broad goals, and to offer solutions that solve the technology and business issues and are able to demonstrate impact.

Solutions can range from an entire power generation, delivery and management system; appliances (productive use of energy, clean cooking); or an enabling technology solution that addresses some of the key challenges in energy access (interoperability, scalability, sustainability, affordability). Teams can compete along the following tracks, noting that solutions may fit into more than one track:

- **Track D: Decentralized Model (TrD)**
- **Track C: Centralized Utility Model (TrC)**
- **Track A: Automation-centric solution (TrA)**
- **Track P: End-use energy (Productive Use of Energy, Clean Cooking) (TrP)**
- **Track E: Enabling Technologies (TrE)**
- **Track S: Student Teams (TrS)**

Decentralized Model (Track D): The proposed solution will serve single homes at the Tier 2 or higher without creating an entire distribution infrastructure in advance of when it is needed. A distribution network may be built and expanded whenever needed by interconnecting smaller systems on an ad-hoc basis to share resources, improve reliability, provide community level services and to realize operational and cost efficiencies. A successful solution will show technical viability and the business model needed to reach scale.

Centralized Model (Track C): The proposed solution is a centrally planned and implemented power generation and distribution model offering the core service at the community level. Individual families are served as customers from the centralized service. Operations and billing follow traditional utility models and may include some level of customer-owned generation and storage. The proposed solutions will address physical and transactive elements needed for sustainable operation and economic viability and will show the solution's potential for scaling.

For the tracks, Decentralized Model and Centralized Utility Model, the proposed solution should address the entire power generation, delivery and management system, including the physical, technical, social and business elements needed to operate the system sustainably.

Automation-centric solution (Track A) [NEW THIS YEAR]: The proposed solution is enabled by automation, with the underlying advantage of autonomous operations demonstrated via increased scale, resilience, simplicity, or a combination thereof. An example is a self-governed interconnection of smaller systems thereby allowing sophisticated solutions to be adopted by communities with insufficient technical exposure and/or skilled support infrastructure. A successful solution must demonstrate technical viability and an underlying business model that addresses scalability. This track prize is sponsored by the IEEE Control Systems Society.

End-use Energy (Track P) [NEW THIS YEAR]: The proposed solution will address appliances that enable productive use of energy (including clean cooking). Examples are appliances for the agri-food value chain (irrigation, cooling, agri-processing, livestock/poultry etc.), appliances enabling commercial activities, energy-efficient cooking appliances etc. The solution can be aimed at a single user solution (e.g., solar water pumps for irrigation, refrigerators, hairdressers and tailors tools etc.) or the community level (e.g. cold-storage rooms, agri-food processing hubs). Similar to the tracks above, a successful solution will show technical viability, the business model needed to reach scale and demonstrate the social and environmental impact of the solution.

Enabling Technologies (Track E): [NEW THIS YEAR]: The proposed solution in this category does not address the entire energy system but enables solving some of the key challenges of energy access solutions such as scaling, affordability, sustainability, interoperability. The competing solution can be a component (e.g., novel battery technology, parts suitable for recycling) or sub-system (e.g., battery management system, systems for remote control, monitoring, health and data analytics, digital payments etc.). Similar to other categories, a successful solution will show technical viability, the business model needed to reach scale and demonstrate the social and environmental impact of the solution.

Student Teams (Track S): This category is open only for teams composed of tertiary education institutions. The proposed solution in this category can be of the nature covered in the above five categories (decentralized model, centralized model, automation-centric solution, end-use energy and enabling technologies). The main difference with the other categories is in the requirements for field-testing — student teams are not required to demonstrate their solution in a target community (as this can be difficult for a student team to execute due to constrained resources) but can perform field-testing in a suitable environment within their reach. However, a student team is free to choose to compete in one of the other categories, if they are able to comply with the field-testing requirements.

Beside the above tracks where teams will actively take part in the competition, there will be an opportunity for teams who do not want to compete or are not eligible due to the competition rules to demonstrate their solutions **(Demonstration Teams)** to the global energy access audience at the EBL-II related events (Global Final or other events).

