**Summary of the 2nd Summer School on Modelling Tools for Sustainable Development**

*GIS- Based Electrification Planning Training*

The Abdu Salam International Center of Theoretical Physics (ICTP), Trieste, Italy

June 11-29th, 2018

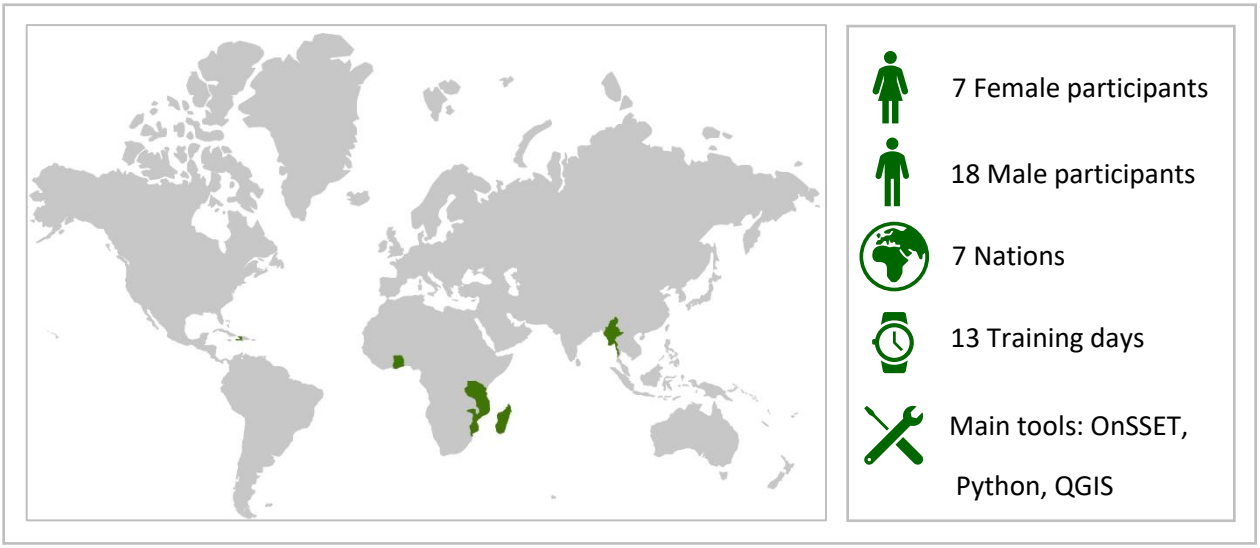
## Introduction

The 2nd Summer School was held under the capacity building component of the Global Program for *Geospatial Electrification Planning Scale Up* which is being implemented at the global level as support to the ESMAP Sustainable Energy for All Technical Assistance Facility (S-TAP), supporting client countries in achieving universal access to modern energy services by 2030. It was organized by ESMAP with a consortium of partners[1].

## Background

The training had 25 participants in total; 22 were nominated by WB TTLs under World Bank projects (representatives of with Government agencies or utilities); and three came from academic institutions [2]. The summer school was overall composed by seven female and 18 male participants.

**Figure 1: High-level overview of the Summer School**




[1] UNDP, UNDESA, DFID, The Royal Institute of Technology- KTH, Cambridge University, The International Center for Theoretical Physics (ICTP), the International Union for Geodesy and Geophysics (IUGG), and the Open Tools, Integrated Modelling and Upskilling for Sustainable Development-Community of Practice.

[2] Makerere University (Uganda), University of Cape Town (South Africa) and UNB - Universidade de Brasilia. sponsored by IUGG, ICTP, National Natural Science Foundation of China (NSFC) or self-funded.

**Table 1: Skill-set of participants (self-reported)**

| Prior experience level | Yes |
|---|---|
| Prior experience in using GIS tools before the training? | 63% |
| Prior experience in using Python before the training? | 5% |
| Prior experience in using OnSSET before the training? | 0% |
| Prior experience in energy modelling before the training? | 58% |
| Prior experience in electrification modelling before the training? | 72% |
| Prior experience in GIS based electrification modelling before the training? | 32% |

**Training content summary**

The division of Energy Systems Analysis at the Royal Institute of Technology (KTH-dESA) based in Stockholm, Sweden was contracted by the WB for the organization and management of the Summer School. The training was conducted by three trainers under the leadership of Professor Mark Howells. The participants were introduced to and trained in the following tools:

- QGIS - free and open-source cross-platform desktop geographic information system (GIS) application that supports viewing, editing, and analysis of geospatial data;
- OnSSET - pen Source Spatial Electrification Tool (OnSSET) [3] - is a bottom-up optimization energy modelling tool that estimates, analyzes, and visualizes the most cost-effective electrification technology. The tool integrated the WB Tiers approach and was developed by KTH;
- Python (using Pycharm and Jupyter) - Python is an interpreted high-level programming language for general-purpose programming. Pycharm and Jupyter Notebook are Python Integrated Development Environment-IDEs, used for running and developing codes.

