TERMS OF REFERENCE

BASELINE HOUSEHOLD ENERGY SURVEY IN SINDH PROVINCE OF PAKISTAN

1. BACKGROUND

Accurate estimates of the electricity access rate in Pakistan presents several hurdles, but it can reliably be said that there are significant access gaps, especially in rural areas. The most recent census, in 2017, indicates that there are over 32 million households in the country, and NEPRA reports just under 23 million household connections[1]—which implies an electricity access rate of just over 70 percent. In Sindh Province, however, the rate is much lower, at 39.6 percent[2]. Efforts to bridge the gap in electricity access have been conducted primarily through grid extension, which is uneconomic in some rural areas because of low population density, high dispersion among rural settlements, and revenue collection issues. Provision of off-grid solutions have relied on small hydropower in the northern provinces of the country, and there have been limited attempts to provide solar home systems (SHSs) in the southern provinces. However, government-provided solar home systems (SHSs) have often suffered from high rates of system failure and abandonment, usually due to a lack of long-term operation and maintenance (O&M) support and limited engagement of the targeted households. In the absence of a decent electricity service, Pakistani households spend an estimated $2.3 billion annually on alternative lighting products/services such as kerosene, gas lights, and battery-powered torches[3].

With a likely access deficit in both the availability and quality of electricity supply, Pakistan has the potential to be a large market for SHSs at a time when commercial provisioning of such systems is starting to take off. [4] However, Pakistan's SHS market is characterized as early-stage, with the only limited adoption of high quality systems and pay-as-you-go technology, despite a potential market size of 22 million households.

Sindh Province is key to increasing the share of renewable energy generation in Pakistan and to developing new ways of providing electricity access. With excellent solar resources, the remoteness of off-grid villages, the inability of many consumers to afford grid connections, and the erratic provision of power argue in favor of expanding the SHS market, with technically and commercially sustainable product solutions.

Sindh Energy Department (SED, or the "Client") has obtained financing and technical support from the World Bank to expand solar power and increase access to electricity under the Sindh Solar Energy Project (SSEP).[5] Component 3 of SSEP targets the second of these objectives, and includes the target of providing SHSs to 200,000 households within the five year project timeline. Under Component 3 SED will identify target districts with low levels of electricity access and provide partial grants to households to

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[1] NEPRA. 2016. "State of Industry Report 2016." http://www.nepra.org.pk/Publications/State%20of%20Industry%20Reports/NEPRA%20State%20of%20Industry%20Report%202016.pdf.

[2] NEPRA in 2017, reported a total number of domestic connections of 3,400,260 in Sindh. This translates into an electricity access rate of 39.6% for Sindh, with roughly 5,185,350 households without electricity connections.

[3] IFC. 2015. "Pakistan Off-Grid Lighting Consumer Perceptions: Study Overview." http://lightingasia.org/Pakistan/market-intelligence/.

[4] WBG. 2018. "Global Off-Grid Market Trends Report: 2018." Washington, DC. https://www.lightingglobal.org/2018-global-off-grid-solar-market-trends-report/.

[5] Refer to Project Appraisal Document for further details of SSEP: http://projects.worldbank.org/P159712?lang=en

assist them in purchasing a SHS from private sector SHS suppliers. SED will also commission a consumer awareness campaign, and a robust monitoring and evaluation (M&E) program.

To support the implementation of SSEP, and in particular the targeting of districts (and households within each district), design of the consumer awareness campaign, and the appropriate level of the grant to be offered to households, SED has committed to carrying out two household energy surveys in Sindh Province, at the start and end of SSEP, using the recently established Multi-Tier Framework (MTF) for measuring energy access. The MTF has been developed by the Energy Sector Management Assistance Program (ESMAP) within the World Bank, in consultation with other international agencies and experts, and has already been deployed in 15 countries.[6]

2. OBJECTIVES OF THE ASSIGNMENT:

This assignment, which corresponds to the first of the two surveys to be commissioned under SSEP, is for a baseline household energy survey in Sindh Province using the MTF. The survey shall collect household level information on electricity consumption, expenditure patterns, spending and usage on alternate forms of lighting and other needs, and some limited data on non-electricity energy usage. The results of the survey shall provide:

- Detailed information on the state of energy access in Sindh for the purposes of provincial and national policymaking, and national and international reporting (including on UN Sustainable Development Goal 7);
- Baseline information to facilitate results tracking under SSEP;
- Information on the behaviors and attitudes of households with low levels of electricity access to inform the implementation of SSEP; and
- A template for carrying out a high-quality household energy survey for potential replication in other provinces or at the national level.

