The GEP User Guide

Release 15-11-2021

KTH dESA

Jul 17, 2023

Contents

1 The Global Electrification Platform (GEP) 3

2 Contents 5

2.1 Overview . . . 5
2.2 GEP Explorer . . . 7
2.3 GEP Generator . . . 8
2.4 GEP Toolbox . . . 10
2.5 GEP Interoperability . . . 12
2.6 Capacity Building . . . 12
2.7 Data Standards . . . 14
2.8 Contact . . . 15

KTH
VETENSKAP
OCH KONST
WORLD
RESOURCES
INSTITUTE
developmentSEED
Google
THE WORLD BANK
IBRD • IDA | WORLD BANK GROUP
ABB
UNIVERSITY OF
CAMBRIDGE
Derilinx

CHAPTER 1

The Global Electrification Platform (GEP)

The 2030 Agenda for Sustainable Development has set the goal of universal access to electricity by 2030 (SDG7). The challenge involves bringing electricity to populations with various socio-economic backgrounds and needs. Despite remarkable progress in the past years, energy access gaps still exist.

Coping with dilemmas of this nature requires thorough analysis of the social, technical and economic characteristics of each target location. This, in turn, requires access to reliable data and information e.g., location of population settlements, electricity demand levels, resource availability, poverty rate and economic activity, distance from functional infrastructure etc. Geographic Information Systems (GIS) and remote sensing techniques are becoming openly available and can now provide a range of location-specific information that has not been previously accessible.

Under this framework, **The World Bank** in collaboration with **KTH dES**, **Development Seed**, **Derilinx**, **World Resources Institute**, **Cambridge university**, **Google** and **ABB** have developed the Global Electrification Platform (GEP). The following sections provide a brief overview.

CHAPTER 2

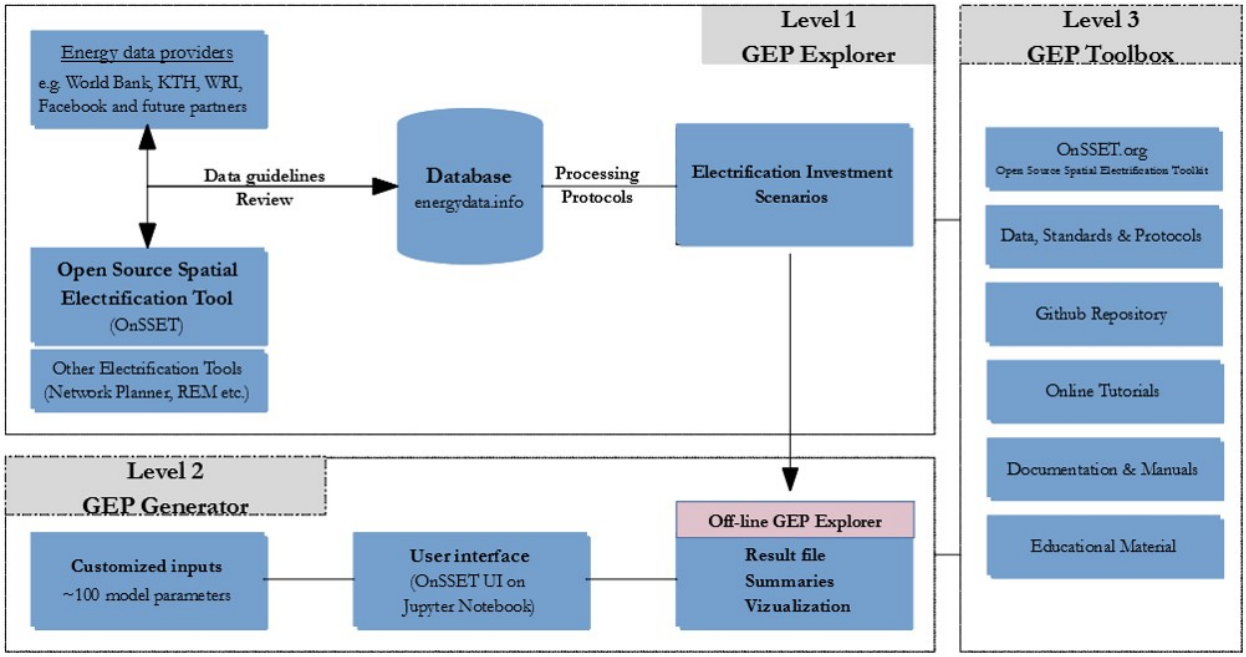
Contents

2.1 Overview

2.1.1 Scope

The GEP is an open portal for electrification investment data, analysis and research. It is being designed upon the principles of openness and transparency and aspires to enable reusability, replicability and reproducibility of embedded processes and data. Based on these principles, GEP output is available in three levels:

- **Level 1 - GEP Explorer**: Up-to-date and openly accessible electrification investment outlooks
- **Level 2 - GEP Generator**: Open source UI for generating electrification outlooks on the fly
- **Level 3 - GEP Toolbox**: Open access and fully-fledged documentation and training material



In addition, the GEP ecosystem has been designed as such to support collaboration and interoperability between institutions, modellers and practitioners engaged in the field of energy access. This is achieved:

- By jointly developing data standards and processing protocols so that disparate practices, software and data can be aligned and streamlined.
- By means of modular configuration, through which different targets can be reached; Data, model and result customization and update is possible on the fly.
- By means of regular and community-inclusive annual updates through which new data, methods, and results can be absorbed as they emerge.

2.1.2 Target audience

The GEP aspires therefore to attract four primary target audiences:

- **High level decision makers** will use output from the GEP Explorer that produces geo-infographic investment options for all target countries.
- **Policy and investment analysts** will use the GEP Scenario Generator to develop tailored scenarios to meet specific policy or investment goals.
- **Data producers and ICT developers** will use the GEP Toolbox and have a target into which additional information and methods can be utilized (with global impact).
- **Global development organizations** will have a platform for country outreach. The software provides a springboard for tailored analysis and engagement from academia to project developers.

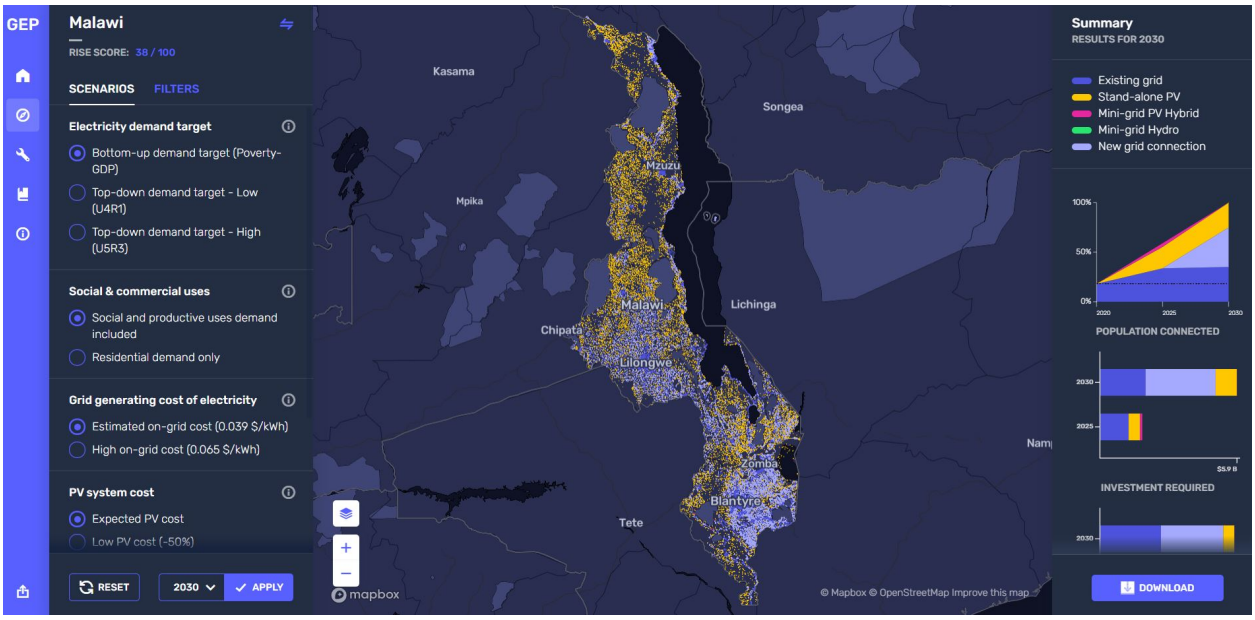
The GEP (in its current format and version) is built upon characteristics and functionalities of the Open Source Spatial Electrification Tool (OnSSET). The GEP team is constantly working on collecting feedback from other institutions active in the geospatial electrification modelling (Columbia University, MIT, NRECA, RLI and others) in order to update and expand GEP's interoperability.