Starting by using a simplified web-based version of OnSSET, the participants gained sufficient knowledge to later develop their standalone country specific models. These models are in large extent based on openly available data that the participants collected during the first week. Some participants also incorporated country specific data that they collected through other channels. Despite the limited time, the participants managed to develop rather sophisticated models, providing important insights, that are great starting points for further development. The models developed and all tools (mentioned above) are open, customizable, and fully transferable for further use after the completion of the training.

To ensure that the trainees (i) saw the application of the models in the real world and (ii) learned how to present the benefits of geospatial modelling to relevant stakeholders to inform policy making and sector investments, the participants were asked to give presentations on the outputs of their country models the last day of the training.

This exercise was also meant, on one hand, to test the internalization of technical skills, and on the other, to communicate complexity and knowledge in a simplified way. Each team received tailored feedback from either WB or other seasoned stakeholders in the field of geospatial planning and client engagement

[3] OnSSET considers spatially explicit characteristics related to energy. Such data include population density and distribution, proximity to transmission and road network, nighttime lights, local renewable energy potential etc. OnSSET focuses on the assessment and deployment of conventional and renewable energy technologies aiming at ensuring access to affordable, reliable, sustainable and modern energy for all.

to improve trainees' ability to present and disseminate the benefits of a data driven approach to electrification planning in their respective institutions. These skills will also be key to support WB engagements under the *Geospatial Electrification Planning in the Africa Region* multi-country project. Each country team was also asked to make a poster with the key findings of the modelling exercise.

**Trainees key highlights of the Summer School**

*Contents and organization of the training*

- Both the trainers from KTH as well as the World Bank staff on site witnessed that the nominated and later selected participants well matched the scope of the training, both in terms of:
  - ability to follow the pace of this highly technically intensive training, as well as
  - expressed interest and personal engagement/investment in the training.
- The heterogeneity of the trainees, in geographic and background was beneficial in enabling the exchange of different perspectives, namely government, utility, and academic ones. It also fostered conversations about the relevance of the country context in determining the eventual outcome.
- The participants have gained a valuable knowledge of the tools offered and main issues in electrification planning.

*Logistics*

- At least nine participants experienced difficulties to cover their costs until reimbursement. There is a need to explore option of providing either the per diem of food vouchers in advance rather than reimbursing ex-post actual costs.

**Key Feedback from Participants**

- Request to support the development of programs at universities to ensure sustainability of capacity building and not losing capacity over time – more focus within the countries to build a culture of application of GIS tools;
- WB taking leadership in connecting development partners and stakeholders involved in geospatial modeling – often a deficit of offered relevant trainings, given the specificities of the country and immediate needs, plus there is confusion about the different model outputs and comparative advantages;
- Large interest for future training activities of the OnSSET-training framework and further development of the country models:
- Need for more focus on software management in countries;
- Lack of updated data is an issue.

**Next steps**

The participants have been encouraged to engage in the OpTIMUS community (Open Tools, Integrated Modelling and Upskilling for Sustainable Development community) to benefit from modeling support for trouble shooting, but also as a forum for feedback and establishment of a Community of Practice across countries.

*(i) Global Program for Geospatial Electrification Planning Scale Up*

- To share contacts of trainees with operations (Rhonda Lenai Jordan) as contact points in the country where operations are being or will be launched – could be good technical supporter of the work and/or with the WB support become good communicators to the Government of the advantages of GIS planning; as well as provide informed support on the specific needs of the country (including trainings and capacity building activities;
- To ensure complementarity of capacity building activities offered under ESMAP with technical assistance provided under WB projects, ensure dialogue to adequately and strategically plan for future ESMAP initiatives, responding to immediate country planning needs;
- Procurement support and capacity building in countries (including summer school and overall provision of services to clients): to expand the vendors' brochure with clearer guidelines and information of different planning options and related tools. Provide a structured overview of need-based solutions so that it is easier for the client to identify the right modelling tool they need.
- To request for data sharing from countries that participated to the training through trainees – would be improvement to the model and could go on the website of the model to also show buy in from countries;
- To explore university exchanges within the Community of Practice.

