

# Technology Requirements Brief (TRB) on Solar Energy for Rural Communities

**Purpose:** This brief facilitates the scanning of global markets for innovative technologies that address core development challenges. It does not constitute the start of a bidding process but rather outlines specific technical requirements with the aim of building a pool of scalable solutions in Solar Energy that meets the technological demands of IsDB Member Countries. These technologies are intended to be integrated into IsDB financed projects to improve project efficiency and overall impact. IsDB may contact suitable respondents to learn more about technology as part of its due diligence before recommending for its deployment.

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## 1. Development Challenge

Global Electrification dataset of 2023 shows that 49% of IsDB member countries have achieved full electricity access for their populations while those countries still experiencing unreliable supply, such as frequent power outages. Limited electricity access constrains economic growth, hampers technology adoption and digitalization, and reduces the efficiency and productivity of critical sectors including finance, healthcare, and education.

Rural communities face even greater challenges, as extending traditional grids can be prohibitively expensive, discouraging providers from investing without subsidies. While solar energy offers an alternative, its adoption is often hindered by the high cost of reliable, high-quality systems. Lower-cost options, though more affordable, typically have shorter lifecycles, making them less sustainable.

## 2. Desired Development Outcomes

To improve access and favorably impact on the associated development outcomes, it is important to scale up rural electrification networks through provision of affordable, reliable and sustainable electricity access to businesses and households in underserved communities, particularly rural areas. Therefore, exploring innovative approaches has become a pressing need to i) increase cost-efficient energy access for households and businesses in underserved communities, ii) reduce reliance on fossil fuels, lower carbon emissions, and iii) empowerment of local economies through productive use of energy.

### 3. Existing conditions, Deployment Context & Readiness

Solar energy is one of the most versatile and rapidly growing sources of renewable energy, in IsDB member countries as well as globally. As the world seeks alternatives to fossil fuels, solar energy stands out as a clean, abundant, and sustainable solution for households seeking to meet their energy needs. Solar technologies capture sunlight and convert it into usable energy forms, such as electricity or heat, through various applications. The widespread use of solar energy systems has been accelerated due to advancements in technology, affordability, and the global push toward reducing carbon emissions.

Deployment of solar energy for household applications in rural communities should come with proper and sustainable business model that involve balancing affordability, accessibility, and sustainability while ensuring financial viability for the provider, primarily through solar home systems, rooftop solar panels, or hybrid setups (e.g., solar + battery + backup grid). This business model aims to reduce reliance on conventional electricity grids, lower household electricity bills for low-to-middle income families with limited upfront capital but long-term savings goals in addition to contributing to environmental sustainability.

### 4. Required information and Technology Functional and Performance Requirements Technology Requirements Table (TECH-aligned)

Generally, innovative solar energy solutions should address the challenges highlighted in this brief, with high cost effective, high transformation potential, be environmentally friendly, easily deployable using turnkey modality (from design to operations), mature and tested, market-ready with proven track record, and be easily adaptable within member country contexts. In addition to equipment, civil works, installation, operation and training, the solution provider should introduce a user case for reducing the long-term financial burden of the people in rural areas by being affordable alternative to kerosene lamps, candles, wood fires etc. In addition, cost comparisons should also be made with in-grid electricity.

#### i) Required information includes the following:

- Evidence of performance – certifications, test results, case studies
- Financial parameters – indicative cost, operational model (CAPEX/OPEX), payback
- Business model and proposed approach for LDMC adaptation
- Existing deployments in developing countries (if applicable)
- Track record of deployment to at least three customers with total sales revenue of at least US\$20 million.

The technology appraisal form (Annex 1) must be completed in addition to the above information requested.

ii) **Specific Technical and Financial requirements:**

The following are the specific technical and financial requirements that are to be met by the innovative solar energy technologies in providing a turnkey solution.

**Technical Specifications and Attributes**

- Recommended Battery: Lithium-Ion Battery (long lifespan, lower maintenance), size 4-5 kWh
- Recommended Inverter: Pure Sine Wave Inverter (better for sensitive electronics), size: 2.5 – 3.0 kW
- Recommended Solar Panels: Monocrystalline with size 1.5 – 2.5 kW
- Systems must withstand dust, humidity, and temperature extremes.
- Modular designs for scalability in diverse rural terrains. Components should be easy to source to ensure long-term maintenance capability.
- Model of delivery that includes a) installation of solution; b) Methodology of providing capacity building/ training provided to customers on usage of the solution
- Details on guarantee provided on solution, maintenance requirements and after-sales service.