2.2 GEP Explorer

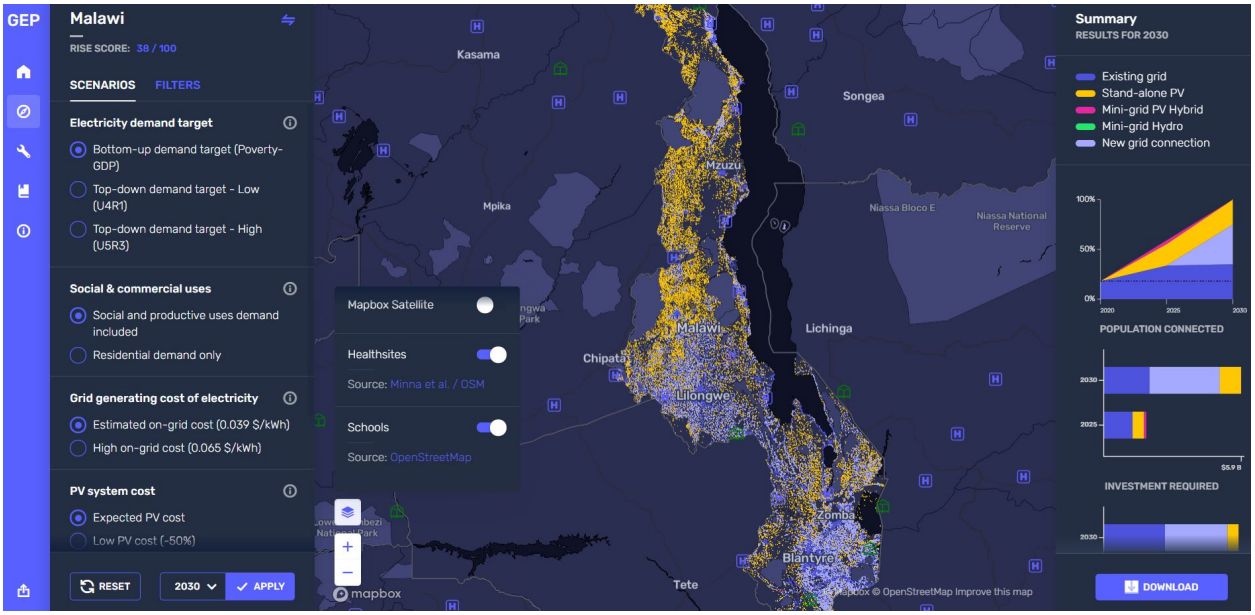
2.2.1 Access GEP Explorer service here

2.2.2 Overview

The GEP Explorer is an open access, interactive, online platform that allows overview of electrification investment scenarios for a selection of countries. The scenarios present how to achieve universal electricity access in two steps. The first step is an outlook for an intermediate investment strategy (up to 2025). The second is explores full electrification by 2030. The user is able to easily move through 96 scenario combinations to meet the access goals.



GEP Explorer allows customized rendering. The user can also select base maps and other available layers (e.g., location of Health & Education facilities) and overlay them with results from the electrification investment scenarios.



The number, type and parameterization of electrification investment scenarios along with their inherent assumptions are presented in the following slides in the form of 'levers'. In the next phase of the project, both scenarios and assumptions will derive from the annual GEP update. The process is open to everyone!

Informing the 96 electrification investment scenarios was based on two types of data; GIS related and non-GIS related. Both have been collected and cured based on suggested guidelines available here.

GEP Explorer is open source. That is, it can be configured and used locally and independently of the online server. More information is available in the interoperability section.

