

# Terms of Reference: “Training of Trainers on Renewable Energy Grid Integration”

## 1. Background information

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The Cornerstone of Rural Electrification (CORE) initiative and the Transforming Energy Access Learning Partnership (TEA-LP) are partnering to support graduate-level university trainings on energy access across Sub-Saharan Africa.

**CORE** is an international initiative initiated by the Alliance for Rural Electrification (ARE), International Renewable Energy Agency (IRENA), Sustainable Energy for All (SEforALL), UN Environment Programme (UNEP), United Nations Industrial Development Organization (UNIDO) and International Copper Alliance (ICA). CORE is managed by ARE. CORE’s mission is to enable resilient rural and peri-urban communities by ensuring safety, efficiency and reliability become the cornerstone of decentralised electrification.

**TEA-LP** is a partnership of universities committed to delivering local professionals to drive the transition to sustainable energy access for all. TEA-LP has supported eight universities across Africa to develop new postgraduate curricula, that vary, in discipline and content, across universities, aiming to respond to the market needs of this rapidly growing sector in their respective countries. The new phase of the TEA-LP runs from 2022 until the end of 2025 and will see 20 new universities delivering energy access curricula for Masters’ students across Africa and the Indo Pacific.

In the context of the development of **trainings for graduate level students at the National University of Lesotho**, CORE is **seeking an expert to deliver a “Training of Trainers on Renewable Energy Grid Integration”**. The training of trainers should take place in **late January 2023**.

## 2. Objectives

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The objective of this activity is to support **National University of Lesotho (NUL)** to successfully deliver training of graduate students by supporting with training of the university’s trainers.

## 3. Scope of work

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CORE is seeking an expert to develop training materials and deliver the training of four trainers for the **National University of Lesotho** across the following **modules** under the headline **“Renewable Energy Grid Integration”**

### Module 1

- Overview of electricity networks (generation, transmission, distribution and supply; buses, substations, transformers, per unit (p.u.) system, protection gear, etc.)
- Modelling of main power system components

- Load Flow Analysis
- Operation and control of power systems
- Simulation of electricity grid components (network topology) using software (e.g. DigSilent)
- How is renewable energy integrated into grid? (Behind the meter – residential and commercial distributed generation (5 – 500 kW); Via distribution lines – community-scale distributed generation (500 kW – 5 MW); Via transmission lines – centralized, utility-scale generation (20+ MW))

#### Module 2

- Modelling of intermittent or variable renewable energy (VRE) generators in software (solar PV, wind turbines, etc.) and their resources (solar radiation, wind speeds, etc.)
- Impacts of VRE generators in grid integrations (resource variability, reactive power support, slow voltage variations, stability under faulted conditions, interaction with protection systems, etc.)
- Requirements of utility-scale renewable power plants
- Review of grid integration studies
- Dynamic studies (voltage and frequency limits) as per the Grid Code requirements for integration of VRE (nominal operating voltage tolerances, nominal operating frequency tolerances, etc.)

#### Module 3

- Analysis of power systems with high penetration of Renewable Energy Technologies (RET) (active power and frequency control, reactive power and voltage control, security and reliability assessment)
- Load flow analysis (variable voltage profiles (p.u.), transmission line loadings (%), contingency (transmission capacity when some transmission lines are offline or out of service), etc.) under different penetrations of VRE generators at point of common coupling (PCC) and nearby substations
- Reactive power support evaluation of wind farms for network re-phasing (dispatching reactive power according to available active power and maintaining power factor under different voltages at PCC)
- Steady state (quasi-dynamic) studies to perform time series power flow to show how voltage varies for different VRE penetrations and to analyze the power flow, steady state voltage, and line loadings under different load generations
- Control strategies for distributed renewable generators

#### Module 4

- Stability studies (voltage, frequency, and rotor angle) to evaluate the system response in the presence of a 3-phase short circuit using the least critical clearing time (CCT) and to examine the recovery of the system parameters following the disturbance (at PCC, major and nearby substations, major generators, etc.).
- Short circuit analysis to determine the short circuit current as the penetration of REGs is increased (using the IEC 60909 standard) and to evaluate available fault current, which will be used to inform protection settings and equipment specifications.

#### Module 5

- Flexibility measures in presence of high RE penetrations
- Mitigation strategies for addressing challenges brought by increased penetration of VRE generators into the grid: Fault ride through (FRT) capabilities, LVRT, HVRT, etc.; Smart grid technologies;

- Advanced metering infrastructure; Energy storage and more flexible generation technologies (pump-storage)
- VRE integration applications in micro-grids and island grids
  - Policy, regulatory, and market instruments to accelerate RE uptake
  - Cost of RE grid integration

The expert delivering the training of energy access trainers should deliver **up to 3 hours of in-person or virtual training per module** for a **total of up to 15 hours of training**.

The trainings will be delivered in **English**.

A final report of **up to two pages** is to be submitted to ARE upon completion of the trainings, including the following:

- **Pre- and post-training** survey results (to trainers participating in the trainings)
- **Number of trainers trained:** monitored before and during training of trainers sessions
- **Number of students/entrepreneurs trained by trainers:** monitored after training of trainers sessions, also monitored on a regular basis (e.g. on a quarterly or half-yearly basis)
- **Number of students/entrepreneurs trained by trainers that gained employment:** Monitored by surveys and direct inquiries to students on (e.g. on a quarterly or half-yearly basis)
- **All of the above is disaggregated into gender-specific data** (e.g. number of female & male students trained, number of women that gained employment)

The deadline for submission of this report is **17 March 2023**.

Additionally, the selected expert will be required to report on the job situation of the students trained 6, 12 and 18 months after the trainings were conducted.

#### 4. Required documents

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Bidders are required to submit the following documents to Jens Jæger, Director of Policy & Business Development, ARE & Manager, CORE: [j.jaeger@ruralelec.org](mailto:j.jaeger@ruralelec.org)

- Technical proposal** of maximum of three pages on the proposed methodology, timeline for delivery of materials and experience of the expert(s) in delivering similar trainings
- Financial proposal** of no more than 1 page (in USD)
- CV** of the expert(s) in format of choice.

#### 5. Timeline

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The deadline for submissions of proposals is **13 January 2023 (23:59 CET)**.

The selected expert(s) will be contacted by **mid-late January 2023**.

The 'training of trainers' sessions should be delivered in **mid-February 2023**.

#### 6. Fees

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The selected expert(s) will be paid a service fee for the delivery of the trainings.



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The fees quoted in the Financial proposal are all-inclusive and not subject to change.

## 7. Payment schedule

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Payments to the selected expert will be made along the following schedule:

- 25% upon signature of contract
- 25% upon submission of interim report
- 50% upon submission of final report

Payments will be payable within 60 days upon receipt and acceptance of deliverable and invoice (electronic version) indicating the contract number and instalment requested.