**Financial requirement**

The following are the proposed financial investment and business model.

<b>Proposed Financial Investment</b>	
Initial Investment Costs	\$5,600 - \$10,500
Operating Cost	\$10 – \$100
Long-Term Cost Analysis (10 – 20 years)	\$5,700 - \$12,500

<b>Proposed Business Models</b>				
Business Model	Ownership	Initial Investment	Typical ROI (%)	Payback Period

Direct Sales/ Upfront Purchas	Homeowner	High (\$4,000 – \$10,000 per system)	10 – 15%+	5–8 years
Solar Lease	Third party	Low or None	4 – 7% (indirect, via bill savings)	No ownership, fixed savings
Pay-As-You-Go	Gradually to homeowner	None upfront	8 – 12%, varies by region	3–6 years to ownership
Community Solar	Shared or subscription	No capital expenditures	3 – 6% (energy bill credits)	Immediate benefits, no ownership
Solar-as-a-Service	Provider	None	4 – 7% equivalent savings	Ongoing subscription

## 5. Potential Risk and Safeguards

In terms of other requirements, it is important to note that turnkey deployment of the innovative solar energy technologies will be aligned with the following mitigation measures to avoid risks:

- **Non-Suitability and/or non-sustainability of technology:** Selected technologies will be subjected to independent evaluations, to determine validity of the claims, and the implications for adapting the technologies. Only proven and tested technologies will be considered, noting that capacity development and technology transfer implications for technology adoption should be clearly outlined in the technology appraisal form (Annex 1).
- **Cost- effectiveness and competitiveness:** Comparative analysis of available technologies will be conducted to ensure that the cost of the proposed technology is reasonable and competitive.

## Annex-1 Technology Appraisal Form (TAF)



### Technological Solution Appraisal

*Department: Cooperation and Capacity Development*

*Division: Science, Technology & Innovation*

*Completed by: Name: ..... Designation: .....*

*Signed: .....*

*Date: .....*



The purpose of this technology appraisal tool is to provide a structured tool and methodology to identify and evaluate deployable technological solutions that respond to the needs of IsDB MCs. The tool will help the Bank and other relevant stakeholders to make informed decisions for investments in any technology. This framework examines the usefulness, adaptability, adoption and sustainability of various technologies (existing and emerging). Methodology

The tool enables IsDB to validate proven technologies that have been sourced through a structured method for individual technologies and comparing multiple technologies in similar or different domains. This customized tool was developed based on a comprehensive desk review of similar tools used by international organizations such as UN agencies as well as private companies, while taking into consideration the role of the Bank in promoting practical technology deployment for addressing MCs' development challenges.

The information required will be collected from the technology provider while additional information will be sourced from the prospective beneficiary to assess the readiness/enabling environment and feasibility of deployment of the proposed solution. The tool can also be completed by IsDB STI staff in consultation with the technology provider and in exceptional cases involve a 3rd party independent evaluator. The framework of assessment is based on six main parameters focused on examining Technical, Economic, Social and Environmental Impacts of the technology as well as the Resource required and related Policy and Regulatory Framework.

**Technical Impact:** This parameter is used to assess the performance of any technology in terms of technical efficiency, technological maturity, ease of installations, reliability, lifetime, etc. (*Maddox, Boozer, & Forte, 2014*) (*Hou, Lu, & Han, 2008*)

**Economic Impact:** Evaluates the economic factors related to specific technology, such as investment costs and operational costs on the implementation of any technology (*Vera Solutions, 2019*).

**Resource Requirements:** looks at the resource requirements (raw materials, equipment, manpower, etc.) during the various stages of technology development and use (manufacturing and operation) (*Daim & Intarode, 2009*).

**Policy and Regulatory Framework:** Examines the existing policy and regulatory frameworks and assesses the impact of any technology adoption and deployment (*IRENA, 2014*).

**Social Impact:** Assesses the impact of technology on the community, which includes social awareness and societal benefits (job creation, affordability, health impacts, etc.). It examines the pros and cons of technology deployment in the community. (*Siksnelyte-Butkiene, Zavadskas, & Streimikiene, 2020*).

**Environmental Impact:** looks into the impact of technology on the environment, with a focus on lifecycle emissions, associated degradation impacts on land, water, air, etc. (Ghosh & Bhowmick, 2014).