SED seeks the services of a reputed firm, or consortium of firms ("Consultant"), which has/have extensive experience in implementing household surveys, preferably with some experience of energy issues. The total sample size for the survey across all 29 districts of Sindh shall be a minimum of 11,000 household survey questionnaires and between 700-900 community questionnaires, with oversampling in 12 districts that have particularly low levels of energy access. The names of the low energy access districts are as follows:

- Thatta/Sajawal;
- Badin;
- Tharparkar;
- Umerkot;
- Khairpur;
- Sanghar;
- Ghotki;
- Kashmore;
- Jacobabad;
- Qambar Shahdadkot;
- Shikarpur;

[6] http://www.worldbank.org/en/topic/energy/publication/energy-access-redefined

- Dadu.

3. SCOPE OF WORK

The assignment has three major components as outlined below. Details of the activities and specific deliverables are provided in Section 4.

i) ***Design and implement baseline household energy survey***: The Consultant shall be provided with two questionnaires: the household MTF energy access questionnaire (https://energydata.info/dataset?q=MTF), and the community questionnaire. The consulting firm shall revise the two questionnaires, with inputs from SED, to reflect the country and regional context. The consulting firm shall carry out tablet- or smartphone-based surveys using Computer Assisted Personal Interviewing (CAPI) or other similar techniques. In addition, the firm shall be responsible for collecting other secondary/administrative data, as needed, for the analysis as well as sampling. The Client aims to achieve a 7-8% margin of error for each of the 12 districts and 15% for each of the other 17 districts. Considering the stratification strategy and the margin of error, the estimated sample is set at a minimum of 11,000 households. The firm shall work with SED, and the World Bank in its advisory role, to identify sample units (lower geographical units down to Primary Sampling Unit (PSU)) using a sampling frame that is representative at a district level. In addition, the firm shall hire and train the survey team, pre-test the questionnaires and their adaptation to local conditions, and finally implement the surveys. The sample selection, questionnaire content and survey team are covered under specific tasks.

ii) ***Clean data and archive them in a suitable format***: The collected data shall be entered into a database and cleaned. The final data including raw and clean datasets shall be delivered in Excel and Stata. The hired consulting firm shall produce their database with GPS coordinates, and start and end timestamp of the samples. The collection of data shall be through a reliable electronic device recording both the GPS coordinates and the timestamp of the sample.

iii) ***Submit the final survey completion report***: The consulting firm shall carry out a basic descriptive analysis of the cleaned data. The report shall include, among others, a detailed description of all pre-survey and survey activities, including issues that arose during the survey, and provide the means used to resolve them in addition to data findings.

4. ACTIVITIES AND DELIVERABLES

The consulting firm shall be responsible for delivering high-quality data and within the specified timeframe. Specifically, the hired consulting firm shall be responsible for the following activities and tasks:

i) Design and implementation of a baseline household energy survey

This includes all the pre-survey activities, starting from sample design to finalizing questionnaires, and administering the survey. The activities under this task are described here.

a. Questionnaire development and revision:

