

Terms of reference (ToR) for the procurement of services below the EU threshold

CONFIDENTIAL

Consultancy contract for Renewable Energy Hosting Capacity & Grid Impact Assessment for APTRASCO–APEPDCL under COEET-AP Using Power Factory Software	Project number/ cost centre: G-012382-001
	Tender number 10024261

0.	List of abbreviations	2
1.	Context.....	3
	Objective:	4
	Target group and other stakeholders.....	4
2.	Tasks to be performed by the contractor	4
3.	Concept.....	8
	Technical-methodological concept	8
	Project management of the contractor (1.6)	9
4.	Personnel concept.....	9
	Team leader	9
	Key expert 1 – Power System Simulation (Transmission & Distribution).....	10
	Key expert 2 (International Expert) - Advanced Power System Simulation	10
	Short-term expert pool with minimum 2, maximum 3 members:	11
5.	Costing requirements	12
	Assignment of personnel and travel expenses	12
	Sustainability aspects for travel	12
6.	Requirements on the format of the tender	14

0. List of abbreviations

APEPDCL	Adhara Pradesh Eastern Power Distribution Limited
APTRANSCO	Andhra Pradesh Power Transmission Corporation Limited
CEA	Central Electricity Authority
CoEET	Centre of Excellence for Energy Transition
DER	Distributed Energy Resources
DISCOM	Distribution Companies
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
MNRE	Ministry of New and Renewable Energy
PV	Photovoltaics
ToR	Terms of Reference

1. Context

The project, titled "Achieve India's Renewable Energy Target of 500 GW by 2030," is a flagship initiative aligned with India's ambitious climate and energy goals. It is politically anchored with the Ministry of New and Renewable Energy (MNRE), Government of India, and represents a commitment by the German Federal Ministry for Economic Cooperation and Development (BMZ) following the Indo-German intergovernmental negotiations held on 1st November 2023 in New Delhi.

The project directly contributes to India's Nationally Determined Contribution (NDC) targets for 2030 and the overarching goal of achieving net-zero emissions by 2070. It operates under the newly launched *Indo-German Platform for Investments into Renewable Energies*, aiming to facilitate strategic collaboration and impactful investments in the sector. Key components of the project include policy and technical advisory to MNRE on the expansion of wind energy and rooftop solar photovoltaics, as well as the modernization of aging renewable energy infrastructure. It also supports the development of local solar supply chains, promotes digital tools for grid operators, and advises on necessary reforms and grid expansion. Furthermore, the project places a strong emphasis on addressing the shortage of skilled labour in the renewable energy sector by promoting the participation of women, thereby fostering inclusive and sustainable energy transitions in India.

India's power sector is undergoing a rapid transition with increasing integration of renewable energy (RE) sources such as solar and wind, driven by ambitious national targets and policy support. This transition is resulting in significant RE capacity addition at both transmission and distribution levels, including utility-scale projects and distributed energy resources (DERs) such as rooftop solar. While this shift supports clean energy goals, it also introduces technical challenges related to grid stability, reliability, and operational performance. Traditionally, power systems were designed for unidirectional power flow. However, higher penetration of RE, especially at the distribution level is leading to bidirectional flows, causing issues such as voltage fluctuations, reverse power flow, increased fault levels, and power quality concerns (e.g., harmonics and voltage unbalance). These challenges necessitate detailed technical assessments to ensure secure and efficient grid operation.

In this context, the present study on "Simulation Studies for Renewable Energy Hosting Capacity and Grid Impact Analysis under APTRASCO and APEPDCL Network under COEET-AP" aims to evaluate the capability of the network to integrate additional RE capacity without violating technical and operational limits.

The study is structured into three work packages. Work Package 1 focuses on data collection, network modeling, and development of a validated base case. Work Package 2 assesses RE hosting capacity through detailed simulation studies, including load flow, contingency, short-circuit, and stability analysis, and identifies key constraints and mitigation measures. Work Package 3 extends the assessment to the distribution level, focusing on power quality and reverse power flow impacts due to high DER penetration.

Overall, the study aims to provide a comprehensive technical evaluation and actionable recommendations to support APTRASCO and APEPDCL in enabling higher renewable energy integration while ensuring grid reliability, stability, and performance.

Objective:

The primary objective of this assignment is to assess the renewable energy (RE) hosting capacity and evaluate grid impacts on selected transmission and distribution networks under APTRASCO and APEPDCL within the COEET-AP framework. The study aims to develop a validated network model and conduct detailed simulation analyses to identify technical constraints related to voltage limits, thermal loading, fault levels, stability, power quality, and reverse power flow.