The information provided under the six criteria would help in analyzing the level of risks associated with a given technology using the proposed Risk Metrics.

### The Assessment Tool

The Technology appraisal framework can be used to assess both emerging and mature technologies in various sectors including agriculture, energy, water, health, digital transformation, etc. It can be applied to examine the performance of any individual technology as well as to compare multiple technologies in similar or different domains. The information provided in this section/Form will form the basis for the evaluation and selection of the technological solution being examined. The Form consists of the following Four sections:

- **Section A: Basic Information about the Technological Solution**, capturing technology related information including the sectoral challenge its addressing and whether it supports the creation of goods and services, etc.
- **Section B: Information on the Solution Provider**, capturing information about the solution provider including institution information, registered status, profile, contact information and field related to SDGs, etc.
- **Section C: Technology Assessment Form** provides a set of guiding criteria in assessing the Technical, Economic, Social and Environmental Impacts of technology as well as the Resource required and related Regulatory Framework.

- **Section D: Risk Assessment Metrics:** to assess risks associated with technology deployment.

### A. Basic Information about the Technological Solution

- 1- **Name of Technological Solution:** \_\_\_\_\_
- 2- **Sector/Thematic**  
*Please specify the sectoral/thematic areas related to technology (Health, Education, Energy, Water, Agriculture, ICT, etc.)*
- 3- **Brief Description**  
*Please provide a brief description of the technology and its applications.*
- 4- **Challenge addressed by the technological solution**  
*Please specify the development challenge addressed by the technological solution, indicating how technology solves this challenge.*
- 5- **Deployment potential:** Does the technology/app/method involved in your solution has a registered status as IPR (Intellectual Property Right) such as patent, trademark, industrial design, copyright, plant variety certificate, etc., protecting against illegal (unauthorized) use, offering for sale? **(Yes / No)** - *please specify*

### B. Technology

- 6- **Solution Provider Name:** \_\_\_\_\_
- 7- **Type of Entity:** *Please select from the list below*
  - *Innovator & SMEs & Startups*
  - *Government Institutions*
  - *NGO*
  - *R&D Institutions**please select registered status/type (NGO, Government entity, R&D, etc.).*
- 8- **Profile of Entity:**  
*please add your entity profile including bios, experience, achievements, and international cooperation's.*
- 9- **Technology application:** *please specify where your technology has been used/applied, indicating the track record of the entity in using this technology?*
- 10- **Contact Information**
- 11- **Field of Technology/Industry**  
*Please specify your field of technology / industry describing what product or service you provide and, who are your beneficiaries/customers/clients? What is the expected benefit of your product or service? What is the value proposition of your proposed work?*
- 12- **UN Sustainable Development Goals (SDGs) focused area/Industry**  
*Please specify the SDGs related to your focused industry.*

### C. Technology Assessment Section

i) Technical Assessment:

<i>Criteria</i>	<i>Assessment</i>	<i>Remark</i>
<b>Technological Maturity:</b> Assessment of readiness levels and maturity of a technology at the global level	<i>Choose from Score (1-3)</i>	1-System prototype; 2- tested and piloted; 3- successfully implemented and operational;
	Time of continuous use per day	Time (in hours)

<b>Reliability:</b> how do you rate the ability of the technology to perform in a given period of time without any failure.	Breakdown Frequency per year (please specify)	Number (per year)
<b>Ease of Installation:</b> How easily the components/parts of the technology can be installed	Man-hours	Number of persons * hours required (Please specify number of hours a person needs to work in order to install)
	Skills needed	<i>Please specify the technical skills needed to install the technology</i>
<b>Scalability:</b> Applications in other sectors with respect to technology	Measure scaleup potential in multi sectors	Yes/No/customization needed
<b>Utility Requirements:</b> How much of the utilities is required to use the technology	Electricity consumption	#Units required
	Water consumption	#Units required
	Alternate energy consumption	Please specify
<b>Operation:</b> to measure the level of sophistication of operations of technology	Periodic Maintenance requirements	Please specify the frequency per /day/month/year
	<b>Accessibility to repairs and maintenance:</b> Who conducts the repairs and maintenance?	1-Technology provider, 2-capacity available in the country, 3-capacity development required
	<b>Usability</b> is how effectively and efficiently consumers can use a technology	Please specify the ease of use of the technology 1–3 (1=very easy, 2= easy, 3= difficult)
	Technology lifespan	#Months/ Years
	Safety Measures	Please specify measures of safety associated with operation of the Technology.