The expectation is that solutions will target different levels of energy access with different levels of technical and business sophistication. Best performers will provide the highest level of performance and functionality at the lowest cost with a viable business model and the ability to rapidly scale in this market segment. The same metrics will apply throughout the competition, but with increasing rigor through the field evaluation and the global final. A team may state their preferred participation category; however, the category decision of the EBL Rules and Judging Committee will be final.

Judging for teams in both tracks depends on the ability to provide value, both at a single-family level and at the community level. Decentralized solutions have traditionally served a single family's needs with higher capital efficiency, but cost-effectively expanding system capacity and service levels to serve community needs has been challenging. Centralized solutions are traditionally better able to provide community level services, but with much higher capital and operating costs, normally requiring oversized infrastructure. End-use Energy Track solutions provide income generating or health and life quality improving opportunities on both single-household and community level. Enabling Technology Track solutions would preferably be usable in a wide variety of energy access solutions and contexts. Achieving economic viability for smaller communities, or for communities where the needs grow rapidly, has also been challenging. Winning solutions are likely to use technology and new business models to offer the best features of both – low capital cost, good asset utilization, flexibility, economic viability and system expansion ability as needed.

ASSESSING SUCCESS:

Participating teams using the process outlined in the next section will submit entries to the EBL competition. The review and judging process will reflect the goals and objectives of the EBL competition. A basic Judging Rubric is shown in Appendix II. Judges will be using this rubric to guide their scoring of the

proposed solutions. The rubric is available for competitors so they can ensure they have addressed relevant criteria in their proposals.

The Online Round will have a simple, two-stage, submission format. Teams will initially submit a short 3-page proposal. The proposals will go through the first screen and invited teams will be invited to submit full proposals (including a field test plan). The full proposals will be reviewed, and the selected teams will go through an interview with Judges, followed by carrying out field testing and participation in the Global Final. Teams should use the guide in Appendix I and II for preparing solutions and presentations, as judges will use the guide in the selection process.

Existing solutions and strategies may not be enough, and that new thinking is required. The judges will be actively looking for the **WOW!** factor in each topic area that shows novel cross-disciplinary thinking, which may provide new strategies for solving the scaling problem. These approaches include, but are not limited to, frugal engineering (ultra-low-cost but fully featured solutions), use of technologies such as PV solar, batteries, power electronics, decentralized control, cybersecurity, communications, IoT, cloud, AI/machine learning, edge-computing, block-chain, pay-go, mobile wallets, data analytics, etc., and new business models.

HOW DO WE BUILD A TEAM – AND WHO CAN PARTICIPATE:

EBL teams can include individuals from academic institutions, start-ups, research labs, NGOs, large corporations or interested individuals. Appendix I provides details on how to participate in EBL.

EBL invites companies that commercially offer products meeting the competition criteria to participate. The simplified process for such companies is to provide product details and specifications, evidence of operation and impact in the field, financial data as appropriate, and a review of the scaling potential. The Judging Rubric in Appendix II provides further details.

EBL specifically invites people who are currently involved with energy-access efforts in the target communities (see Appendix I and II) to become involved, and to bring their first-hand knowledge of the needs and aspirations of people in these communities to EBL teams. EBL also invites student teams from across the globe to participate. Faculty support in an advisory role is permitted but must be declared and should not trigger conflict of interest or intellectual property (IP) ownership issues as defined in the Official Contest Rules. EBL is also interested in fostering the development of 'open platforms' and 'open-source' software to enhance collaboration and promote creativity.

Solving complex problems can appear challenging for small teams with limited access to resources or newer technologies. EBL is establishing collaboration mechanisms so individuals and organizations seeking to partner can connect and collaborate.