Additionally, the objective is to determine the maximum RE integration capacity without compromising grid reliability and performance, and to recommend appropriate technical, operational, and planning measures to enhance the network's capability for higher renewable energy penetration.

Target group and other stakeholders

CoEET-AP, APTRANSCO, and APEPDCL

2. Tasks to be performed by the contractor

The consultant will be responsible for the following work packages:

The consultant shall conduct the specified studies under Work Packages 1 and 2 for at least one transmission substation under APTRANSCO, with substation details to be provided during the implementation phase. Work Package 3 shall be undertaken for one distribution substation under APEPDCL.

Work Package 1: Data, Modelling & Base Case Development

1.1 Inception & Planning

- Conduct a kick-off meeting with all relevant stakeholders.
- Finalize the selected transmission substation and study boundary (including 2–3 levels of upstream and downstream network).
- Define study assumptions and technical criteria (voltage limits, contingency conditions, grid code requirements).
- Prepare and submit an **Inception Note** outlining methodology, assumptions, and work plan.

1.2 Data Collection & Validation

- Collect detailed technical data for the selected substations, including:
 - Bus configuration, transformers, transmission lines, and switchgear
 - Connected generation sources (including renewable energy)
 - Load data (peak and off-peak conditions)
- Collect data of the surrounding network influencing the substation.
- Validate collected data using:

- SCADA snapshots
 - Utility planning and operational reports
- Identify data gaps and document assumptions for missing or incomplete data.

1.3 Network Modeling in PowerFactory

- Develop the transmission network model in DIgSILENT PowerFactory.
- Include the selected substation and all connected network elements.
- Model neighbouring buses and interconnections impacting the study area.
- Accurately represent system components, including:
 - Transmission lines
 - Distribution Lines
 - Transformers
 - Generators
 - Loads, etc
- Ensure completeness and consistency of the developed model.

1.4 Base Case Development & Validation and Scenario & Study Case Development

- Perform load flow analysis for the developed model.
- Validate system performance by checking:
 - Voltage profile across buses
 - Loading of lines and transformers
- Align simulation results with actual system operating conditions.
- Finalize the **Base Case Model** for further analysis.
- Develop multiple study scenarios, including:
 - Peak load scenario
 - Minimum load scenario (critical for RE integration)
 - High renewable energy generation scenario
- Define contingency cases (N-1 conditions) for reliability assessment.
- Configure and organize all study cases within PowerFactory for simulation.

Work Package 2: Hosting Capacity Assessment & Recommendations

Activities:

2.1 Renewable Energy Integration Modeling

- Identify suitable RE injection point(s) at the selected substation.
- Model RE plants (solar/wind/hybrid) in DIgSILENT PowerFactory.
- Define plant parameters, including capacity, control mode, and grid code compliance settings.
- Establish a stepwise (incremental) RE capacity addition approach for simulations.

2.2 Load Flow Analysis and Contingency Analysis (N-1)

- Perform load flow simulations for increasing levels of RE integration.
- Assess system performance with respect to:
 - Voltage limits

- Thermal loading of lines and transformers
- Identify violations and determine limiting thresholds.
- Simulate contingency scenarios, including line and transformer outages.
- Evaluate system performance under each contingency condition.
- Identify constraints and critical elements under outage scenarios.

2.3 Short Circuit Analysis and Dynamic & Stability Analysis

- Calculate fault levels at the substation and nearby buses.
- Verify compliance with equipment ratings and protection limits.
- Simulate system disturbances, including faults and line tripping events.
- Evaluate system response in terms of:
 - Voltage recovery
 - Overall stability performance
- Identify stability-related constraints for RE integration.

2.4 Voltage Stability Assessment and Hosting Capacity Determination

- Perform PV and QV curve analysis.
- Identify weak buses and assess voltage stability margins.
- Increase RE capacity in a stepwise manner.
- Determine the maximum allowable RE capacity based on:
 - Voltage limits
 - Thermal limits
 - Stability constraints
 - Fault level limits
- Identify the **binding constraint** that limits further integration.

2.5 Sensitivity Analysis and Mitigation Measures

- Evaluate system performance under:
 - Different RE capacities and operating conditions
 - Load variation scenarios
- Validate the robustness and reliability of results.
- Recommend measures to enhance hosting capacity, including:
 - Network upgrades (lines/transformers)
 - Reactive power compensation (e.g., STATCOM, capacitor banks)
 - Operational strategies and control measures

2.6 Reporting & Knowledge Transfer

- Prepare a comprehensive final report covering:
 - Methodology, assumptions, and results
 - Hosting capacity values
 - Identified constraints and recommendations
- Submit all relevant outputs, including:
 - PowerFactory model files
 - Simulation results and datasets

- Conduct at least one stakeholder workshop/presentation to share findings and build capacity.

