# AETOS_model

*Release v1.0*

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# CONTENTS

**Important**

This documentation is under active development. All content is openly available to support transparency, reproducibility, and extensions by the modelling community.

# OVERVIEW

This is the documentation for the **AETOS (Africa–Europe Energy Transition OSeMOSYS)** model, developed under the RE-INTEGRATE project (Horizon Europe, Grant No. 101118217).

The **Africa–Europe Energy Transition OSeMOSYS (AETOS)** model is a multi-country, open-source energy system model that explores long-term energy pathways and trade between Africa and Europe. It extends and integrates the **OSeMBE (Europe)** and **TEMBA (Africa)** frameworks, providing the most detailed representation to date of national power systems, intra-continental trade, and cross-continental grid interconnectors and gas pipelines.

AETOS is designed to analyze how Africa and Europe can transition toward net-zero energy systems while considering electricity and natural gas trade. The model enables researchers, policymakers, and analysts to explore scenarios that capture infrastructure investments, policy pathways, and sustainability targets across **78 countries**.

CHAPTER

TWO

# KEY FEATURES

- **Geographic coverage**: 48 African countries and 30 European countries (incl. Finland, UK, Switzerland) each modeled individually.
- **Time horizon**: 2021–2055 annual analysis.
- **Demand coverage**: National electricity generation and gas demand (other sectors such as transport, buildings, and services not explicitly modeled yet).
- **Energy trade representation**: Grid interconnectors, Natural Gas pipelines, LNG infrastructure.
- **Units & currency**: Capacities in GW, fuel flows in PJ, emissions in $MtCO_2$, and all costs in constant 2021 USD.

CHAPTER

THREE

# FINDING THE GITHUB REPOSITORY

All model code, data-processing scripts, and workflow tools are openly hosted in the AETOS GitHub repository. You can browse the source, submit issues, or contribute improvements.

CHAPTER

FOUR

# HOW TO CITE

If you use AETOS in your work, please cite:

```
E. Kousoulos et al. (2025).
The Africa-Europe Energy Transition OSeMOSYS (AETOS) Model:
A Multi-Country Framework for Cross-Continental Energy Trade.
Zenodo. DOI: https://doi.org/10.5281/zenodo.17638228
```