People not allowed to participate in or to contribute directly to the solutions proposed or implemented by an EBL team include IEEE employees, members of the EBL Rules and Judging Committee, individuals who have a direct role in enforcing the metrics and rules for the competition and any other category of persons outlined in the contest rules. Individuals who cannot participate in EBL may provide financial support for a team. The team must declare this support and it must be approved, in writing, by the EBL Rules and Judging Committee. Review of submitted proposals will follow IEEE guidelines, typically used for review of technical papers, for conflict of interest management. In case there are questions regarding

eligibility of an individual to be a part of an EBL team, the decision of the EBL Rules and Judging Committee will be final.

Please visit the EBL website at www.empowerabillionlives.org to review the Official Contest Rules for teams submitting entries into the competition.

APPENDIX I
DETAILED INSTRUCTIONS FOR SUBMISSION OF EBL ONLINE PROPOSAL

INSTRUCTIONS FOR PROPOSAL SUBMISSION

ONLINE ROUND 1: Deadline April 1, 2022

Teams will submit their proposals online at https://empowerabillionlives.org/compete/resources/ . The process is as follows.

Team Registration

- Fill out an online form indicating the team's 'Intent to Participate' in the competition as soon as possible.
- Upon receipt of this 'Intent to Participate', The proposal submission system (Open Water) will assign the team a Nomination Application identification number which allows the team to fully access EBL collaboration resources as they build a team and proposal.
- A Team Leader can only submit one proposal.

Concept Paper Submission

- EBL review leaders will review the 'Intent to Participate', primarily to see alignment with EBL goals and objectives, and may provide guidance to the team.
- Each team must submit a Concept Paper in Adobe PDF format by the above stated deadline. The Concept Paper must not exceed 3 pages in length, should be in the format specified, and must conform to the following requirements:
  - The Concept Paper must not exceed 3 pages in length including graphics, figures and/or tables.
  - The Concept Paper must be submitted in Word.doc or Adobe PDF format.
  - The Concept Paper must be written in English.
  - Page 1 should include Title, Target Track, Concept Summary, Relevance with EBL Goals, Team Organization and Capabilities, and may have photographs to support the Concept Paper.
  - Pages 2 and 3 are for the main body of the Concept Paper, including Challenges, Innovation, Proposed Work and Impact.
  - All pages must be formatted to fit on a 8-1/2 by 11 inch (or A4) paper with margins not less than 3/4 inch on every side. Text must be in font size 12 (except for figures and references), and it is the team's responsibility to ensure that the Concept Paper can easily be read by the Reviewers.
  - The Concept Paper is to be registered on the EBL submission platform and the EBL Control Number (Nomination Application ID# next to the Team Name at the Top of the submission page) should be included on the right-side header of every page. The Concept Paper can be uploaded on the site only after the Control Number is allocated.
- The Online Round submission must be uploaded anytime starting on September 7, 2021. Submissions will not be accepted after 11:59 pm EST (US) **December 31, 2021**.

Concept Paper Decision Process: 2 January 2022 – 31 January 2022

- Team submissions will be reviewed by a panel of reviewers to check for alignment with EBL-II goals and objectives, and an ENCOURAGE/DISCOURAGE/OUT-OF-SCOPE response will be provided back to the teams. It is anticipated that this feedback and guidance will be provided by January 31, 2022.
- The review criteria for Concept Papers are:
    - Alignment with EBL Goals and Criteria
    - Impact if Successful
    - Overall Technical Viability
    - Business Model
    - Field testing readiness
    - WOW Factor

Online Round 2 submission and decision process (15 June – 15 July 2022)

- Submission of a full proposal including Field-Testing plan by qualified teams by **1 June 2022**
- The Full Proposal must not exceed 10 pages in length including the cover page, graphics, figures and/or tables.
- The full proposal should contain sections on Technical Solution, Impact, Business Model and Field-testing. Teams are encouraged to study the Judging Rubric (Appendix II) as they formulate their entry.
- The full proposals will be reviewed, and the selected teams will go through an interview with Judges (anticipated to take place in June/July 2022 followed by carrying out field testing and participation in the Global Final.
- The reviewers will score the entries with guidance from the Judging Rubric shown in Appendix II.