2.2.3 Target Audience

The GEP Explorer aims to support first-order engaging discussions between:

- High-level country counterparts (politicians, government officials, managers)
- Financiers and Investors
- Consultants
- Practitioners
- NGOs and IGOs

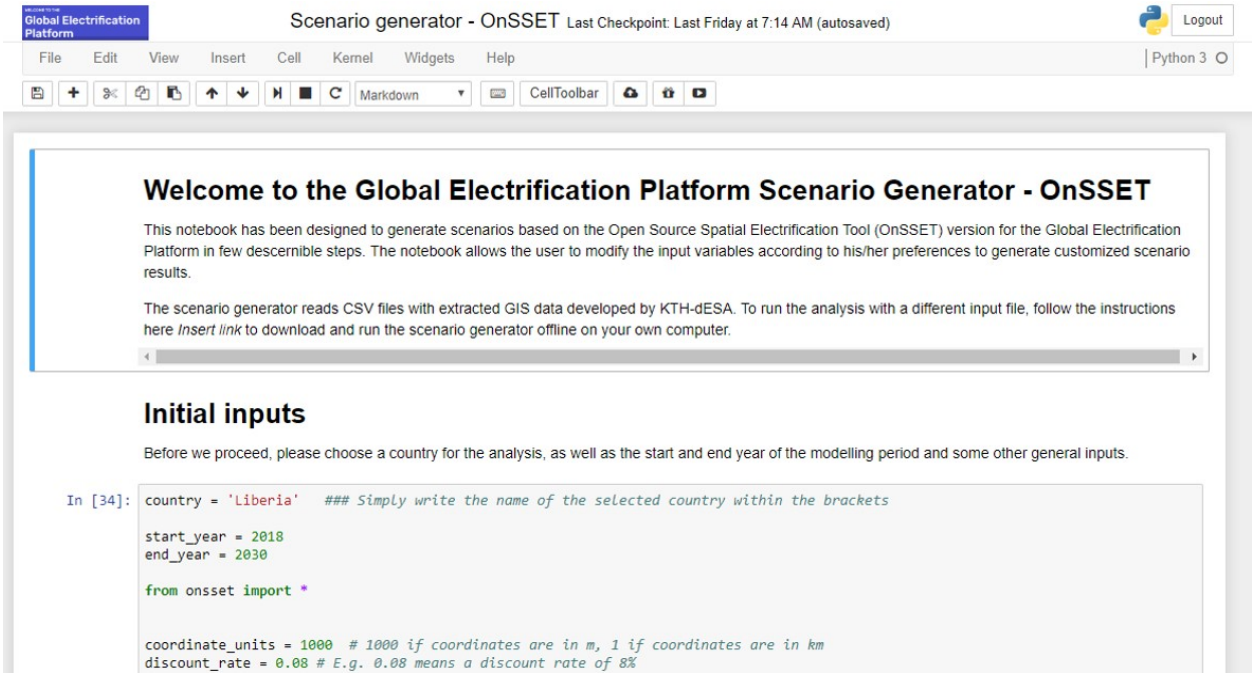
It can also be used to provide investment outlook info for regular processes. Possible examples include the IEA WEO, WBG GTF, WBG SEAR, UN-HLPF, EMP-Africa, EMP-Asia Pacific etc.

2.3 GEP Generator

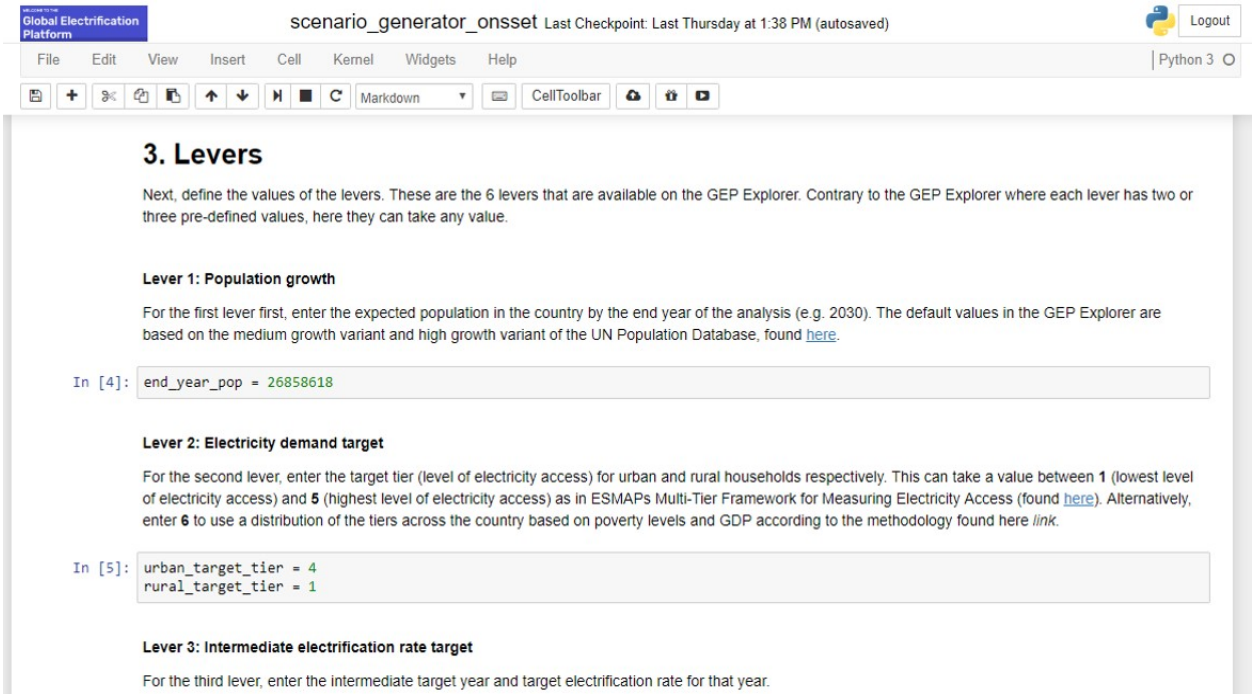
2.3.1 Access GEP Generator services here