## 4.1 Welcome

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### 4.1.1 Overview

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### 4.1.2 Key Features

- **Geographic coverage**: 48 African countries and 30 European countries (incl. Finland, UK, Switzerland) each modeled individually.
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A Multi-Country Framework for Cross-Continental Energy Trade.
Zenodo. DOI: https://zenodo.org/records/17007181
```

## 4.2 Model Architecture

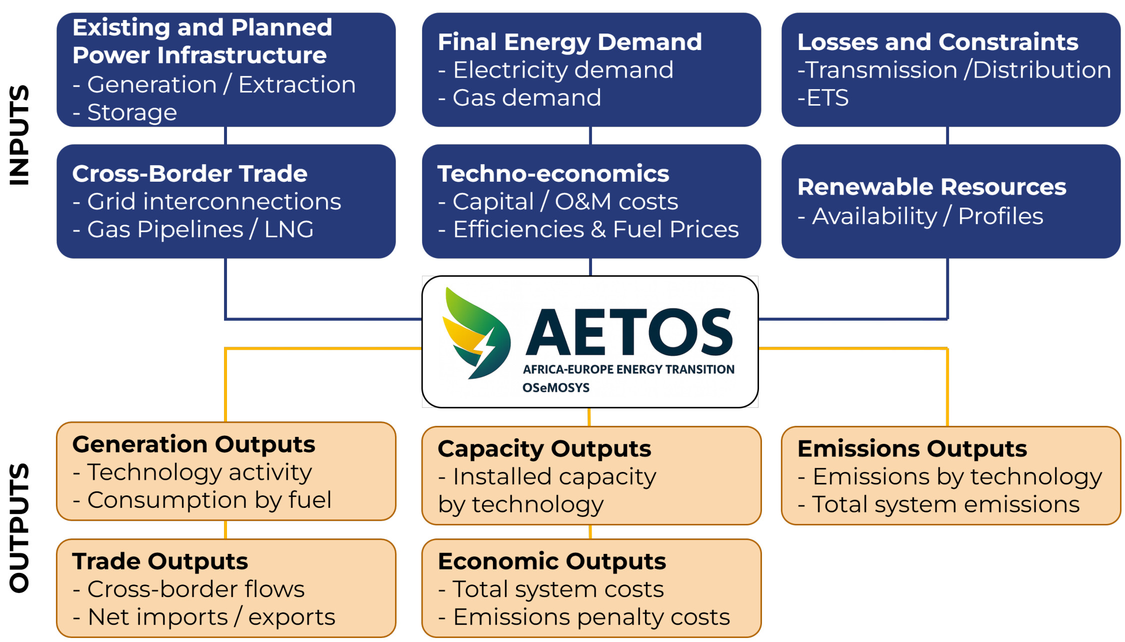
### 4.2.1 Model Structure

The AETOS model builds on the OSeMOSYS framework to provide a transparent, open-source tool for cross-continental energy system analysis. Its design philosophy emphasizes reproducibility, comparability across regions, and scalability from national to continental level.

#### Framework & Philosophy

- Fully based on the OSeMOSYS open-source modeling framework.
- Emphasis on transparency, open data, and reproducibility.
- Designed for multi-regional, long-term scenario exploration.

The diagram below shows the **AETOS input–output structure**, linking key datasets to model outputs:



### Regions & Countries

AETOS covers **78 countries** across Africa and Europe, with each country modeled individually.:

**Africa (48)**

| Country | ISO |
|---|---|
| Algeria | DZ |
| Malawi | MW |
| Angola | AO |
| Mali | ML |
| Benin | BJ |
| Mauritania | MR |
| Botswana | BW |
| Morocco | MA |
| Burkina Faso | BF |
| Mozambique | MZ |
| Burundi | BI |
| Namibia | NA |
| Cameroon | CM |
| Niger | NE |
| Central African Rep. | CF |
| Nigeria | NG |
| Chad | TD |
| Rwanda | RW |
| Côte d'Ivoire | CI |
| Senegal | SN |
| Djibouti | DJ |
| Sierra Leone | SL |