*(ii) Partnerships*

- Ensure stronger coordination of activities with other stakeholders (e.g. UNDESA) to provide just in time support and tailoring of capacity building activities to countries' immediate needs, and avoid overlapping (potential for start coordination in test countries);
- Development of a manual containing an overview of planning needs to empower clients to pick and choose what they need (could be used for TTLs at the Bank too);
- Expansion of Optimus consortium to establish a 'go to' one shop for energy sector modelling and related capacity building activities;

*(iii) Improvement of Future Trainings*

The establishment of regional centers of expertise is being explored. There is interest shown from both Makerere university and Universidade de Brasilia as well as University of Cape Town.
Further, listed below are the lessons learned emerged from the Summer School, to inform future capacity building activities conducted under the *Geospatial Electrification Planning Scale Up*:

- Start the training with having the participants present their country context with key KPIs (overview of main sector challenge, which will inform and adapt the recommendations from the model – participants will have to keep that in mind – finding solutions for the real world);
- Building on above point, to rightfully assess the results of a model the participants needs to gain an understanding of the system the model is aimed to reflect, so that the key KPIs are not only identified and presented but reflected upon. In addition, ensure that the participants can question the models, understand that the results will never be better than the input data, and that results of models are highly dependent on assumptions;

- Participants could be required to bring an overview of all GIS activities (and datasets, including permission to share) in the country. This would help WB teams to easily get a high-level gap analysis of GIS datasets and capacity in the country, as well as provide inputs for energydata.info;
- Final presentations could include the main challenges associated with the implementation of the outputs of the model, for Government consideration. Perhaps a 1-page summary of findings and recommendations could be added as an exercise. A stronger emphasize on the elevator pitch directed to higher level decision makers should also be given;
- Potentially concentrate the focus of the Summer School on electrification in Africa only, at least our track. Potential collaboration with IEA to provide training on energy sector modelling for different countries simultaneously as part of the establishment of a 'one shop' for energy modeling;
- Communicate with the clients to better link the training activities with what is being done in operations. This both to identify the priority of the country but also to better supplement traditional in country trainings;
- Explore how to cut down time and cost with e-learning (pre-training);
- Explore option of participants of past trainings to attend level 2 training/track;
- Earlier deadlines for nominations and selection process of the participants, to cut down the costs of late bookings of flights;
- Though female participation was strongly encouraged, this should be further emphasized.

**Appendix II- Summary of Responses from Questionnaire**

The participants were asked to fill in two sets of questionnaires after the completion of the training. The response rate was of 76 and 84 percent for the first and the second questionnaires respectively. Below is a selection of the results.

**Data accusation**

Among the 16 datasets that were used for the modelling exercise, the following were in large extent obtained domestically (Figure 2-4).

**Figure 2: Road Networks**

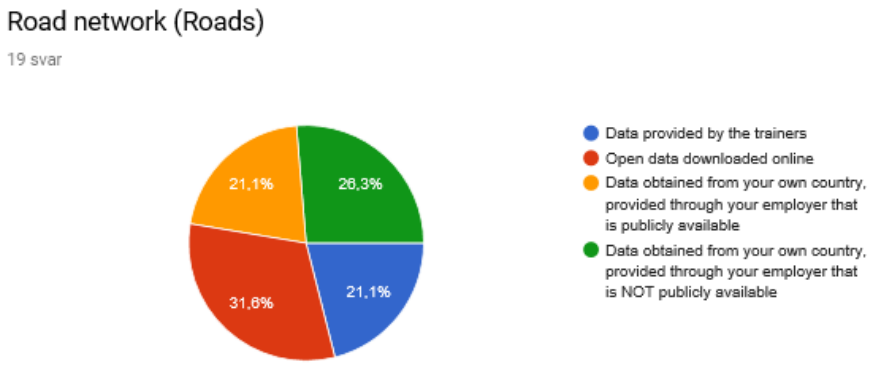



**Figure 3: Substations**

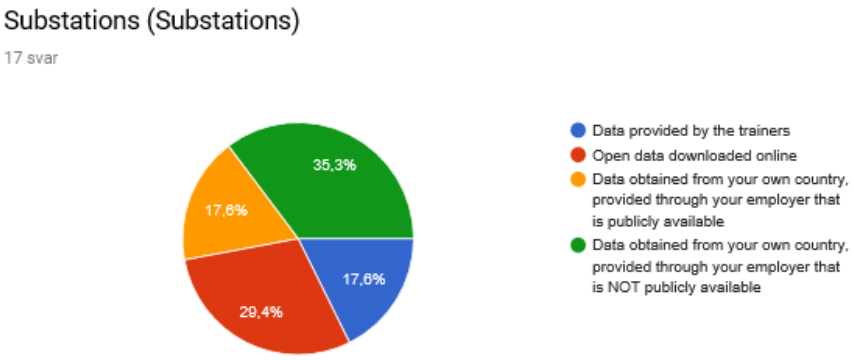
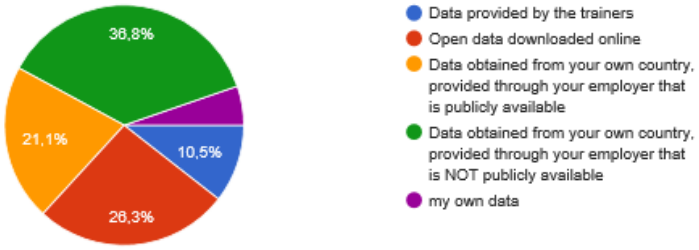