Field Testing: 1 August 2022 and 15 January 2023

Final details on the process for the Field-testing Round will be released prior to the close of the Online Round but are expected to include the following elements.

- Participation of team representatives in the Field-testing Round is mandatory (for all but Student Teams), including demonstration of a working solution, interview of community member and consumer and preparing a presentation to a panel of judges for the Global Final.

Devices in the field will use independent third-party data acquisition to obtain data on device and system performance. This data will be shared with the Teams.

GLOBAL FINAL ROUND: March 2023

The teams that successfully go through the Online Round and complete Field Evaluation will be eligible to participate in the Global Final Round in Orlando, Florida, US, March 2023 (IEEE APEC Conference).

Final details on the Field Evaluation and Global Final will be released prior to the close of the Online Round.

Prizes at the Global Final will include a Global Grand Prize Winner, Student Team Award, and may include Regional Awards and Global winners in each of the tracks, as well as additional prizes.

EBL intends to provide the data loggers used in the Field-Testing Round and may provide some funding to offset travel costs for one Team member to attend the Global Final. EBL will also provide a letter of support to accepted teams so they may fund-raise to offset costs of field-testing and travel for team members to

the Global Final should they be invited. EBL will also provide a crowdfunding platform for teams to fund-raise.

APPENDIX II

JUDGING RUBRIC

INFORMATION FOR COMPETITORS AND JUDGES/REVIEWERS:

Proposals will be judged on the quality of plans presented in the proposal, the likelihood that a team will be successful in meeting the EBL objectives, technical and production feasibility, degree of innovation, and meeting the "WOW!" factors that will generate community excitement and acceptance. Other key criteria are evidence of each team's commitment, capability, experience, and resources to implement their solution in alignment with the metrics provided, over the duration of the entire competition.

Proposal instructions are outlined in Appendix I. Teams invited to participate in field testing and the Global Final are expected to adhere to the basic plans described in their proposals. Only one proposal per team.

This Judging Rubric provides guidance for reviewers and judges who will be evaluating proposals submitted by competing teams in the Empower a Billion Lives competition. It also provides transparency and alignment between competitors and reviewers/judges. The team's success will be assessed using three factors –

- **Impact Score:** measures the impact that the solution has on the family, the community and the environment.
- **Technology Score:** measures how technology is used to solve key challenges including scaling, interoperability, automation, sustainability, affordability.
- **Business Score:** assesses the business model including economic viability, scaling & sustainability.

Each factor has various sub-factors, with examples provided herein to guide the competitors and judges. It should be understood that these are examples and teams can use other criteria that they feel are compelling for their proposed solution. The total score will be the sum of the three individual scores and will be a key factor the judges consider in making their final determination of the Teams moving forward in the Online Round to field testing and the Global Final Round.

Important note: Not all the requirements and criteria presented below will be applicable to all the tracks, in particular End-Use Energy and Enabling Technologies. In most cases, the applicability of the requirement to a Track is obvious and not explicitly indicated.

BROAD SOLUTION REQUIREMENTS:

Qualification Requirement: The proposed set of products or services have to meet customer's growing needs. Proposed solutions should provide at least Tier 2 electricity access (Tier 2 is defined by the ESMAP Multi-Tier Framework for household electricity supply to be min 50 W peak for 30 minutes or min 200 Wh daily supply capacity). Anticipate that a target family may start below a Tier 2 level, but may grow over several years to Tier 2 levels of consumption. The solution should be able to meet the energy needs of the Target Household and the Target Community through this journey.

Target Community:

- 20-1000 homes per community with low population density
- Average purchasing power $1500/year per household
- Currently off-grid with little to no penetration of solar lanterns (Tier 0-1)
- Possibility of a poor grid on a 7-10 year horizon for some locations
- Mostly residential and agricultural, some small commercial, light manufacturing activities present – seeking to transition to a community with much higher income earning potential
- Less than 50% of households have bank accounts, and less than 30% have smartphones

Target Household:

- A typical target household is five people including two parents under forty years of age, with three children under the age of 10. Parents typically have no formal education or crafts training. The family's primary language is a regional language. Their average income is $1.90 per person per day or $1,500 per year for the whole household. (Calculated on a purchasing power parity basis.) Child labor is not allowed.