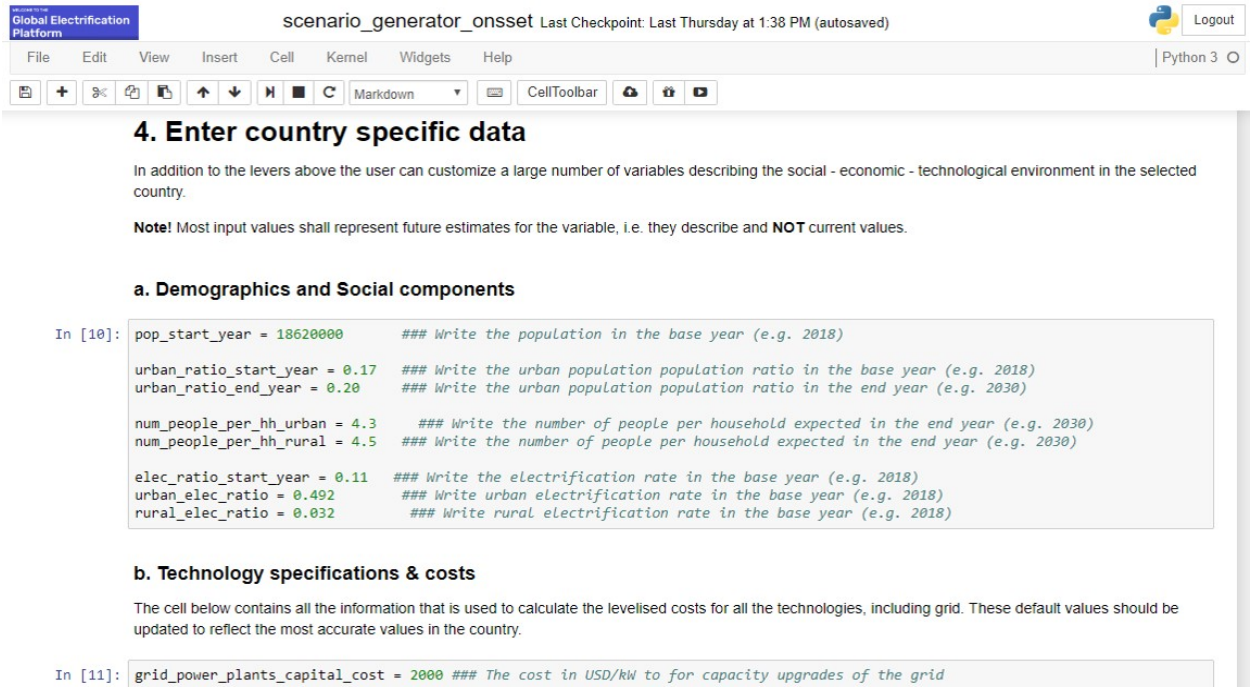
2.3.2 Overview

Replicability and reproducibility are key components of the GEP. The GEP Generator provides policy analysts with a tool to re-generate or modify investment electrification scenarios using an open source, user friendly interface. The GEP Generator is based on the Open Source Spatial Electrification Tool (OnSSET.org) and is developed as an interactive Jupyter Notebook.