**Figure 4: Transmission Networks**

## Transmission Network (Transmission_Network)

19 svar



**Questions on the online platforms (UNDESA/UNDP – The World Bank)**

The questions in this section focus on the use of two online platforms developed by KTH dESA in collaboration with UNDESA/UNDP and the World Bank. A selection of the results is presented in Figure 5 and 6 and Table 2,3 and 4.

**Figure 5: Awareness of platforms**

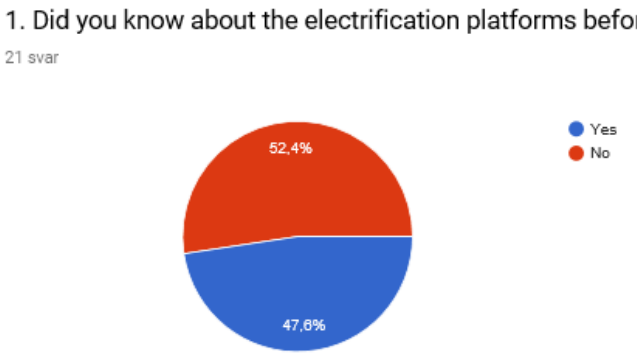



**Figure 6: Usefulness of platforms**

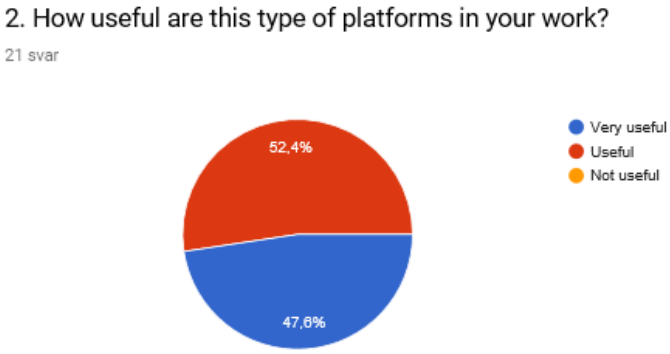


**Table 2: Platforms- General feedback**

| **4. What additional elements would you have in the online platforms in order to make the results more comprehensive/informative/useful?** |
|---|
| None |
| purchasing abilities |
| Personalize electrification tiers and enable urban/rural differentiation of targets |
| Economic justification of the technology selected |
| change some parameters values to align with our reality |
| Transformers and Medium Voltage Lines to be used as input data |
| The online platforms can sometimes be a black box. Need to show the code behind the visualization and perhaps provide simple steps showing how the model was built and visualized. This can help in increasing adaption of the model. |
| Level of the voltage |
| No additional elements |
| Costs for transmission, generation and distribution should be separated<br>other productive uses of electricity should also be taken into account. |
| Updated data |
| Easier access to the data used in the platform /downloading shapes directly from the platforms |

**Table 3: Platforms- Missing aspects**

| **5. What aspects of electrification are critical and missing from these platforms?** |
|---|
| None |
| biomass generation |
| Biomass generation, hybrid systems |
| - Biomass is not considered on the input<br>- Only solar restriction is taken in account but other source may have its restrictions (e.g.: protected area for hydro, urban area for wind farm)<br>- Source used in grid extension is not precise |
| Most aspect are covered |
| Other renewable source is not in the platform |
| Other sources of the energy for the generation of electricity are missing from these platforms |
| No comments |
| Considering the existing renewable off grid systems as well as the Medium and Low Voltage network |
| Number of Transformers and the Length of proposed MV Lines |
| financing sources, productive uses, ability to pay for the power |
| Electrical Distribution line distance, transformer location |
| Clear interpretation of the results. |
| Customer base and costing |
| more emphasis on mini grid hydro and wind, and clustering of population in villages and settlements |

**Table 4: Platforms - User-friendliness**

| **2. How easy was it to access the online tool and run a scenario?** | |
|---|---|
| **Very easy** | 29% |
| **Easy** | 52% |
| **Hard** | 19% |