Universal Access to Electricity
Training Handout

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1. Introduction

OnSSET is an **O**pe**n** **S**ource **S**patial **E**lectrification **T**ool that can be used in order to estimate, analyse and visualize the optimal electrification option for an unserved area [1]–[3]. The selection is based on the least cost alternative between:

- The extension of the national grid
- Mini-grid systems on island mode (PV, Wind, Hydro, Diesel) and
- Isolated stand-alone systems (PV, Diesel)

The tool has been developed in order to ensure access to modern, reliable, affordable and sustainable electricity services for all by 2030 (SDG 7).

The objective of this exercise is to help the users understand the basic elements of the electrification tool (OnSSET), explore its capabilities and use its results in order to support policy and strategy development in the energy field.

2. Assignment per group

Group A

Task: Write policy notes based on the online electrification results

The objective of this group is to practise how to interpret the model results in order to formulate policies or inform investment decisions. The point of departure is the online version of OnSSET. By changing the pre-defined parameters via the online interface (e.g. diesel price, grid LCoE, electricity access target) the group should simulate the anticipated future conditions in the electricity sector of Afghanistan.

Furthermore, by using the results of the least cost electrification analysis (acquired from the online interface), the group should identify the best solution per location, quantify the investment requirements, design an electrification plan and formulate policy notes to facilitate the plan's implementation. In particular, the following tasks should be performed:

Task 1. Describe in bullet points the 5-10 most important obstacles that currently hinder full energy access in Afghanistan (this task is not related to the model; base your answer on your experience and knowledge).

Task 2. Explain how the electricity system (demand – supply) of the country will most probably look like in 15 years (e.g. 2030). What is the expected

electrification rate? Which energy resources are expected to be exploited in order to achieve full access to electricity?

Task 3. Simulate a full access to electricity scenario on the OnSSET tool using relevant country specific input data (e.g. population, electricity access target, resources availability, techno-economic data for the technology options) obtained from the report "A GIS Approach to electrification planning in Afghanistan".

Task 4. Identify the optimal electrification mix **(Population Distribution)** per region as well as the total investment requirements for full access to electricity **(Total Cost of Electrification).** Do the solutions reflect the country's vision? Is the country able to afford this transition? If not, what about reconsidering the scenario parameters?

Task 5. Design an electrification strategy per region. Where should the transmission network be expanded? Which areas are more favourable to mini grids and which to stand-alone systems? Which resources are primarily utilized? What is the penetration of renewables (in terms of mini-grid and stand-alone systems) in the electrification mix? How is that penetration affected by diesel price fluctuation?

Task 6. Formulate policy notes that would help facilitate the implementation of the electrification strategy. Introduce subsidies in support of the deployment of certain technologies etc.

Group B

Task: Provide suggestions for electrification planning based on the stand alone version of OnSSET.

Group B has also as a starting point the stand alone version of OnSSET. Based on the given set of characteristics describing the existing conditions of Afghanistan (e.g. population, electricity access target, resources availability, techno-economic data for the technology options), the objective of the group is to identify the least-cost electrification mix, determine capacity additions by technology and total investment requirements for providing electricity to all unserved areas.

In particular, the following tasks should be performed:

Task 1. Determine and list the data requirements to build the model. Read "A GIS Approach to electrification planning in Afghanistan" and collect the relevant data.

Task 2. Use the stand alone version of OnSSET in order to insert the findings into the model.

Task 3. Identify the optimal (least cost) electrification option for Afghanistan for different scenarios varying a number of factors such as electrification tier and diesel price

Task 4. Based on the results, write notes that will support higher level policy managers in developing electrification strategies. Do the solutions reflect the country's vision for electrification?

3. Group discussion

In this section, each group should select a representative who will summarize the respective group's approach and findings.

Group A will present solutions for meeting the electrification target at the national/regional level. The group should be able to answer the following questions:

- What are the most important hindrances to full electrification of Afghanistan?
- What is the electrification strategy that Afghanistan should follow in order to achieve this goal by 2030?
- What is the suggested energy policy that could facilitate the implementation of the electrification strategy?

Group B will highlight electrification challenges/options in the studied area. The group should be able to answer the following questions:

- What are the main electrification challenges in the country?
- What is the optimal electrification option identified for various scenarios?
- Is the policy proposed by group A consistent with the findings here?

The two groups shall compare their findings, analyse and discuss potential differences and collaboratively suggest improvements in the electrification planning process of Afghanistan.

For further clarifications please refer to the instructors.

Good Luck!

4. References

[1] D. Mentis, M. Welsch, F. Fuso Nerini, O. Broad, M. Howells, M. Bazilian, and H. Rogner, "A GIS based approach for electrification planning - A case study on Nigeria," *Energy for Sustainable Development*, 2015.

[2] D. Mentis, M. Andersson, M. Howells, H. Rogner, S. Siyal, O. Broad, A. Korkovelos, and M. Bazilian, "The benefits of geospatial planning in energy access – A case study on Ethiopia," *Appl. Geogr.*, vol. 72, pp. 1–13, Jul. 2016.

[3] F. F. Nerini, O. Broad, D. Mentis, M. Welsch, M. Bazilian, and M. Howells, "A cost comparison of technology approaches for improving access to electricity services," *Energy*, vol. 95, pp. 255–265, Jan. 2016.

[4] C. Taliotis, A. Shivakumar, E. Ramos, D. Mentis, V. Sridharan, O. Broad, and L. Mofor, "An indicative analysis of investment opportunities in the African electricity supply sector — Using TEMBA (The Electricity Model Base for Africa)," *Energy Sustain. Dev.*, 2016.