Skill workshop 01.
How sustainable are your energy transition pathways? Assessing energy system optimization results with ENBIOS

Preparation

Miquel Sierra, Alexander de Tomás, Cristina Madrid López

Sostenipra Research Group. Institute of Environmental Science and Technology. Universitat Autonòma de Barcelona. (ICTA-UAB)

How is the workshop structured?

In this workshop we are going to show you how to install and run ENBIOS following a simple case study that only considers two technologies (wind onshore and photovoltaics openground) and targets from the Spanish National Energy and Climate Plan (PNIEC).

Our simplified energy system looks as shown in Figure 1. This is what we call a dendrogram.

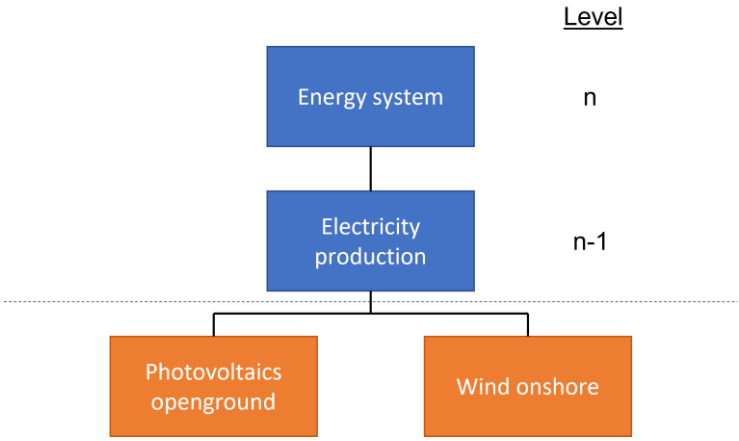


Figure 1. Case study dendrogram schematic representation.

Now we are going to calculate the environmental impacts of this energy system, considering three scenarios of the Spanish National Climate and Energy Plan (PNIEC): Current (2015),

Tendential (2030) and Target (2030). You can find more information about the scenarios here: https://www.miteco.gob.es/en/prensa/pniec.aspx.

These are the steps we will follow:

1. Run the simulation and calculate four indicators only (Climate Change, Fossil Depletion, Natural Land Transformation and Water Depletion) for the total system from the LCIA method "ReCIPE Midpoint (H) V1.13".
2. Comment the results together.
3. Modify the input data to analyze alternative scenarios and include other indicators.

Where can you find the necessary materials?

All the materials for the workshop are located in this Google Drive folder (https://drive.google.com/drive/folders/1YC6dtH-pPvL2UjO-z_udw6YKJ8lLBrZm?hl=es). The structure of the folder is the following:

1. **Files: contains all the necessary files you will use during the workshop. Download all of them in a local folder in your hard drive.**
    a. Case_study_ECEMP.ipynb: Jupyter Notebook we will follow during the session.
    b. flow_out_sum.csv: input data file with scenarios, technologies and electricity produced.
    c. BaseFile_case_study_ECEMP.xlsx: excel file to configure the ENBIOS simulation.
    d. case_study_ECEMP.yaml: yaml file to execute the ENBIOS simulation. It tells ENBIOS where it can find the BaseFile and the input data file.
    e. results_indicators_example.csv: an example file of how your output should look like once you run ENBIOS.
    f. lcia_implementation_units_filtered.xlsx: necessary file to run the results visualization.

2. **Intermediate file samples**: this file won't be used during the workshop. It contains files that are generated from some data preparation commands. However, in case you want to test those commands in the future, in this folder you have a Jupyter Notebook with instructions you can follow.
3. **Documents**: contains documentation that might help you during the workshop:
    a. Guidelines.pdf: it is this document.
    b. ENBIOS User Manual.pdf: the most updated version of ENBIOS Manual.

Software requirements and installation

In order to follow the workshop, you must have the following software installed:

- Python >=3.7
- Anaconda or miniconda (not a requirement, but recommended)
- ENBIOS python-package
- Other python-packages (seaborn)

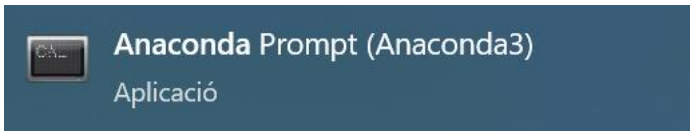
- Jupyter Notebook

ENBIOS is a Python-based package. To install it, complete the following steps:

▪ Install Python (CPython) >=3.7 runtime.

Anaconda3 is recommended (https://docs.anaconda.com/anaconda/install).

▪ Open an Anaconda terminal:



▪ Create a Python virtual environment:

conda create -y -n enbios python==3.8 pycurl cython

▪ Activate the ENBIOS environment:

conda activate enbios

▪ Install ENBIOS and dependency Nexinfosys:

pip install nexinfosys enbios

- To continue with the installation, install the other necessary python-packages in the ENBIOS environment by writting the following command in the terminal:

  pip install seaborn

- Finally, install Jupyter Notebook:

  pip install notebook

For further details on the installation, please check the ENBIOS User Manual (in Google Drive, Documents folder).

Open the Jupyter Notebook

We will guide the session through a Jupyter Notebook that you can find in the Google Drive: Folder -> Files -> Case_study_ECEMP_simple.ipynb.

Download it to your local hard drive. Then, follow these steps:

- Activate ENBIOS environment (if not activated already):

  conda activate enbios

- Change directory to the local folder where you downloaded the materials

  cd [your local route here]

- Open Jupyter Notebook

  jupyter-notebook

- Go to your browser (where Jupyter Notebook should have opened), look for the Case_study_ECEMP.ipynb (in the local file where you have just downloaded it) and click on it.

Figure 2. What you should see when you open Jupyter notebook in the local folder