- The consulting firm shall use the English version of the MTF energy access household survey questionnaire and the community questionnaire, developed by the World Bank, as a starting point. ESMAP-World Bank has prepared standardized questionnaires and major changes should be avoided. The hired consulting firm, however, shall be responsible for adapting the questionnaires to get context-specific responses, carefully considering the importance of cross-country comparability upon consultation with SED Staff. The consulting firm shall review the questionnaires and improve the wording, ordering, skip-patterns and placement of questions where necessary to ensure objectivity and accuracy. Additionally, the firm shall collect requisite background information to inform data collection activities.
- The consulting firm shall be responsible for the translation of the questionnaire into local languages (Sindhi). The translation shall be checked and approved by SED to ensure accuracy.
- CAPI: The consulting firm shall develop necessary scripts/programs (or customize existing scripts in case of CAPI), enter the questionnaires electronically into tablets in suitable formats, and develop necessary web-server with the capability to receive the completed questionnaires via the internet (using Wi-Fi technology and cloud-based computing technology) and process them. The preferred CAPI software is Survey Solutions; however other well-known programs providing comparable functionality shall also be acceptable by mutual agreement. The software programs shall have the basic capabilities of tablet-based questionnaires, including efficient response entry, skip patterns, and basic validation of the data. The firm shall outline how data will be stored, validated, backed-up and transmitted to SED. SED shall be able to access the data throughout the data collection process. Paper-based surveys shall only be allowed in specific cases with valid justification and upon agreement with SED, e.g. due to security concerns.
    a. It is the responsibility of the survey firm to acquire software licenses and equipment for the surveys.
    b. Questionnaires shall be programmed with logical skip pattern. The first draft of the CAPI version or other software shall be done before the training begins. After the training and pre-testing, the software program shall be revised incorporating the feedback from the training and pre-testing.
    c. The questionnaire shall allow valid open-ended and “other” textual responses outside of the response options provided in the questionnaire. The “other” category shall be elaborated in the text with an additional entry.
    d. The program shall incorporate basic validation such as range and consistency checks, as the data are entered.

b. Estimate the sample size, design the sampling strategy and conduct household listing:

- The sample selection for the household surveys for each of the districts shall be based on a 2-stage stratified random sampling strategy and representative of the province (29 districts) and urban/rural areas. In addition, the sampling strategy shall be representative and secure certain precision for each of twelve targeted districts (See Section 2) by oversampling. The total sample size for a household survey shall be a minimum of 11,000 households and the sample size for the community survey shall be 700–900 depending on the number of PSUs. The methodology

for the sampling and the determination of the ultimate sample size shall be closely coordinated with SED and the ESMAP-World Bank team.

- Access to the sampling frame: The Consultant shall use the most recent population and housing census at Enumeration Area (EA) level as the sample frame for the first sampling stage. The Consultants shall access the sampling frame and their relevant maps from the most recent population data and should be ready to liaise as appropriate with the Pakistan Bureau of Statistics office. The technical proposal shall describe how the Consultant will access to the sampling frame or alternatively develop the own sampling frame. To ensure that the most efficient sampling design is used, it is expected that the primary sampling unit (PSU) is the EA (block, ward, etc. for urban areas) of about 150-250 households in average, and 12-15 households should be selected from each PSU. If the size of an EA is too large (more than 500 HHs), the EA may be split. This segmentation shall be based on 250 households.
- Stratifying parameter:
    a. Grid electrification status: The Consultant shall use GIS Maps that detect Lighting Output for the Sindh province, and highlight high and low energy access areas in Sindh, for better targeting and sampling. The GIS Lighting Maps for Sindh province have been developed by the International Finance Corporation (IFC), part of the World Bank Group, and shall be provided by the World Bank-ESMAP team to the consulting firm for this survey. The Consultant shall have a GIS specialist as a part of the project team that has the knowledge and expertise to work in an ArcGIS format. In addition to that, the Census can also provide information on the grid electrification rate at the EA level which could be used for the stratification activity for the survey. For the sampled EAs, grid connectivity rate shall be obtained through household listing activity (see below), which is expected to be the most accurate estimation.
    b. For this project, MTF household survey sampling strategy shall aim to: (1) keep a 50:50 ratio between the national grid-electrified and non-electrified households for the overall sample and (2) keep an 80:20 ratio between rural and urban households.
- Household listing activity: The consulting firm shall gather electrification data to determine the status for the EAs identified (from secondary sources such as GIS, population census, and/or utility database), as that shall help determine the breakdown of electrified and unelectrified EAs. Once EAs are selected for the survey, the firm shall conduct the 'household listing' activity. As part of this activity, enumerators shall visit and list all households within the boundaries of each EA to construct a sampling frame for the households. During the listing activity, enumerators shall collect key information for the second stage stratification and selection including 1) household head name 2) household size and 3) grid connection status (either by observation or by asking). Enumerators must receive proper training for the implementation of this activity. Once the list of households in each EA is completed, 12-15 households shall be stratified and selected from each EA/village randomly unless there is a critical reason to select more households per EA. From electrified EAs, both households with and without electricity shall be selected. Please note that the information collected on the households during the listing activity shall be saved in an electronic format (e.g. Excel) – this will make the random selection of the households more convenient and facilitate the calculation of weight. The Consultant shall submit a detailed description of sampling methodology including sample size calculation and stratification strategy for review and approval prior to field implementation.

