

Note : The TOR describes consultant work to study improved rural electricity services through renewable energy based distributed power generation, develop a viable business model, determine barriers to sustainable operations and replication of such projects, and design a strategy to promote renewable-energy based grid-connected distributed power generation and supply.

Terms of Reference

1. Background

<Brief description and objectives of project>

2. Objectives of the Assignment

2.1. To develop a sustainable service delivery model (business model) for improvements in rural electricity supply through distributed generation and supply of power using renewable sources of energy.

3. Scope of Work

3.1. The study would examine past experiences in Distributed Generation and Supply of power in *Country X* and abroad, determine barriers to sustainable operations and replication of such projects, and design a strategy to promote renewable energy based distributed generation and supply in *Country X*.

3.2. There are several elements that need to be studied in the context of developing commercially viable business model for DG: (i) renewable resource availability/ pricing (available micro hydro potential/biomass availability); (ii) technology aspects for generation of power as well as generation-supply-grid interface; (iii) rural electricity demand, linkage to productive use of electricity and willingness to pay (iv) tariffs, subsidy and full cost recovery issues for a viable business model and (v) institutional and commercial arrangements for distributed generation and supply in grid-connected mode. The study would examine each of these elements and recommend ways of addressing the identified challenges/ barriers. This would require close interaction with agencies and experts from various fields, such as rural consumers/communities, equipment suppliers, project developers, financiers, regulators and governments.

3.3. The study will essentially focus on biomass based generation and mini-hydro. It would identify focus states/districts at an early stage, in consultation with the Ministry of Power and with the concurrence of the concerned states. These states/districts will be subject to an in-depth analysis of issues pertaining to technology, fuel availability, economic and commercial viability, and policy and regulatory framework.

4. Detailed Description of Tasks

Task-1: Review of Past Experiences and Earlier Studies

4.1. The consultants would examine the earlier studies on experiences in distributed generation and systems in *Country X* and abroad. An indicative list of studies conducted in the past is attached in Annex-1 to this Terms of Reference. The consultants may obtain copies of these reports from the Bank. The consultants would also conduct site visits to some of the earlier pilot projects and hold meetings with the relevant agencies. The review would encompass various aspects of design of distributed generation and supply projects, including choice of technology; fuel availability and cost; electricity market and take-off arrangements; ownership and other

institutional arrangements; regulatory arrangements; subsidy arrangements (if any); and, economic, social and environmental impact etc.

- 4.2. Based on the above review and meetings, the consultants would identify the key success factors for establishing a replicable model for distributed generation and supply of power, and also identify the barriers to replication experienced in the past.
- 4.3. On the completion of Task-1, the consultants would deliver a report. In addition, a national level consultative workshop would be organized at this stage.

Task-2: Early Conceptualization of the Business Model

- 4.4. At this stage, the consultants are expected to come up with a rough concept of the likely business model based on the review of past studies/experiences and consultations with various stakeholders. Going forward, the consultants would test and refine this model against detailed analysis of various aspects, including economic and financial analysis, policy and regulatory framework and institutional arrangements. The draft model would also be strengthened by evaluating it in light of actual data/information from the selected states / districts.

Task-3: Review of Distributed Generation Technologies and Identification of Select States based on Renewable Energy Resource Availability

- 4.5. *Review of Distributed Generation Technologies*: The consultants would examine the various renewable energy technologies to assess the generation capacity and quality of supply, especially across seasons and times of day. The consultants would also explore hybrid technologies that offer enhanced generation capacity and better quality of supply. The indicative capital costs as well as the indicative operating costs for each fuel type and technology would be determined and compared to arrive at the per unit cost of generation in each case.
- 4.6. *Technical aspects of grid connectivity of the generation plant*: To allow for drawl from grid in case of shortages and supply to grid in case of excess generation, the technical aspects of grid connectivity would be examined. Issues to be examined include (but are not restricted to) power quality, dispatch, safety, metering, billing etc.
- 4.7. *Review of Renewable Energy Resource Availability*: Working with the Government of *Country X*, the consultants would identify select states/areas where availability of renewable energy resources and willingness of state agencies make it conducive to test development and scaling-up of DG schemes to improve rural electricity supply and services. The availability of renewable energy resources would be assessed in these select states using data from secondary sources.
- 4.8. On the completion of Task-2, the consultants would deliver a report.

Task-4: Economic and Financial Analysis

- 4.9. The consultants would undertake a detailed economic and financial analysis of distributed generation and supply in each of the select areas. The consultants are expected to gather area-specific data and information for the analysis.
- 4.10. *Assessment of Demand for Electricity in the selected areas*: The consultants would carry out a willingness to pay survey based on a limited sample of about 250 people each in the selected areas. Based on this survey, the consultants would develop an indicative electricity demand curve for the area. The consultants would also analyze the demand for electricity across seasons and during different hours of the day. Based on the projections of economic growth in the area, the consultants would determine the likely growth in demand for electricity.
- 4.11. *Economic Linkages*: The consultants would also explore ways in which economic activities may get enhanced through availability of electricity. This would be based on review of

information from secondary sources and discussions with relevant agencies. The consultants would reassess the willingness to pay and the demand curve in the light of possible efforts at strengthening economic linkages of power availability. Based on an economic analysis of the costs and benefits of DG projects the consultants would determine the economic rate of return of such projects under various scenarios.