| DR Congo | CD |
| Somalia | SO |
| Egypt | EG |
| South Africa | ZA |
| Equatorial Guinea | GQ |
| South Sudan | SS |
| Eritrea | ER |
| Sudan | SD |
| Eswatini | SZ |
| Tanzania | TZ |
| Ethiopia | ET |
| Togo | TG |
| Gabon | GA |
| Tunisia | TN |
| Gambia | GM |
| Uganda | UG |
| Ghana | GH |
| Zambia | ZM |
| Guinea | GN |
| Zimbabwe | ZW |
| Guinea-Bissau | GW |
| Kenya | KE |
| Lesotho | LS |
| Liberia | LR |

continues on next page

Table 1 – continued from previous page

| Country | ISO |
|---|---|
| Libya | LY |

**Europe (30)**

| Country | ISO |
|---|---|
| Austria | AT |
| Lithuania | LT |
| Belgium | BE |
| Luxembourg | LU |
| Bulgaria | BG |
| Latvia | LV |
| Switzerland | CH |
| Malta | MT |
| Cyprus | CY |
| Netherlands | NL |
| Czechia | CZ |
| Norway | NO |
| Germany | DE |
| Poland | PL |
| Denmark | DK |
| Portugal | PT |
| Estonia | EE |
| Romania | RO |
| Spain | ES |
| Sweden | SE |
| Finland | FI |
| Slovenia | SI |
| France | FR |
| Slovakia | SK |
| Greece | GR |
| United Kingdom | UK |
| Croatia | HR |
| Hungary | HU |
| Ireland | IE |
| Italy | IT |

### Technologies & Fuels

The AETOS model represents **3,283 technologies**, spanning all major fuels and system components.

Table 3: Fuels

| Category | Fuels |
|---|---|
| Fossil | Coal, Lignite, Natural Gas, Fuel Oil / Heavy Fuel, Light Fuel, Diesel Oil, Refinery Gas, Derived Gas |
| Renewables | Solar, Wind, Hydropower, Biomass, Geothermal, Tidal, Ocean/Wave, Waste |
| Secondary / Vectors | Nuclear, Battery, Electricity |

### Temporal Resolution

- **Horizon:** 2021–2060 (yearly time steps).
- **Intra-annual resolution:** 16 time-slices (4 seasons × 4 daily periods), ensuring seasonal and daily demand peaks are fully captured.