Work Package 3: Power quality and reverse power flow analysis for distribution substation

This work package focuses on assessing the impact of increasing renewable energy penetration on distribution substations, particularly in terms of power quality and reverse power flow. The key activities include but not limited to:

- Collection and review of substation data, load profiles, and distributed energy resource (DER) penetration.
- Assessment of power quality parameters such as voltage variations, harmonics, and unbalance against applicable standards.
- Analysis of reverse power flow scenarios and their impact on transformers, protection systems, and voltage profiles.
- Simulation of different load and generation scenarios to evaluate system performance and hosting capacity.
- Identification of risks and recommendation of mitigation measures, including technical solutions and operational strategies.
- Preparation of a concise report with key findings and actionable recommendations.

Deliverables:

The following deliverables will be provided as part of the assignment:

- **Inception Report**
Detailing study methodology, assumptions, data requirements, selected substations, and overall work plan.
- **Data Collection & Validation Report**
Compiling collected network data, validation approach, and documented assumptions for data gaps.
- **Validated Network Model (DigSILENT PowerFactory Files)**
Complete and functional simulation model of the selected transmission network, including all study cases and scenarios.
- **Base Case & Scenario Analysis Report**
Results of load flow simulations, base case validation, and defined study scenarios (peak, minimum load, high RE, contingency cases).
- **Renewable Energy Hosting Capacity Assessment Report**
Detailed analysis covering load flow, contingency (N-1), short-circuit, stability, and voltage assessments, along with identified constraints and hosting capacity limits.
- **Power Quality & Reverse Power Flow Assessment Report**
Analysis of voltage variations, harmonics, reverse power flow conditions, and associated impacts at the distribution level.
- **Mitigation Measures & Recommendations Report**
Technical and operational solutions to enhance hosting capacity and improve grid performance.

- **Final Consolidated Report**

Comprehensive document including methodology, key findings, simulation results, constraints, and actionable recommendations.

Certain milestones, as laid out in the table below, are to be achieved during the contract term:

Milestones/partial works	Deadline/place/person responsible
Work Package 1: Data, Modelling & Base Case Development	15 th August 2026
Work Package 2: Hosting Capacity Assessment & Recommendations	30 th December 2026
Work Package 3: Power quality and reverse power flow analysis for distribution substation	15 th November 2026

Period of assignment: from 20th of July 2026 until 30th December 2026.

3. Concept

In the tender, the tenderer is required to show *how* the objectives defined in Chapter 2 (Tasks to be performed) are to be achieved, if applicable under consideration of further method-related requirements (technical-methodological concept). In addition, the tenderer must describe the project management system for service provision.

Note: The numbers in parentheses correspond to the lines of the technical assessment grid.

Technical-methodological concept

Strategy (1.1): The tenderer is required to consider the tasks to be performed with reference to the objectives of the services put out to tender (see Chapter 1 Context) (1.1.1). Following this, the tenderer presents and justifies the explicit strategy with which it intends to provide the services for which it is responsible (see Chapter 2 Tasks to be performed) (1.1.2).

The tenderer is required to present the actors relevant for the services for which it is responsible and describe the **cooperation (1.2)** with them.

The tenderer is required to present and explain its approach to **steering** measures with the project partners (1.3.1) and its contribution to the **results-based monitoring system**.

The tenderer is required to describe the key **processes** for the services for which it is responsible and create an **operational plan** or schedule (1.4.1) that describes how the services according to Chapter 2 (Tasks to be performed by the contractor) are to be provided. In particular, the tenderer is required to describe the necessary work steps and, if applicable, take account of the milestones and **contributions** of other actors (partner contributions) in accordance with Chapter 2 (Tasks to be performed) (1.4.2).

The tenderer is required to describe its contribution to knowledge management for the partner (1.5.1) and GIZ and to promote scaling-up effects (1.5.2) under **learning and innovation**.

Project management of the contractor (1.6)

The tenderer is required to explain its approach for coordination with the GIZ project. In particular, the project management requirements specified in Chapter 2 (Tasks to be performed by the contractor) must be explained in detail.

The tenderer is required to draw up a **personnel assignment plan** with explanatory notes that lists all the experts proposed in the tender; the plan includes information on assignment dates (duration and expert days) and locations of the individual members of the team complete with the allocation of work steps as set out in the schedule.