- 4.12. *Assessment of Detailed Cost Structure for Power Generation and Distribution:* Building on the generic assessment of cost structures under task-2, the consultants would carry out a detailed assessment of costs taking into account area-specific information. The analysis would also include the likelihood of fluctuations in fuel prices and its impact on viability of projects. Based on the assessment of cost structures, the threshold where grid connected power is less economic than off grid power may be determined.
- 4.13. *Fuel supply issues:* The consultants would develop a model to project the likely cost of biomass fuel as the market develops, suggest ways of controlling prices, and also examine the viability of the distributed generation investments under various scenarios.
- 4.14. *Evaluation of Likely Environmental Benefits and Potential for Carbon Finance:* The consultants would also evaluate the likely environmental benefits of investments in distributed generation based on renewable energy, and assess the potential for Carbon Finance. The impact of likely carbon cash flows in enhancing the commercial viability of distributed generation and supply projects would also be examined.
- 4.15. *Assessment of Commercial Viability of Distributed Generation and Supply investments* would be carried out based on the above. The study would determine the quantum type and duration of hand-holding support required for DDGs to be successful.
- 4.16. *Review of Existing Subsidy Schemes:* The consultants would review the existing subsidy schemes by Ministry of Power and Ministry of New and Renewable Energy, and examine ways in which Distributed Generation and Supply projects may draw upon these resources, including the need for and adequacy of these subsidies for such ventures.
- 4.17. On the completion of Task-3, the consultants would deliver a report on “*Economic and Financial Analysis of Distributed Generation and Supply Projects*”.

Task-5: Policy and Regulatory Framework to Support Distributed Generation and Supply

- 4.18. Based on the review of international experience in policy and regulatory frameworks for promoting distributed generation and supply of electricity, the consultants would develop an appropriate framework for *country x*. Such a framework would include -
- 4.19. In preparing such a framework, the consultants are expected to take into account the existing Renewable Energy policy and regulatory regime, National Electricity Policy, National Tariff Policy, Guidelines under the RGGVY program - including Franchisee Guidelines etc.
- 4.20. The regulatory issues to be examined by the consultants would include, inter-alia:
 - a. Determination of Tariff for retail consumers
 - b. Pricing of power and imbalance settlement in case of grid connected systems
 - c. Technical standards and safety requirements for distributed generation projects
- 4.21. On the completion of Task-4, the consultants would deliver a report on “*Policy and Regulatory Framework for Supporting Renewable Energy based Distributed Generation of Power*”.

Task-6: Institutional Arrangements at Program and Project Levels

- 4.22. *Institutional Arrangements at Project Level:* The consultants would evaluate various options for ownership structure of the distributed generation and supply projects, based on learning from

past experiences, taking into account the socio-economic characteristics of the identified states/areas. The consultants are expected to build upon past experiences and also interact with local NGOs and other agencies in each of the select areas to discover the various possible ownership arrangements. Institutional arrangements options may include models with common ownership/control of generation and supply functions, and where these are segregated.

- 4.23. *Assessment of Entrepreneurial Interest:* The consultants would examine the various possibilities with regard to the involvement of entrepreneurs (local, corporate, and community based) in the provisioning of rural electricity services. The consultants are expected to interact with various agencies to identify interest from potential fuel providers, generation, and distribution franchisees.
- 4.24. *Institutional Arrangements at Program Level:* The consultants would suggest institutional arrangements at the program level, covering among others, arrangements for financing the generation investments, financing the distribution operators/franchisees, technical support for project development, technical training for distribution operators.
- 4.25. In addition, the consultants would also examine the options for flow of subsidy and tax concessions – both capital and revenue support. It is expected that the consultants would examine the existing subsidy schemes under Ministry of Power, Ministry of New and Renewable Energy and any other schemes offered by the state governments, to evaluate possible tie-in with these schemes.
- 4.26. *Program Management:* The consultants would suggest the requirements from the lead implementing agency for such a program and the institutional capacities needed. The existing institutions under GoI as well as any potential private institutions would be examined for fulfilling this role, and the capacity enhancements needed would be identified if any of the existing institutions is found suitable.

