# **File structure**

* Africa-TCO-Model
* data
  + AfricaTCOData.xlsx (input data file)
  + SOGOptimizationData.xlsx (input data file)
  + CountryMotorizationRateData.xlsx (input data file)
  + GeneratedSolarIrradiationData.csv (intermediate input file)
  + CORRECTED\_GeneratedSolarIrradiationData.csv (intermediate input file)
  + GEOData\_IDXCountryCoords.xlsx (input data file)
* model
  + .py (module scripts of the model)
  + TCO\_Model\_Environment.yml (anaconda environment)
* output
  + .xlsx and .pkl files computed by the main TCO model
  + \_\_plots (folder with plots created by the model)
  + \_\_tables (folder with tables created by the model)
  + Input Data PKL Files (folder with organized input data for proper model execution)

# **Define folder paths**

Folder paths must be defined once at the beginning of select scripts including *externalParameters.py*, *getSolarIrradiationData.py*, *plots\_Primary.py*, and *plots\_AfricaHighRes.py.* The following is a list of all possible folder paths across the scripts.

* input folder (pointing to location of folder *data* in the TCO model parent folder)  
  r'…/Africa-TCO-Model/data/'
* output folder (pointing to location of folder *output* in the TCO model parent folder)  
  r'…/ Africa-TCO-Model /output/'
* output plots folder (pointing to location of folder *\_\_plots* in the output folder)  
  r'…/ Africa-TCO-Model /output/\_\_plots/'
* output tables folder (pointing to location of folder *\_\_tables* in the output folder)  
  r'…/ Africa-TCO-Model /output/\_\_tables/'
* Input data PKL files generated during main TCO run folder (pointing to location of folder *Input Data PKL Files* in the output folder)  
  r'…/ Africa-TCO-Model /output/Input Data PKL Files/'

Use / for MacOS and \ for Windows!

# **Run the model**

Once the folder paths are defined, import the anaconda environment (.yml file) for correct dependencies. Finally, to run the model, there are three separate possible run’s:

1. To run the solar off-grid system optimization, just run *sogOptimization.py*.  
   *NOTE: optimizaiton runs for the off-grid system are performed one model year at a time and can be quite computationally expensive. Included in the folder data is a file called SOGOptimizationData.xlsx that is already formatted and thus an additional run of sogOptimization.py is not required.*
2. To run the main TCO model, just run main.py.
3. Once the main TCO model is run, you can call the two plotting scripts by running *plots\_Primary.py* and *plot\_AfricaHighRes.py*.  
   *NOTE: Included in the plot runs is the LCA analysis and data formatting.*

# **Things to watch out for**

1. You can manually specify the number of Monte Carlo runs in the *externalParameters.py* script in the function called *getMonteCarloDraws()* on line 429. Depending on the number of draws specified, the Input Data PKL Files will change, so make sure you have either pre-run the organization files, or simply organize them again. You can choose to re-run the organization of the Input Data PKL Files by setting the ep.initialize() arguments to TRUE (i.e. in the script *main.py* on line 37). Note that the formal analysis assumes N=10,000 draws.
2. The solar irradiation data generated in the script *getSolarIrradiationData.py* is manually corrected for a few data points. This corrected file is also included in the input data folder and should be used accordingly in the *sogOptimization.py* script.
3. In order to run the getSolarIrradiationData.py script, a python package called pvlib must first be installed. See link for installation instructions: <https://pvlib-python.readthedocs.io/en/stable/user_guide/installation.html#standardrelease>
4. Note that the solar off-grid optimization code takes quite a long time to run (on the order of a couple of days). To save run time, we have pre-run this optimization for all three model years (2025, 2030, 2040) and saved the results together in the input data file called SOGOptimizationData.xlsx, which is then read directly into the main TCO script. Please feel free to use this input data file directly.

# **Additional information**

Expected Install Time: 5-10 minutes (simple download and setup of python packages)

Expected Run Time (on normal desktop computer):

* TCO Model (main.py): 30 minutes (for N=10,000 draws)
* Plots (plots\_Primary.py): <5 minutes
* Plots (plot\_AfricaHighRes.py): 5-10 minutes (depending on draw size)
* Solar off-grid optimization (sogOptimization.py): 2-3 days (for all model years)
* Solar Irradiation Data (getSolarIrradiationData.py): <5 minutes

Expected Output:

* Sample output data included (*output* folder) for N=1000 draws.

Software Dependencies: all included in the TCO\_Model\_Environment.yml file