## i) Economic Impact Assessment:

Parameters	Assessment	Amount in USD
<b>Deployment Cost (Capital expenditure):</b> Investment expenditure required to acquire technology (equipment cost, service charge, etc.)	Cost of equipment/software application/Intellectual Property Rights cost (I PR)	Please specify based on the country in use \$
	Licensing/ Subscription cost costs fees	Please specify in \$
<b>Operation and Maintenance Cost:</b> Costs associated with operations and maintenance of the technology (raw materials, energy, labour, etc.)	Cost of raw materials and consumables (if any)	Please specify based on the country in use \$
	Estimated Service Maintenance cost	Please specify based on the country in use \$
	Estimated Labour cost	Please specify based on the country in use \$
	Estimated training cost to operate the technology	Please specify \$
	Expected annual depreciation rate	Please specify \$
	Repair Costs	Please specify \$
	Investment returns/profitability rate	Percentage (%) sales to expenses

<b>Expected Return on Investment:</b> Annual return as a percentage of the capital cost	Taxation requirements for deployment	% value
<b>Benefit:</b> benefits obtained as a result of using technology	Benefit generated by increased production	Please specify
	Benefit generated by reduced costs	Please specify
	Other direct benefits generated that can be quantified	Please specify
	Other indirect benefits (that may not be quantified)	Please specify

## ii) Resource Requirements

Parameters	Assessment	Units
<b>Raw Materials:</b> Nature of raw materials required to assemble/build the technology	Type of raw material used	Please specify
	Availability of raw materials	Available/Scarce/ Not available
	Substitutes for the raw material	Available/Scarce/ Not available
<b>Domestic availability of equipment</b> used in the technology (assess the availability of local spare parts required)	Spare parts available/not available	If available, please provide the list
	<b>Interoperability:</b> ability of the new technology to work in sync with existing ones	Yes/ No
	Opportunities for domestic reproduction of the parts	Yes/ No. Please specify
<b>Manpower/Skills:</b> of skills required to operate the technology	Number of Manpower needed to operate the technology	Please Specify
	skills required	Please Choose: Skilled/semi-skilled or NOT skilled
<b>Training Needs:</b> Is there any specific training required to operate the Technology	training needs	Yes or no, if Yes, please specify the training needs cost/staff
<b>Technology Infrastructure requirements:</b> what infrastructure is required to host the technology	Infrastructure needs may place a heavy burden on the deployment of a particular technology, so we need to understand any specific requirement	Please specify (e.g. 5G internet connection, greenhouse, ICT lab, office space, etc.

## iii) Policy and Regulatory Support (recipient of Technology):

Parameters	Assessment	Score
<b>Policy Instruments:</b> policy support, regulations, and standards to promote any technology:		
<b>Policy/regulatory</b> instrument to support the diffusion/acquisition/implementation of technology		Exist (Yes/No) <i>Please specify</i>
<b>Standards:</b> standards and legal boundaries for any technology	Quality control, standards, guidelines, prohibition, quota, ban, etc. (Direct support, indirect support technology by putting restrictions on others)	Exist (Yes/No) <i>Please specify</i>
<b>Incentives:</b> favorable and motivations for a particular technology/innovation support towards encouraging the deployment of technology.	Fiscal incentives (Capital subsidy, investment tax credits, production tax credits, production-linked incentives/feed-in-tariff—preferential tax, purchase obligation, power purchase agreement, etc.)	Exist (Yes/No) <i>Please specify</i>
<b>Governmental support:</b> Is there support/endorsement from the Government for the use of the technology?	Governor, line ministry, local government, parliament/ senate, head of state, etc	(Yes/No) <i>Please specify</i>
<b>Programs for innovation Support:</b> Government's intervention in supporting research & development and innovation for new technologies	Support for technological innovation	Specify
	R&D support	Specify
	Technology upgradation support	Specify
<b>Technology Sourcing Country:</b> Assess the ease in Technology Transfer/sourcing from global tech partners/companies	Ease of sourcing (planning, transportation, implementation, cost, etc)	1–3 (1=very easy, 2= easy, 3= difficult), if difficult please mention the reason(s)
	Regulatory Matching (countries follow different standards, regulations, rules, etc.)	1–3 (1=high, 2=medium,3= low)
	Trade restrictions/barriers	Exist or not; if yes:1–3 (1=high level, 2= moderate level, 3= low level)
	Intellectual property Rights (IPR) protection	Exist or not;