Task-7: Program for Strengthening Institutional Capacity of Nodal Agency

- 4.27. Based on the program level Institutional arrangements identified in Task-5, the consultants would support the *Government of X* in identifying the nodal agency that would be tasked with designing, promoting and monitoring the DG expansion program.
- 4.28. The consultants would develop a program for strengthening the institutional capacity of the nodal agency, keeping in view the role and responsibilities identified for the agency in task-5.
- 4.29. On the completion of Tasks-5 and 6, the consultants would deliver a report on “*Institutional Arrangements at Program and Project Levels for Distributed Generation and Supply Projects*”, including a separate section on “*Program for Strengthening Institutional Capacity of the Nodal Agency*”.
- 4.30. **Summary Final Report and Dissemination Workshop :**

At the end of the assignment, the consultants would compile the key observations and recommendations from the various component tasks into an easy-to-read summary final report. The report would be disseminated to various stakeholders through a workshop organized by the consultants.

5. Deliverables and Timelines

Sr.	Deliverable	Related to Tasks	Timeline
1	Report on “ <i>Comprehensive Review of Past Experiences in Distributed Generation and Supply of Power in Country X</i> ”.	Task-1	6 weeks

2	National Level Consultation Workshop	Task-1	8 weeks
3	Early Concept of the DG Business Model	Task-2	9 weeks
4	Report on “ <i>Review of Distributed Generation Technologies and Assessment of Renewable Energy Resource Availability across Select States/Areas</i> ”.	Task-3	10 weeks
5	Report on “ <i>Economic and Financial Analysis of Distributed Generation and Supply Projects</i> ”.	Task-4	14 weeks
6	Report on “ <i>Policy and Regulatory Framework for Supporting Renewable Energy based Distributed Generation of Power</i> ”.	Task-5	18 weeks
7	Report on “ <i>Institutional Arrangements at Program and Project Levels for Distributed Generation and Supply Projects</i> ”.	Tasks-6,7	22 weeks
8	Summary Final Report and Dissemination Workshop	All	24 weeks

6. Expected Skill Sets and Team Composition

6.1. The consultant’s team should have an appropriate mix of experience and expertise in *Country X* and abroad with respect to renewable energy issues, rural electricity access, and power sector policy/regulation. Specifically, the consultants should have:

- a. In-depth knowledge of *Country X* power sector, especially with regard to policy, regulation and program implementation for rural electricity access.
- b. Strong understanding of technical and financial feasibility of renewable energy technologies, and the integration of renewable energy in the operation of electricity supply system (grid connected and off-grid).
- c. In-depth knowledge of the current renewable energy policy and regulatory frameworks in *Country X*, including subsidy support, financing schemes and technical support from the government for such projects.
- d. International experience and knowledge in areas of technology, policy/regulatory frameworks, institutional structures and subsidy arrangements for renewable energy and rural electricity access.
- e. Strong financial modeling and analytical skills, including skills for conducting economic analysis of complex projects with strong cross-sectoral economic linkages.
- f. Expertise in assessing environmental impact/benefits of projects, including potential for Carbon Finance.
- g. Expertise in conducting demand assessment through willingness to pay surveys and knowledge of related econometric techniques.

6.2. *Key Team Positions:* Some of the key positions in the expected in the consultant’s team are indicated below. It is expected that the team leader would be spending a majority of his/her time on this assignment during the entire duration of the assignment, whereas the others would be spending a majority of their time on the assignment, during the tasks ear-marked for them.

- a. Team Leader
- b. Renewable Energy and Rural Electrification Expert
- c. Policy and Regulatory Specialist
- d. Financial and Economic Analysis Expert
- e. Community Mobilization Expert
- f. Rural Development Expert
- g. Private Sector Development Expert

The consultants are expected to propose additional members in their team, to provide expertise in other areas/tasks identified by them in the proposal submitted to the Bank.

Indicative List of past studies related to Distributed Generation of Power and Rural Electrification

1. *Rural Access to Electricity: Strategy Options for India*, Discussion Paper by Rajesh Sinha, Andrea Ryan Rizvi and Joseph Daniel Wright, World Bank, August 2004.
2. *Technical and Economic Assessment of Off-grid, Mini-grid and Grid Electrification Technologies*, World Bank Report by Masaki Takahashi and Anil Cabraal, September 2006.
3. *Energy Strategies for Rural India: Evidence from six states*, ESMAP Report, August 2002.
4. *Report on Recommendations on Franchisee Arrangements*, Pricewaterhouse Coopers Study for the World Bank, 2005.
5. *Institutional arrangements Report by PwC*
6. *Best Practices for Sustainable Development of Micro Hydro Power in Developing Countries*, ESMAP Report, August 2000.
7. *The Benefits of Rural Electrification in Rural India: Implications for Education, Household Lighting and Irrigation*, Paper by Barnes, Fitzgerald and Peskin, 2002.
8. *Water Electricity and the Poor: Who Benefits from Utility Subsidies?* World Bank Publication, Book by Kristin Komives, Vivien Foster, Jonathan Halpern and Quentin Wodon.
9. *Increasing Energy Access in Developing Countries: The Role of Distributed Generation*, USAID Study, May 2004

Note: The above is only an indicative list of past studies and the consultants are expected to leverage numerous other studies and policy documents in course of the assignment.