LOW ENERGY USE FAMILY: Minimal System Performance with Proposed Solution	**HIGH ENERGY USE FAMILY:** Expanded System Performance as Family Situation Improves
▪ Min 200 Wh/day and min 50 W peak power ▪ Available min of 4 hrs/day, and 2 hrs/night ▪ Lighting and phone charging are high priority ▪ Digital inclusion & productivity enhancement ▪ Family is financially constrained, using services when funds are available	▪ Min 1,000 Wh/day or min 200 W peak power ▪ Minimum of 6 hrs/day, and 4 hrs/night ▪ Lighting and phone charging are high priority ▪ Appliances and productivity are important ▪ Family aspires to grow, productivity and community services increasingly important

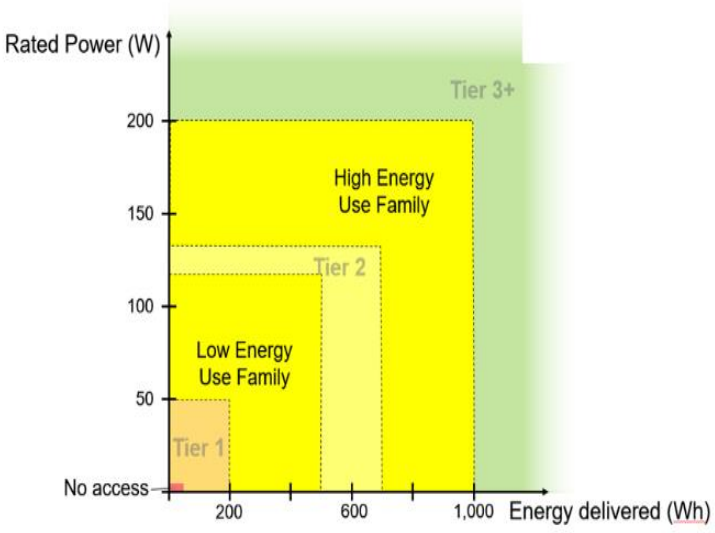

Fig 1: Tier 1 and Tier 2 usage as defined by ESMAP multi-tier framework

Impact Score

It is anticipated that many teams will not have fully informed answers on the Impact Score section during the Online Round. Judges/reviewers expect the teams to show an understanding of the problem, a pathway to a proposed solution, and preliminary results that show that the team has a viable approach and knowledge of the technology areas they intend to use. The Field Test Review and the Global Final will take an increasingly rigorous assessment on the factors shown below.

Table 1.1 below shows the various factors that judges will consider in assessing a team's Impact Score.

Table 1.1 – Impact Score

	Key Factors to Consider
Creates Value for Family and Community	Meets basic LOW-ENERGY USE family residential needs
	Expands to meet HIGH ENERGY USE family needs (including clean cooking, digital inclusion and basic comforts in an energy constrained context
	Improves livelihood and enhances income earning potential for single family
	Meets critical community needs *TrD: Interconnected single home solutions meet community needs* *TrC: Utility system meets community needs* *TrP: Appliance suitable for community productive energy needs*
Easy for Target Family to Use	Simple to deploy and use for target family
	Allows family to affordably meet increasing energy needs
Affordable	Meets family cost and service targets and expandability
	Flexible pricing/payments options, PAYG, subsidized payments
Creates positive social impact	Health and well-being improvements, gender inclusivity
Environmental impact	Reduces or avoids GHG emissions, reduces e-waste, enables circular design
Resiliency	Suitable for providing energy access in communities impacted by climate change, political and social instabilities
WOW factor	WOW factor

As an illustrative example, here are some possible impact issues competitors can consider. Competitors are encouraged and free to use metrics that are consistent with their solution and storyline.