The users are able to replicate the electrification investment scenarios available in the GEP Explorer. They can also develop their own scenarios – and visualize them independently. This allows building custom scenarios (~100 interchangeable parameters) that better match local specificities or specific policy measures i.e. borrowing options, technology purchases, formulating concession programs, and subsidies.





The GEP Generator can be ran locally on the user's computer without any dependency on online servers.

2.3.3 Target Audience

The GEP Generator aims to support specific key services:

1. Capacity building activities:
    1. Integrated into annual trainings: ICTP Global Summer School / Energy Modelling Platform(s) to provide a basic introduction to geo-spatial electrification training.
    2. Implemented in training and outreach with analysts in-country as part of new and ongoing electrification projects
    3. Become one of several key components in the OpTIMUS.community global Micro-Masters
2. Driver of development:
    1. Provides analysts with the ability to move beyond pre-cooked results provided in the GEP Explorer to more nuanced scenarios. Scenarios that are flexible to conditional national constraints for goals: developing detailed policy, engaging with financiers, exploring technology deployment and market potentials etc.
    2. Being cost-free enables the GEP community to develop first order electrification plans rapidly at a drastically reduced cost. These can be used in country engagement activities.

2.4 GEP Toolbox

2.4.1 Overview

The GEP Toolbox provides access to all the ICT 'widgets' used in the development of the GEP including tools, methods as well as user manuals and training material. All available in an open an accessible way through various

channels. It provides the potential and flexibility needed to fully change the underlying modelling methods and/or generate new models.

2.4.2 Tools and methods

The Open Source Spatial Electrification Tool (OnSSET)

The current set of results in the GEP were created using a modified version of OnSSET, openly distributed as gep-onsset. In the interests of transparency and collaboration, the modelling process is open for feedback and improvements from other institutions, experts and practitioners. Based on this process, the GEP will be updated annually with improved data and processes, as well as new models.

A peer-reviewed academic publication supporting OnSSET modifications for GEP has been developed throughout the duration of the project and is available online since April 2019.

Code for developing population clusters

The identification of settlements is the basis of the electrification analysis in many models. In GEP settlements are represented as vector clusters. KTH dES has developed a methodology for generating such vector clusters based on open access datasets. In the interests of transparency and replicability, KTH dES has also developed the supporting open source code. In addition, a more detailed description of the methodology is available here.

The above methodology requires geospatial processing in python.

Code for extracting GIS information to vector clusters

Geospatial electrification models are inextricably connected with GIS data. Extracting geospatial information to each vector cluster (see above), is therefore a necessary yet time consuming process. The extraction commands can be executed manually in QGIS; however, the KTH team has developed an open source code in order to automate the process.

In GEP, 26 GIS layers have been used to inform vector attributes as presented here.

Data-service and explorer

These refer to the web & data service supporting the GEP. More information is available here.

User guides & training material

GEP aims to support decision making in various levels. Documentation has been developed and tailored to support the rapid uptake of all GEP services, including:

- User guides and how-to-use instructions for all tools and methods (refer to each one of them on GEP's Github page)
- Education and Training material on Google's Open Online Education platform

2.4.3 Target Audience

It is envisioned that this material will be used in/for:

- Remote, self-learning through video Lectures

- In-country training activities (see example here)
- Regional training (such as held at the Energy Modelling Platform EMP) and the OpTIMUS Global Summer School on Modelling Tools for Sustainable Development
- Post-graduate curricula (i.g OpTIMUS Micro-Masters)

2.5 GEP Interoperability

The GEP is expected to be a part of a continuous data and model discovery process. This process will discover and develop new data via remote sensing, machine learning, development of new theory and modelling. New data will be compiled, processed in models and new information is expected to be produced during the operation of the GEP. To ensure that new data and models can easily be integrated to the GEP ecosystem, guidelines for its form and description, as well as handling protocols have been developed.

2.5.1 Data guidelines

The GEP team has put together a list of input/output datasets and parameters that are common between several GIS based electrification modelling tools. Each dataset/parameter comes along with suggested standards and metadata describing several characteristics that are important in the integration process. These include type, format, source, author and licence among others.

The list is available here.

In this stage, the above list was informed based on the functionalities of OnSSET. However, the GEP team is collecting feedback from other institutions active in the geospatial electrification modelling in order to update and expand the current list.