The tenderer is required to describe its backstopping concept. The following services are part of the standard backstopping package, which (like ancillary personnel costs) must be factored into the fee schedules of the staff listed in the tender in accordance with Section 3.1 of the GIZ AVB:

- Service-delivery control
- Managing adaptations to changing conditions
- Ensuring the flow of information between the tenderer and GIZ
- Assuming personnel responsibility for the contractor's experts
- Process-oriented steering for implementation of the commission
- Securing the administrative conclusion of the project

4. Personnel concept

The tenderer is required to provide personnel who are suited to filling the positions described, on the basis of their CVs (see Chapter 6), the range of tasks involved and the required qualifications.

The below specified qualifications represent the requirements to reach the maximum number of points in the technical assessment.

Team leader

Tasks of the team leader

One of the experts (listed below in this document), preferably the one who will be managing all activities, will also assume the role of the team leader.

Qualifications of the team leader

- Education/training (2.1.1): university degree in Science (Master or equivalent), Engineering or Management.
- Language (2.1.2): Business fluency in English C1
- General professional experience (2.1.3): 7 years of professional experience in the energy/electricity sector. Part time experience will not be counted.
- Specific professional experience (2.1.4): 6 years in the following areas:

- 2-years of experience in managing similar assignments on RE integration, hosting capacity, and grid impact analysis. (45%)
 - 1-year hands-on experience with solar PV, open access solar, and/or hybrid energy systems. (15%)
 - 2 years' experience of transmission and distribution systems, grid codes, and regulatory frameworks in India. (30%)
 - 1 years demonstrated experience in stakeholder coordination with utilities/government agencies. (10%)
- Leadership/management experience (2.1.5): 4 years of management/leadership experience as project team leader or manager in a company.
 - Regional experience (2.1.6): 5 years of work experience in India
 - Development cooperation (DC) experience (2.1.7): 2 years of experience working in development cooperation

Key expert 1 – Power System Simulation (Transmission & Distribution)

Tasks of key expert 1

- He/she is responsible for all three work packages.

Qualifications of key expert 1

- Education/training (2.2.1): university degree (Master or equivalent) in Science, Engineering or Management.
- Language (2.2.2): Business fluency in English C1
- General professional experience (2.2.3): 6 years of professional experience power system studies in both transmission and distribution sector
- Specific professional experience (2.2.4): 5 years of experience involving below areas:
 - 2 years hands-on experience in load flow, contingency (N-1), short-circuit, and stability analysis. (25%)
 - 2 years of experience in RE integration studies, hosting capacity assessment, and grid impact analysis. (40%)
 - 1 years of experience in DIgSILENT PowerFactory or equivalent tools, Indian grid standards and utility practices. (35%)
- Regional experience (2.2.6): 3 years of work experience in India

Key expert 2 (International Expert) - Advanced Power System Simulation

Tasks of key expert 2

- He/she is responsible for mainly work package 2 and 3.

Qualifications of key expert 2

- Education/training (2.3.1): Master's degree in electrical engineering / Power Systems or equivalent

- Language (2.3.2): Business fluency in English C1
- General professional experience (2.3.3): 6 years of professional experience in power system analysis and renewable energy integration
- Specific professional experience (2.3.4): **6 years of experience** involving below areas: |
 - 2 years of experience in network modelling, voltage stability, power quality, and inverter-based resource modelling, load flow studies, harmonics analysis, and grid stability assessments for both transmission and distribution. (30%)
 - 2 years of experience in RE integration studies, hosting capacity assessment, and grid impact analysis. (40%)
 - 2 years of experience on advanced simulation tools like DIgSILENT PowerFactory software. (30%)

Soft skills of team members

In addition to their specialist qualifications, the following qualifications are required of team members:

- Team skills
- Initiative
- Communication skills
- Socio-cultural skills
- Efficient, partner- and client-focused working methods
- Interdisciplinary thinking

Short-term expert pool with minimum 2, maximum 3 members:

Tasks of Expert Pool

- To support in Data Collection & Analysis, Network Simulation and Grid Impact Analysis

Qualifications of expert pool

- Education/training (2.6.1): University degree in Engineering (Electrical/Mechanical/Civil), Renewable Energy, Science, Management, Economics, or related disciplines. |
- Language (2.6.2): Business fluency in English C1
- General professional experience (2.6.3): 3 years of professional experience in data collection, validation, and basic power system analysis. Part time experience will not be counted.
- Specific professional experience (2.6.4): **3 years of experience** involving below areas: |
 - 1 years of experience on power system simulation tools like power factory software. (50%)
 - 1 years of experience on renewable energy technologies. (25%)
 - 1 years of experience on data collection, report preparation and coordination with clients. (25%)
- Regional experience (2.6.5): 3 years of work experience in India

The tenderer must provide a clear overview of all proposed short-term experts and their individual qualifications.