c. Background Research and Field Investigation

- Although the questionnaire shall be tested in the field, this may not be able to capture some specific situations or conditions. Therefore, it is important that background research and field investigations be carried out prior to or during the questionnaire development. Specifically, the Consultant is expected to conduct background/market research and field investigations covering the following minimum issues: a) different types of electricity access solutions available in each district and their usage (mini-grid, SHS, solar lighting systems, UPS, Diesel Generators etc.); b) Estimated price of these alternate electricity access solutions; c) Prices for component-based SHS and integrated SHS by capacity types; and d) The connection cost for the national grid.

d. Recruit and train interviewers, field supervisors and data editors and managers:

- The consulting firm shall be responsible for hiring and training enumerators, field supervisors, editors, and data managers. Training should be conducted in the presence of SED staff and the ESMAP-World Bank team. Interviewers shall be able to interact with all classes of people, be skilled at building rapport and be experienced.
- The level of education shall vary depending on the type of position but the emphasis shall be placed on their level of experience in household survey work and CAPI. They must also be available for the full period of the survey (refer to Table 2 for more details on all different types of position with their education and experience requirements). Interviewers and supervisors shall be trained for 10–12 days including 2–3 days of the pre-testing and feedback session for the household survey. Specific training to enhance the understanding of interviewers and field supervisors on the energy sector[7] is required in addition to the introduction to the survey instrument and CAPI approach. CAPI programming should be completed prior to the training session and be available for enumerators to learn and practice the tablet during the training and pre-testing phases.
- Participants shall be required to attend all sessions and prove competence through tests, mock interviews, and exercises administered during the training. The Consultant shall train a few extra individuals to make up for any absentee or non-performance.
- The Consultant shall develop an instruction manual (interviewer guide) for the training, which should cover a detailed explanation of the critical questions, how to articulate them in an understandable way, how to approach the respondents, probing techniques, and so on. Instruction manuals shall be developed before the start of the training and revised during the training and pretesting as needed.
- The following components must be included in the training:
  - *Theoretical*: Training shall include a reviewing each question in the questionnaire for field supervisors and enumerators to fully understand the objective of each question. Standard quantitative interviewing techniques and field protocols shall also be covered.
  - *Classroom practice:* Training shall include individual and group exercises to become familiar with asking and filling questionnaires. This part of the training may include in-class demonstrations, where the questionnaire is projected and one interviewer

[7] Such as, types of grid electrification (i.e., national grid, regional, or mini-grid), source of electric power including mini or micro hydro electricity generation, various sizes of diesel generator, solar PV home system technology and components, how the system function, types and wattages of lighting and other electric appliances are required.

completes the questionnaire in front of the classroom. The training may also use vignettes, where the firm designs case scenarios based on typical sites (perhaps those found during the supervisor training or piloting) and have interviewers complete the questionnaire based on the vignette. Finally, the trainees should conduct mock interviews on the same subject, and have the interviewers fill in a questionnaire for the interview to test consistency across the interviewers. This stage of training shall be done using both paper and CAPI.