- **Creating Value for Family**:
  - **Basic Low-Energy Use examples**: Space lighting, cell phone charging, radio, television, etc.
  - **High-Energy use examples**: Digital access (laptop or tablet), fan, refrigerator, smart cooking
  - **Enhances single family income earning potential**: Enhances existing non-electrical occupations (dairy, pottery, masonry, weaving, agriculture, sewing, food packaging, etc.); increased income from agri-food activities (irrigation, food processing, cooling, livestock/poultry machinery), new income from activities requiring electricity (advanced sewing, power looms, food stalls,

refrigeration, printing, internet café, etc.); new income from energy infrastructure (sharing energy resources, technical and non-technical support jobs)
    - **Meeting critical community needs examples:** Public lighting. water pumping & purification; education including digital access, lighting, cooling; health facilities (local health centers, telemedicine); job creation through light manufacturing
- **Easy for Target Family to use**:
    - **Simple to deploy and use**: No local technical support needed; Suitable for users with no education (including illiterate users); Rugged in typical use scenarios
    - **Allows Target Family to affordably meet increasing energy needs (example)**: Building blocks allow growth to high-use whenever family needs and can afford; Simple to use wiring and connectors to interconnect discrete elements; Allows use of energy and resources from others in the network to minimize family investments and costs
- **Affordable examples**:
    - **Meeting Target Family cost, level of service & expandability objectives:** Estimate cost per year for family at minimum use level; Show affordable pathway to grow as family needs and ability to pay increase; Is it easy for family to transition from low-use to high-use in 5 years; Preserves value of investment as grid (finally) arrives
    - **Flexible Pricing/PAYG:** Allows pay-as-you-go billing or equivalent functionality; No bank account needed, mobile payments, micro-finance, credit history; Supports electronic wallets – e.g. PayTM, or use of cryptocurrencies; Reduces family cost by providing value to external stakeholders
- **Environmental impact examples:**
    - **Reducing e-waste** by extending life-time of components and systems; use of recyclable, abundant and non-toxic materials; facilitating repairability, reuse and recyclability of components and systems
    - **Avoiding or reducing GHG emissions** by replacing polluting energy sources by clean ones
- **Resiliency**
    - **Easily deployable solutions** in contexts of displaced populations, communities affected by extreme events caused by climate change.
- **WOW factor**:
    - Provides new and unexpected insight and novel way of creating value for target customers

Tech Score

It is anticipated that many teams will not have fully informed answers on the Tech Score section during the Online Round. Judges/reviewers expect the teams to show an understanding of the problem, a pathway to a proposed solution, and preliminary results that show that the team has a viable approach and knowledge of the technology areas they intend to use. The Field Test review and Global Final will take an increasingly rigorous assessment on the factors shown below.

Table 1.2 below shows the various factors that judges will consider in assessing a team's Tech Score.

Table 1.2 – Tech Score

	Key Factors to Consider
System Specification	Generation and energy storage *Meets min Tier 2 requirements*
	Power delivery, control and monitoring
Scalable	Technology enables rapid scaling and large device fleet management
Expandable	System expands as need grows without large upfront investment
Operations and sustainability	Ease of installing, commissioning, maintaining and servicing system and fleet of devices and wires (if needed)
Interoperability	Enables use of solutions from different vendors at the end-user level; stimulates standardization of hardware, software and architectures; enables integrated power system of the future
Cloud Connectivity	Novel low-cost communications backbone (or similar function without connectivity)
Advanced Features	System optimization and analytics
WOW factor	WOW factor

As an illustrative example, here are some possible impact issues competitors can consider. Competitors are encouraged and free to use metrics that are consistent with their solution and storyline.

