

HOW TO RUN THE MODEL IN OSeMOSYS: “Modeling policy pathways to maximize renewable energy growth and investment in Democratic Republic of the Congo using OSeMOSYS”

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i. Introduction

To gain a thorough understanding of OSeMOSYS and the CCG ClicSAND interface, there is an Open University training course in Energy and Flexibility Modelling: OSeMOSYS & FlexTool available here:

<https://www.open.edu/openlearncreate/course/view.php?id=8395>. There is an alternate online version of the course available for Windows users.

The CCG-SAND interface was created by Carla Cannone based on the energy modelling tool OSeMOSYS, to organize input data via an Excel-based graphical user interface. Once the required data, such as capital costs and operational life are inputted, the clicSAND interface produces a text file as the output. The [Starter Data Kit for DRC](#) includes base data files for DRC. The scenarios run in this analysis are based on the ‘CongoDemRep_LCv2_SAND’ data from the Starter Data Kit, while the SAND files for each of the five scenarios used in this study can be found in this Zenodo repository.

A text file can be generated from each SAND file, which is then converted to an OSeMOSYS Cloud version online. After an online run of OSeMOSYS Cloud, a results folder can be produced that contains a csv Excel file. This file contains the results for specific parameters such as the total annual capacity and total CO2 emissions. The data within the .csv file are transferred to an Excel spreadsheet containing the results template where graphs can be created to present the final results. Below is a step-by-step guide to first running the model, based on the Open University Hands-On exercises 1, 2 and 3 (Tan et al., 2022a, Tan et al., 2022b, Tan et al., 2022c).

1. Install Mono framework for Mac

Download Mono with this website <https://www.mono-project.com/download/stable/>. Click on 'Download Mono 6.12.0 (Visual Studio channel*)' to start the download. The Mono package will be in your Downloads folder. Click on it. Click on 'Continue' and 'Agree' in the pop-up screen until you see 'Install'. Once clicked on 'Install', the installation process is complete and can click 'Close'. 'Move to Trash' to finish.

2. Install gcc, cbc and glpsol

To install gcc, you need to run a command in a terminal. Click on command + space bar to activate spotlight search and type in "terminal" and click or press enter on the first option. Copy and paste this command into the terminal: 'xcode-select –install' and hit enter. Then click on 'Install' and 'Agree'. Once the pop-up stating installation is complete, click on 'Done'. To install cbc and glpsol, copy and paste the commands from <https://raw.githubusercontent.com/ClimateCompatibleGrowth/clicSANDMac/main/install.sh> to your terminal in one go and press enter.

3. Installing clicSANDMac

Download the latest clicSANDMac.zip from here: <http://doi.org/10.5281/zenodo.5879056>. The zip file will be in your downloads folders. Unzip it by clicking on it. A pop-up screen will appear stating macOS cannot verify the developer of clic-SANDMac.pkg. Click 'Open'. Click 'Continue' and then 'Install'. Once the installation was successful, click 'Close' and then 'Move to Trash' to finish. clicSANDMac will be in your 'Applications' folder.

4. Run a scenario using clicSANDMac or using OSeMOSYS Cloud

4.1 clicSandMac run

- a) Open clicSANDMac in your Applications folder. The clicSAND pop-up will appear, click on 'Export Templates' and direct to a folder for your scenario, e.g. DRC_UNC_Scenario. This automatically saves a blank copy of four files: CCG-SAND Interface v.12.xlsm, OSeMOSYS_code.txt, Results Databased.accdb, and ResultsTemplate.xlsm. The five SAND files used in the analysis for this study can be found on Zenodo: DRC UNC SAND, DRC BAU SAND, DRC RF SAND, DRC FH SAND, and DRC RF+FH SAND (see Table 1).

Table 1. The five scenarios modeled in this study, their short names, and a brief overview of their most important features

| Full Scenario Name | Scenario Short Name | Scenario Overview |
|--|---------------------|---|
| Unconstrained | UNC | No additional model constraints added |
| Business as Usual | BAU | No investment in off-grid renewables permitted |
| Renewable Friendly | RF | 16% capital cost reduction (subsidy) applied to all RETs |
| Fossil Hostile | FH | 70% capital cost increase (tax) applied to all fossil fuel technologies |
| Renewable Friendly and Fossil Hostile (combined) | RF+FH | Both 16% RET subsidy and 70% fossil fuel technology tax applied |

- b) Go to the 'ToDataFile' sheet in the SAND interface of one of the five scenarios, for example the UNC scenario. Click on the top left corner of the spreadsheet which selects all data within the sheet. Right click and copy. Paste this data from the ToDataFile into a 'New Document' of the TextEdit app. Save your new TextEdit file with a related name e.g. DRC_UNC_Scenario in your related folder and close it. We now have a .txt file. Now go to 'Applications' folder and open clicSANDMac.
- c) The same clicSAND pop-up will appear – click on the three-dot button [...] on the right of the Data Source (txt) to upload the txt file made in the previous step. The three-dot button below to the right of the Model will always be the OSeMOSYS_code.txt file that was automatically generated when clicking on Export Templates previously in Step 4. Once these two files have been selected, click 'Run'. You will see whether the run has been successful in the clicSANDMac pop-up. This generates 3 new files in your designated folder for the selected scenario.

4.2 OSeMOSYS Cloud run

- a) As an alternative to running clicSAND locally, it is possible to reproduce the results of this study using the accompanying OSeMOSYS SAND Excel files. There is one SAND file for each of the five scenarios.
- b) To run one of the scenarios on OSeMOSYS Cloud, open one of the Excel workbooks, navigate to the ToDataFile sheet, copy all of the sheet contents, and paste it into a blank plain text .txt file.

- c) Name and date this .txt file appropriately, and save it. Then, using clicSAND, input the file path for the .txt file just created in the “Data Source (txt)” field, and enter the file path for the OSeMOSYS Cloud .txt file in the “Model” field.
- d) Then click the “Generate OseMOSYS Cloud Input Data” button in clicSAND. This should generate a new .txt file in the same location as the .txt file entered into the model field, with a “cloud_data.txt” suffix. The scenario is now ready to be run in OSeMOSYS Cloud.
- e) Create a new model, a new version, and a new run in OSeMOSYS Cloud as needed, and select the OSeMOSYS Cloud .txt file for the “Model file” field and the clicSAND generated “cloud_data.txt” file in the “Data file” field. Set the “Server type” field to “Large server,” and uncheck the box to send an email after the run is completed.
- f) Run OSeMOSYS Cloud to get the scenario results. Visualize and manipulate results as needed using the “Results visualization” instructions above. Use this video resource for further assistance with running OSeMOSYS Cloud and analyzing results.

5. Results visualization

- a) Download the conversion.app.zip here: <http://doi.org/10.5281/zenodo.5879056>. Once downloaded, unzip and open the file. This file will convert the results .txt file into a csv file. Once the pop-up window has opened, choose the results .txt file generated in Step 6. Choose an output name, e.g., UNC_results and save this output name. Click on ‘Run’ to finish. A .csv file will be generated in the UNC folder. Open the file and copy all the data.
- b) Open the Results Template file in the UNC folder. Delete the example data and paste your results into the spreadsheet.
- c) There are several tabs to visualize your results, such as Annual Electricity Production, Electricity Production by Timeslice, Annual Total Capacity, Annual CO2 Demand, and Capital Investment to name a few.

6. References

Cannone, C., Allington, L., Pappis, I., Barron, K.C., Usher, W., et al. (2021) *Selected ‘Starter Kit’ energy system modelling data for DR Congo (#CCG)*. doi:10.21203/rs.3.rs-493235/v1.

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