- *Pre-test/pilot the questionnaire:* After the theoretical and classroom practices, the interviewers shall pilot the full questionnaire on several rural and urban sites (outside the study sample). Please, refer to the following section on "Pre-test/pilot the questionnaire" for more detailed information.
- *Evaluation:* As part of the training, interviewers, supervisors, and data entry clerks should be evaluated based on their understanding of the questionnaire and their ability to record data using the same test scenarios as used in the classroom practice. The training period shall conclude only once the field teams have demonstrated mastery of the designated tasks. Decisions as to which field staff shall take part in the data collection must be made based on this evaluation. The firm shall submit the result of the training and evaluation of enumerators and supervisors.

e. Pretest/pilot the questionnaires:

- Pretesting should ensure that the questions are relevant, well sequenced, clear, and easy to understand, the codes used for close-ended questions are relevant, and the duration of the interviews are within reasonable limits of what is expected.
- The Consultant shall be responsible to conduct the pretesting of the questionnaire. The pretesting shall be conducted for at least 20 households, 1-2 urban and rural communities prior to finalizing the questionnaire. After the pre-test, a feedback session shall be arranged and the questionnaire shall be revised fixing errors detected and addressing issues raised during the pretesting, and then the questionnaire shall be finalized. The actual survey work cannot commence until the SED provides clearance on the final version of the questionnaire and CAPI program.

f. Provide logistical and other support to enumerators and supervisors:

- The field enumerators and supervisors will require logistical support and subsistence during the survey work. The Consultant is responsible for the support and relevant expenses (for transport, per-diem, etc.) in a manner consistent with the standard of similar surveys in the country.
- The Consultant is also responsible for obtaining necessary permits or clearance for the survey implementation.

g. Carry out the surveys:

- The household interviews shall be conducted during a single visit. In exceptional cases (for example, if the respondent does not have time to continue or is not at home) it may be necessary to return to a household/village on more than one occasion, but this shall not be the

norm. It is expected that the average length of administering the household questionnaire shall be 1.5 hours.

- For the household survey, the questionnaire would preferably be administered to the household head (or head's spouse depending on the module of the questionnaire). Community survey should be administered for each of the communities (villages/urban blocks) where households will be interviewed. Community survey shall take no more than 30 minutes, and supervisors can administer it while enumerators are interviewing households. Community survey shoall be answered by people who are knowledgeable about the community such as village leaders, school headmasters, etc. These people shall be identified before the interviews.
- The firm shall provide a detailed field procedure plan, including:
    - Calendar of activities, including the expected time that each team shall spend in each enumeration area;
    - Provisions for ensuring data quality, including procedures for addressing data inconsistencies/misreporting when identified;
    - Management information/reporting tools to track the progress of survey implementation including a number of interviews conducted;
    - Supervision and spot check plans to ensure adherence to data collection protocols and confirm the quality of data collection and entry;
- The Consultant must adhere as closely to the survey plan as conditions allow during survey implementation. If field conditions dictate changes in the plan, the field supervisors must inform the firm's management which shall then inform the SED team to discuss and evaluate the situation as early as possible.
- The duties of the enumerators shall be:
    - Visit the selected households and ensure their participation;
    - Conduct face-to-face interviews with the selected respondents, after obtaining their permission first;
    - Record the answers and code them accurately;
    - Ensure completeness and accuracy of the answers and perform accuracy checks on the questionnaires whenever applicable (for tablet-based surveys many of these shall be done automatically);
    - Take note of any values for categorical variables that are not already defined in the questionnaire;
    - Deliver completed questionnaire to supervisors (for paper-based interviews) or transmit them to a central server over the internet (tablet-based interviews);
    - Safeguard the confidentiality and privacy of the collected information.
- The duties of the supervisors shall be:
    - Explain clearly to each enumerator his/her duties and responsibilities;
    - Provide all logistical support and materials to field enumerators;
    - Supervise all activities of the enumerators during the data collection process through random spot checks;
    - Ensure that the interviewers undertake the survey in the households chosen for the sample without substitution;
    - Assess the quality of the work of the enumerators and the quality of the data from each completed questionnaire;

- Provide feedback to enumerators on quality assurance;
- Liaise and report activities to the survey coordinator;
- Check completed questionnaires and approve them for data entry.

ii) **Cleaning and archiving data in a suitable format**

After completion of the survey, the firm shall be responsible for data entry and cleaning as mentioned in the Scope of Work. For tablet-based surveys, data entry should be almost automatic, as it only involves the immediate transmission of data from tablets to a central web server, which shall then be converted into a usable format using a statistical software, such as Stata. CAPI questionnaire scripting shall check the consistency and quality of data immediately when enumerators enter the values, but the Consultant shall be responsible for ensuring the quality of data collected. At the end of data cleaning, the Consultant shall deliver the raw as well as the clean data to SED in Stata and Microsoft Excel, with all variables labeled and adequately documented. The survey forms shall record GPS coordinates of the households and communities surveyed. The Consultant shall develop a GIS database based on those GPS coordinates. The database shall have the capability of displaying locations of the households on a map. The Consultant shall deliver the following items to the SED team:

- The original (raw) as well as cleaned data with complete labelling for variable names as well as value options
- GIS database,
- All related documentation including the complete set of questionnaires in English; possible values (and explanation) of all categorical variables; other values that enuemrators record and
- Picture information taken during the interview.

The data and documentation shall be the property of SED, and the consulting firm may not use them in any way without the permission of SED.

iii) **Submit the final survey completion report**

The Consultant shall carry out the data cleaning as well as the basic data analysis. This involves reporting the basic descriptive statistics of major variables in each section. Findings shall be included in the survey completion report. The report shall include, among others, a detailed description of all survey preparation and implementation phases, including issues that arose during the survey, and provide the means used to resolve them; this, in addition to the findings from data analysis. The Consultant shall submit a draft report to the SED team and shall revise it incorporating the comments from the SED team. The Consultant is responsible for the overall quality of the report. The final report shall be submitted in English.

5. TEAM COMPOSITION & QUALIFICATION REQUIREMENTS

The Consultant shall have an appropriate mix of experience and expertise. To ensure optimal management of fieldwork, a team member shall not oversee more than one of these key positions during the fieldwork. At least 15% of the project team members hired by the Consultant shall comprise of female and/or disabled staff. The key positions are indicated in the table below.

Team Member	Qualifications	Years of Experience
Key Staff		
Project Manager/Team Leader	At least MSc or equivalent	10 years
Subject Matter Expert (rural energy/electrification/ICS)	At least BSc or equivalent	5 years
Economist/ Statistician	At least BSc or equivalent	5 years
GIS Specialist	At least BSc or equivalent	5 years
Non-Key Staff		
Survey Coordinator	At least BSc or equivalent	5 years
Translator	At least BSc or equivalent	5 years
CAPI Programmer	At least BSc or equivalent	5 years
Data Management Assistants	At least BSc or equivalent	2 years
Field Supervisors	At least an Associate degree or equivalent	2 years
Surveyors	At least an Associate degree or equivalent	2 years

6. REPORTING REQUIREMENTS AND TIME SCHEDULE FOR DELIVERABLES

Following are the deliverables and tentative schedule for the task, which should serve as an input for the schedule to be included in the technical proposal.

iv) **Deliverables and submission schedule**

Deliverables	**Submission schedule**
1. Draft inception report (containing work plan, timetable, and sampling plans)	2 weeks after the award of the contract
2. Submit revised survey questionnaires to the SED	3 weeks after the award of the contract
3. Feedback/comments from the SED	3 weeks after the award of the contract
4. Submit the final inception report (based on the comments received from the SED)	5 weeks after the award of the contract
5. Hiring and training of interviewers and field supervisors	7 weeks after the award of the contract
6. Pretesting of the questionnaires	7 weeks after the award of the contract
7. Feedback sessions based on pretesting	7 weeks after the award of the contract
8. Submit final questionnaire, CAPI program, pre-testing result, and training evaluation report	8 weeks after the award of the contract
9. Survey activities start	At the start of the 9th week after the award of the contract
10. Interim progress reports on survey activities	Every 2 weeks after the start of the survey
11. Survey activities complete	20 weeks after the award of the

	contract
12. Data entry and cleaning completion	24 weeks after the award of the contract
13. Submission of raw and cleaned data and field report after completion of the field work	26 weeks after the award of the contract
14. Feedback on the draft survey report by SED	28 weeks after the award of the contract
15. Final version of the report	30 weeks after the award of the contract
16. Final version of the data and documentation	30 weeks after the award of the contract

Selection Method

1.1 The Consultant will be selected through Least Cost-based Selection ("L**CS"**) in accordance with the procedures set out in the World Bank Procurement Regulations for Borrowers, 2016 (revised November 2017 and August 2018).