5. Costing requirements

Assignment of personnel and travel expenses

Per diem allowances are reimbursed as a lump sum up to the maximum amounts permissible under tax law for each country as set out in the country table in the circular from the German Federal Ministry of Finance on travel expense remuneration (downloadable from the [German Federal Ministry of Finance – tax treatment of travel expenses and allowances for international business travel as of 1 January 2026 \(GERMAN ONLY\)](#)).

Accommodation allowances are reimbursed as detailed in the specification of inputs below.

With special justification, additional Accommodation costs up to a reasonable amount can be reimbursed against evidence.

All business travel must be agreed in advance by the officer responsible for the project

Sustainability aspects for travel

GIZ has undertaken an obligation to reduce greenhouse gas emissions (CO₂ emissions) caused by travel. When preparing your tender, please incorporate options for reducing emissions, such as selecting the lowest-emission booking class (economy) and using means of transport, airlines and flight routes with a higher CO₂ efficiency. For short distances, travel by train (second class) or e-mobility should be the preferred option.

CO₂ emissions caused by air travel must be offset. GIZ specifies a budget for this, through which the carbon offsets can be settled against evidence.

There are many different providers in the market for emissions certificates, and they have different climate impact ambitions. The [Development and Climate Alliance \(German only\)](#) has published a [list of standards \(German only\)](#). GIZ recommends using the standards specified there.

Specification of inputs

Fee days	Number of experts	Number of days per expert	Total	Comments
Team Leader	1	10	10	
Key Expert 1	1	20	20	
Key Expert 2 (International Expert)	1	30	30	
Short-term expert pool	2-3		70	

Travel expenses	Quantity	Number per expert	Total	Comments
Per-diem allowance in country of assignment	40			Lump sum/per day
Overnight allowance in country of assignment	40			<p>Overnight stays abroad:</p> <p>Note: Under the BMF travel expense regulations, overnight allowances not exceeding 100% of the lump sum amounts can be submitted for reimbursement against evidence. Up to 75% of the maximum rates specified in the travel expense regulations can be submitted for reimbursement on a lump-sum basis.</p> <p>Please indicate in the price schedule whether your offer is on a lump-sum basis or against evidence.</p>
Transport	Quantity	Price EUR	Total EUR	Comments
International flights <i>India</i>	2			Travel to the place of service delivery India- Vizag City
Domestic flights	12			Flights within the country (Vizag city) of assignment during service delivery
CO ₂ compensation for air travel	1	1.260,00	1.260,00	A fixed budget is earmarked for settling carbon offsets against evidence .
Travel expenses (train, car) car/taxi/etc.	50			Travel within the country of (Vizag city) assignment, transfer to/from airport.
Other travel expenses	2			e.g. visa costs against evidence (is related for the trip of the Key Expert 2 only – there might be 2 trips in total) .
Other costs	Number	Price EUR	Total EUR	Comments
Flexible remuneration	1	10.000,00	10.000,00	A budget of EUR 10.000,00 is foreseen for flexible

				<p>remuneration. Please incorporate this budget into the price schedule. against evidence</p> <p>Use of the flexible remuneration item requires prior written approval from GIZ.</p>
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6. Requirements on the format of the tender

The structure of the bid must correspond to the structure of the ToRs. In particular, the detailed structure of the concept (Chapter 3) is to be organised in accordance with the positively weighted criteria in the assessment grid (not with zero). It must be legible (font size 11 or larger) and clearly formulated. The bid must be drawn up in English (language).

The complete bid shall not exceed **20** pages (excluding CVs & other supporting company documents). If one of the maximum page lengths is exceeded, the content appearing after the cut-off point will not be included in the assessment. External content (e.g. links to websites) will also not be considered.

The CVs of the personnel proposed in accordance with Chapter 4 of the ToRs shall be submitted using the EU (<https://europass.cedefop.europa.eu/documents/curriculumvitae>) format. The CVs shall not exceed 4 pages. The CVs must clearly show the position and job the proposed person held in the reference project and for how long. The CVs must be submitted in English (language) only.

Please calculate your price bid based exactly on the aforementioned costing requirements. In the contract, the consultant has no claim to fully exhaust the days/travel/workshops/ budgets. The number of days/travel/workshops and the budget amount shall be agreed in the contract as 'up to' amounts. The specifications for pricing are defined in the price schedule.

The technical offer must not contain any price information. Technical and financial offers must be submitted as separate pdf and an Excel file document.