## iv) Social Impact Assessment

Parameters	Assessment	Units
<b>Social Acceptance:</b> Measures the level of acceptance of the technology among local stakeholders		
<b>Awareness</b> (about the technology and its impacts)		1- Low/2- Medium/3- High
<b>Perception</b> - How is the technology perceived by the community		1- Low interest /2- Neutral/3- High interest
<b>Culture and Norms:</b> Does the technology fit into the cultural and social norms of the recipient		(Yes/No), if No <i>Please explain</i>
<b>Number of Potential Beneficiaries:</b> Number of people/members of society, institutions benefitting from the technology	This includes direct and indirect beneficiaries (those closely linked to the technology and other secondary beneficiaries)	<b>Number of people = (please specify direct and in direct)</b>
		<b>Number of Institutions = (please specify direct and direct)</b>
<b>Job creation potential:</b> opportunities for new job creation		
<b>Number of direct and indirect potential jobs/generated -</b>		Number of jobs (please include full-time, part-time jobs)

<b>Gender diversity:</b> Technology can be used by all groups including people with special needs	Yes or no, if not, please elaborate
<b>Standard of Living:</b> Potential to improve the standard of living of citizens by providing access to essential services or goods offered by the technology	
<b>Improving standards of living</b> (in terms of income levels, wealth, etc.)	Contribution of Technology to improving standards of living 1- Low/2- Medium/3- High Please explain
<b>Affordability</b>	To what extent the technology is accessible to all segments of the population? 1-Cheap and Affordable to all; 2- Specific group with medium income level; 3- High income only

## v) Environmental Impact

Parameters	Metric	Units
<b>Impact on Ecosystem:</b> Impact of technology on the natural habitat of various living beings		
Impact on biodiversity (living beings)	1-4 (1=High, 2=Medium, 3=Low, 4= none)	
Impact Air quality	1-4 (1=High, 2=Medium, 3=Low, 4= none)	
Impact on water resources	1-4 (1=High, 2=Medium, 3=Low, 4= none)	
Impact on land	1-4 (1=High, 2=Medium, 3=Low, 4= none)	
<b>Life Cycle Environmental Impact:</b> impact of local pollutants and Greenhouse Gas Emissions (GHG)/ throughout the lifespan of a technology		
Emissions of harmful substances	1-4 (1=High, 2=Medium, 3=Low, 4= none)	
GHG emissions	1-4 (1=High, 2=Medium, 3=Low, 4= none)	
Noise pollution: Assess the level of unpleasant noise/sound produced because of using the Technology	1-4 (1=High, 2=Medium, 3=Low, 4= none)	

## D. Risk Assessment

<b>Technology Sustainability :</b> Assess the potential for losses due to technology failure	
Change in technology usage/obsolescence	Please chose from 1-3 (1=High, 2=Medium, 3=Low)
Competing emerging technologies	Please chose from 1-3 (1=High, 2=Medium, 3=Low)
Changes in policy and regulations supporting the diffusion/use of the technology, etc.	Please chose from 1-3 (1=High, 2=Medium, 3=Low)
<b>Financial Risk:</b> various financial risks associated with the operation and maintenance of any technology	Rate
Investment Costs	1-3 (1=High, 2=Medium, 3=Low)
Operational costs	1-3 (1=High, 2=Medium, 3=Low)
Payback period	1-3 (1=High, 2=Medium, 3=Low)
Political risk and uncertainty	1-3 (1=High, 2=Medium, 3=Low)
<b>Resource Risk:</b> Assess the potential risk associated with key resource availability.	
Dependency on imports for raw material availability	1-3 (1=High, 2=Medium, 3=Low)
Global supply chain disruptions	1-3 (1=High, 2=Medium, 3=Low)
Labour requirement	1-3 (1=High, 2=Medium, 3=Low)
Raw material price volatility	1-3 (1=High, 2=Medium, 3=Low)
<b>Social Risk:</b> Potential risk of adoption of the Technology by the community	

Long-term impact on a community in terms of acceptance/social norms	1-3 (1=High, 2=Medium, 3=Low)
Impact on employment	1-3 (1=High, 2=Medium, 3=Low)
Impact on quality of life, affordability, health impacts	1-3 (1=High, 2=Medium, 3=Low)
<b>Environmental Risk:</b> Potential harm to the environment caused by any technology/project	
Long-term impact on the ecosystem, GHG emission potential, noise pollution, etc.	1-3 (1=High, 2=Medium, 3=Low)