2.5.2 GEP annual updates

Every year an updated version of the GEP will be released. This will include an annual suite of Electrification Investment Scenarios (EISs) on GEP Explorer, providing a set of least cost investment scenarios for each target country. These updates will reflect advances in algorithms and models, improvements in data input, as well as increased scenarios defined by increasingly relevant and available 'levers'.

A process will be set up for active updating in collaboration with partners such that the latest available modelling, data and analysis is both used and compatible with the GEP. Similarly, each year, advances in standards and updated teaching material will be released.

Official release of the annual update is expected to take place in the last quarter of each year. Call for inputs and collaboration will be made after the annual release.

2.6 Capacity Building

Capacity Building is a crucial component of the Global Electrification Platform (GEP). The GEP team has conducted more than 10 workshops since 2018 primarily through two annual events: the Energy Modelling Platform for Africa (EMPA) and the Summer School on Modeling Tools for Sustainable Development at ICTP (see list below).

The goal of these events is to increase geospatial capacity across government units, academia, development partners and private sector that are actively angaged in planning, policy & decision-making for achieving critical development targets, like SDG7.

If you are interested in participating in these events - either as trainer or trainee - please do not hesitate to contact the GEP Team.

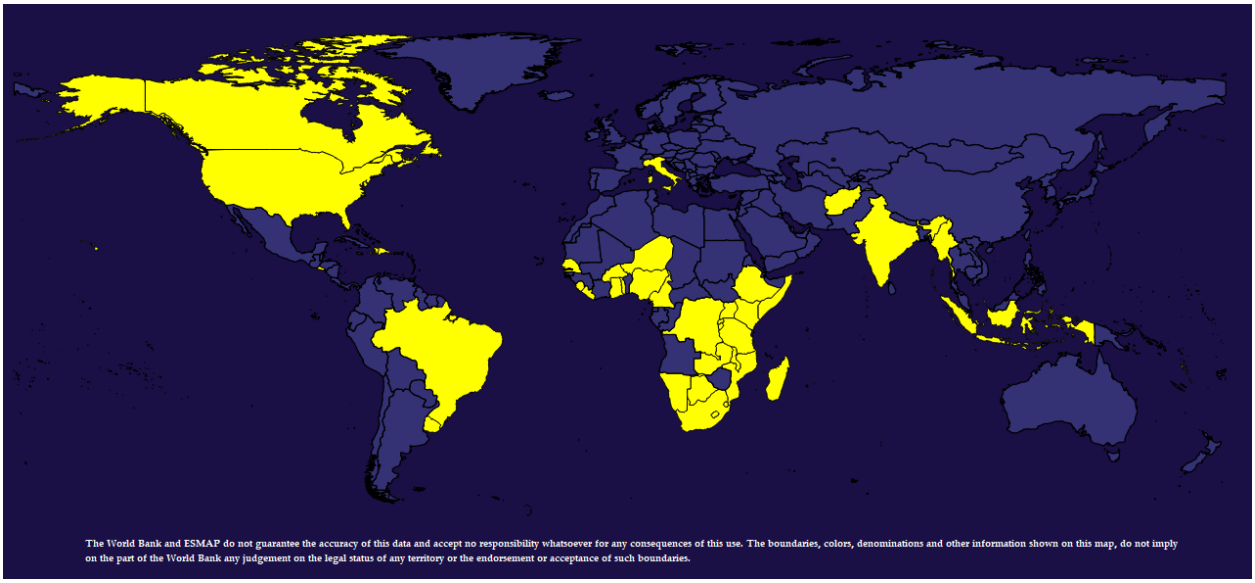
2.6.1 Past Capacity Building Activities

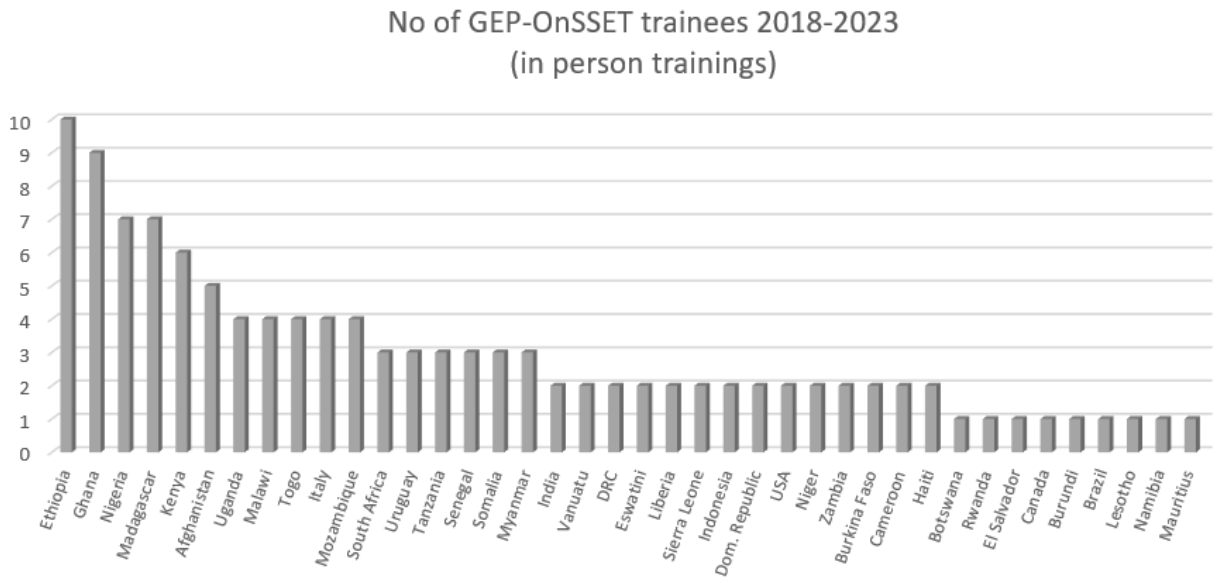
So far, the following capacity building activities have been hosted as part of this initiative:

1. EMPA – Ethiopia, Addis Ababa, January 2018
2. ICTP Summer School – Italy, Trieste, June 2018
3. EMPA – South Africa, Cape Town, January 2019
4. ICTP Summer School – Italy, Trieste, June 2019
5. Online Capacity Building in Somalia, May 2021
6. ICTP Summer School (Virtual training), June 2021
7. EMPA (Virtual training), November 2021
8. ICTP Summer School (Virtual training), June 2022
9. EMPLAC (Virtual Training), October 2022
10. EMPA – Namibia, Windhoek, April 2023
11. ICTP Summer School – Italy, Trieste July 2023