- **System Specification examples**:
  - **Generation and energy storage:** Peak watts; watt-hours per day; availability on-demand; cycle efficiency, life, charge-discharge cycles, size, safety
  - **Environmental system footprint**: Delivers Tier 2 power and energy with low carbon footprint; compact and lightweight; easy and intuitive to install, commission, & operate; operates in target environment; fully recyclable at the end of life
- **Scalability examples:**
  - Measurement, bill delivery and dues collection in target community; minimizing cost of managing fleet of energy devices in multiple regions; remote stop and start service upon theft, non-payment or non-compliance; Not dependent on region-specific service providers
- **Expandability examples**:
  - Ability to expand with family/market growth and need

    - Easy interconnection of single-family home sources and storage to create a higher capacity system to meet community needs
    - Fully plug and play, modular, easy in-field upgrades, expand loads/sources
- **Operations and sustainability:**
    - Easy install & commission process without need for trained field personnel; Servicing/maintenance by local people with minimal technical training; automated fleet management process, including remote diagnostics; managing regional compliance needs
- **Interoperability examples:**
    - Appliances of different vendors compatible with the energy system; interoperability with other types of energy systems (microgrids, SHSs, grid); open-source solutions that enable scaling
- **Cloud Connectivity examples:**
    - Benefits of cloud and internet connectivity, asset tracking, fleet management, additional value delivery from external stakeholders, ability to realize these functions without Cloud Connectivity
- **Advanced Features examples**:
    - **System optimization & Data Analytics**: estimate energy availability over week, learn profiles; Cloud connectivity and fleet data access for superior optimization; Advanced data analytics across device fleet, allows 'sharing economy' model
- **WOW Factor**:
    - Uses technology in novel ways to provide exciting new value and has game changing potential

Business Score

It is anticipated that many teams will not have fully informed answers on the Business Score section during the Online Round. For the Online Round, the judging metrics are intended to guide the teams and the judges on factors that are considered important and to have the teams express how they are thinking about these issues.

Table 1.3 below shows the various factors that judges will consider in assessing a team's Tech Score.

Table 1.3: Business Score

	Key Factors to Consider
Financial Model	Simple financial model, including key assumptions *Target is to serve two representative communities - of 100 homes, 1000 homes, where consumption grows from LOW-USE to HIGH-USE in 5 years*
	Economic viability
	Value Stacking
Scaling	Billing and Collection Model
Resilient	Dropping prices
	Sporadic income streams
External Funding	Subsidies
	Novel funding models to help scaling
	Value for external stakeholders
WOW factor	WOW factor

As an illustrative example, here are some possible impact issues competitors can consider. Competitors are encouraged and free to use metrics that are consistent with their solution and storyline.

Business Score Factor Examples:

- **Financial Model examples**: Estimate of cumulative capital expenses needed through Year 1 and Year 3 (includes total product, plant, poles, meters, civil works and other costs); total operating and financing costs estimated through Year 1 and Year 3 (includes distribution, sale, commissioning, maintenance, servicing, fuel, etc.); Total revenues expected through Year 1 and Year 3, and assumptions on price of energy and customer billing model
- *Teams are expected to have increasingly complete business models and information as they get closer to the Global Final competition*
- **Economic Viability examples:** Price of energy delivered to customers to reach breakeven for 100 home LOW-USE community; Price of energy delivered to customers to reach breakeven for 1000 home HIGH-USE community; show when breakeven occurs
- **Value stacking:** enabling and creating multiple value streams

- **Scaling example:**
  - Purchase or service/lease model with Pay-Go and remote disconnect; mobile wallet, bank-less transactions, microfinance, credit; ability to bill and compensate prosumers who own generation and storage; automated to enable scaling to 1 million total customers
- **Resiliency example:**
  - **Dropping prices:** Impact of rapidly dropping prices of PV solar, batteries and other technologies on the economic viability of the business model
  - **Sporadic income streams:** Ability of business model to handle a customer base whose income can be sporadic and unreliable (pay when they can)
- **External Funding factors:**
  - **Subsidies:** Subsidies or grants used, and plan for economic viability without subsidies
  - **Novel funding models for scaling:** Novel funding and operational models (e.g. peer-peer funding, crowdsourcing) for rapid scaling & economic viability
  - **Value for external stakeholders:** Value generated for external stakeholders (financial institutions, credit monitoring, digital inclusion, other), and the impact on the financial model
- **WOW factors:**
  - Uses business model innovations to provide unexpected value and improve chances to reach scale