As of July 2023, 119 trainees from 40 countries have completed the GEP-OnSSET training. About 70% of the trainees are working as electrification & policy analysts in government agencies and institutions; about 20% are coming from academia and research organizations and the remaining 10% from development organizations and the private sector. Most of the participants are from Sub-Saharan Africa; trainees from Latin America & the Caribbean and Southeast Asia & the Pacific and other regions have also participated over the years.

GEP-OnSSET capacity building efforts between 2018-2023





2.6.2 Open Access Course at Open University

The Climate Compatible Growth (#CCG) program together with the UN, the World Bank and other International Organizations have developed a collection of online courses aiming at developing capacity for better evidence-based policy making with analysts and academics from across the world. One of the courses focuses on energy access modelling and more specifically, on the Global Electrification Platform and OnSSET.

In this course one can learn about energy access modelling and how to conduct a geospatial electrification analysis. The course serves as an introduction to the Open Source Spatial Electrification Tool (OnSSET) and offers a unique opportunity to learn about spatial data collection, cleaning, curation and use into electrification modelling. After the completion of the course, one will be able to better undestand the basic concepts of geospatial electrification modelling, build a country model from scratch and explore custom-developed electrification investment roadmaps.

All material is open access and has been developed by forward-looking organizations, who know the importance of community accessibility, continuous improvement, and accountability.

Learn more about this course here.

2.7 Data Standards

Data are fundamental to the Global Electrification Platform, and as such, we have put effort into documenting the data input and output standards in order to facilitate easier data exchange with our partners.

As a jumping off point, we have published the data standards. We are continuously working with partners and clients to identify commonalities in our data collection and our data needs and work towards data conversion tools that allow for easier integration of new data into all our processes.

If you are interested in collaborating on data standards, please contact the GEP team, or follow up at this Github repository

2.8 Contact

For any questions, feedback or general inquiries please to not hesitate to contact the development team.

- **The World Bank**: Ashish Shrestha ashrestha1@worldbank.org
- **KTH Energy Systems**: Andreas Sahlberg asahl@kth.se
- **Development Seed**: Olaf Veerman olaf@developmentseed.org
- **Derilinx**: Eric Soroos eric@derilinx.com
- **WRI**: Dimitrios Mentis Dimitrios.Mentis@wri.org