**Seasons (S)**

| Code | Season | Days |
|---|---|---|
| S1 | Winter | 90 |
| S2 | Spring | 92 |
| S3 | Summer | 92 |
| S4 | Autumn | 91 |
| | **Total** | **365** |

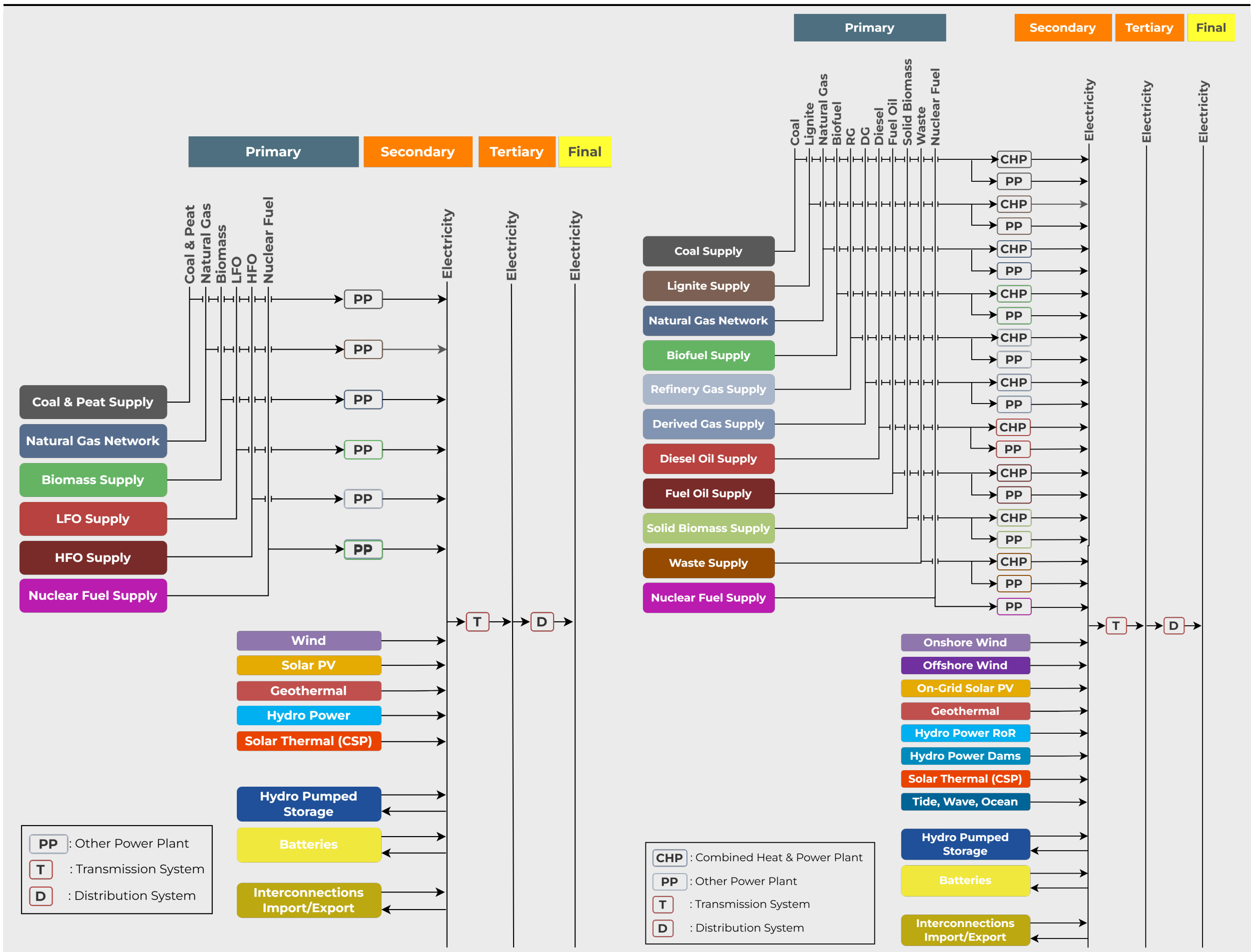
**Daily parts (P)**

| Code | Start (h) | End (h) | Duration (h) |
|---|---|---|---|
| P1 | 0 | 7 | 7 |
| P2 | 7 | 17 | 10 |
| P3 | 17 | 21 | 4 |
| P4 | 21 | 24 | 3 |
| | | **Total** | **24** |

## 4.2.2 System Design

### Reference Energy System

These Reference Energy Systems (RES) provide a schematic view of how **energy resources, technologies, and demand sectors** are connected within the model. They illustrate flows from **primary resources** (fossil, renewable, imports) through **conversion technologies** (power plants, trade infrastructure, storage) to meet **final electricity and gas demand**.

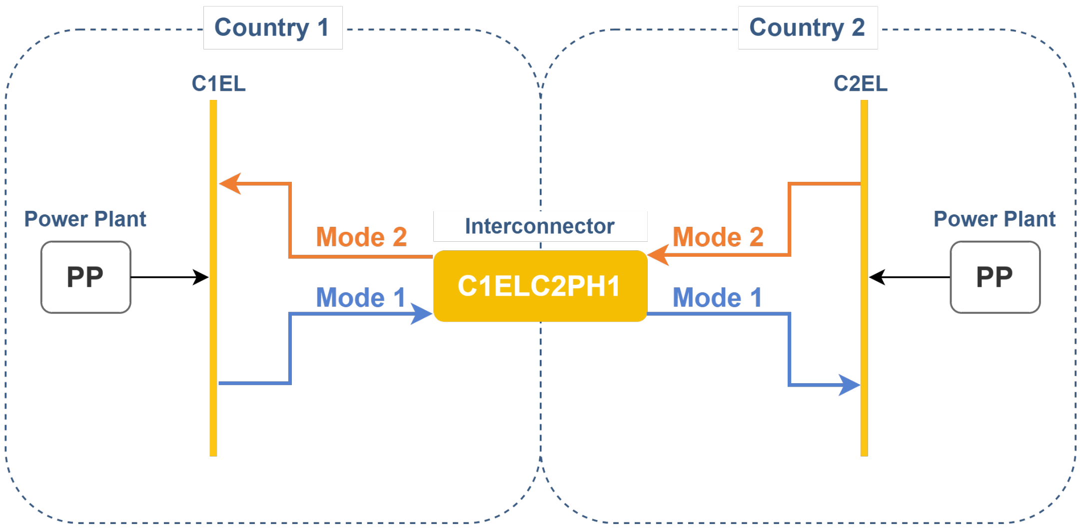



## Interconnection Structure

The model represents electricity interconnections explicitly. Each link between two countries is modeled as a **bidirectional interconnector** with two modes:

- **Mode 1:** Power flow from *Country 1* → *Country 2*
- **Mode 2:** Power flow from *Country 2* → *Country 1*

This structure allows detailed accounting of **imports, exports, and trade balances**, while consistently linking power plants, demand, and regional grids.



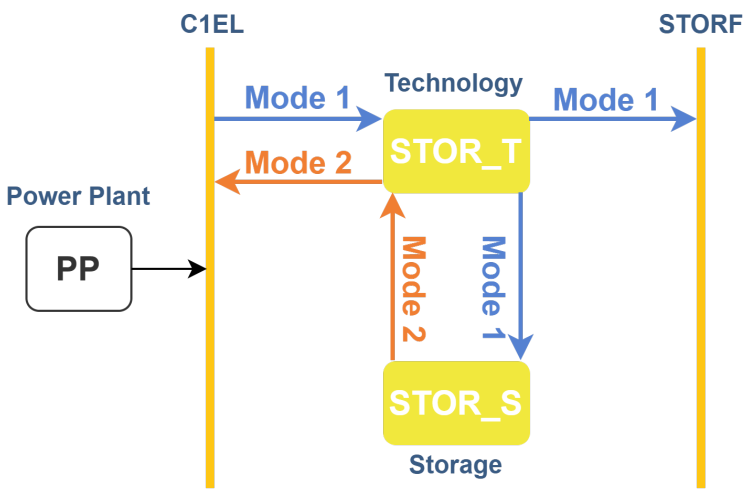

### Storage Structure

The model represents storage explicitly by separating **technology operation** and **storage content** into two linked components:

- **STOR_T (Technology):** governs charging and discharging of energy.
- **STOR_S (Storage):** tracks stored energy across time periods.

Two modes are used:

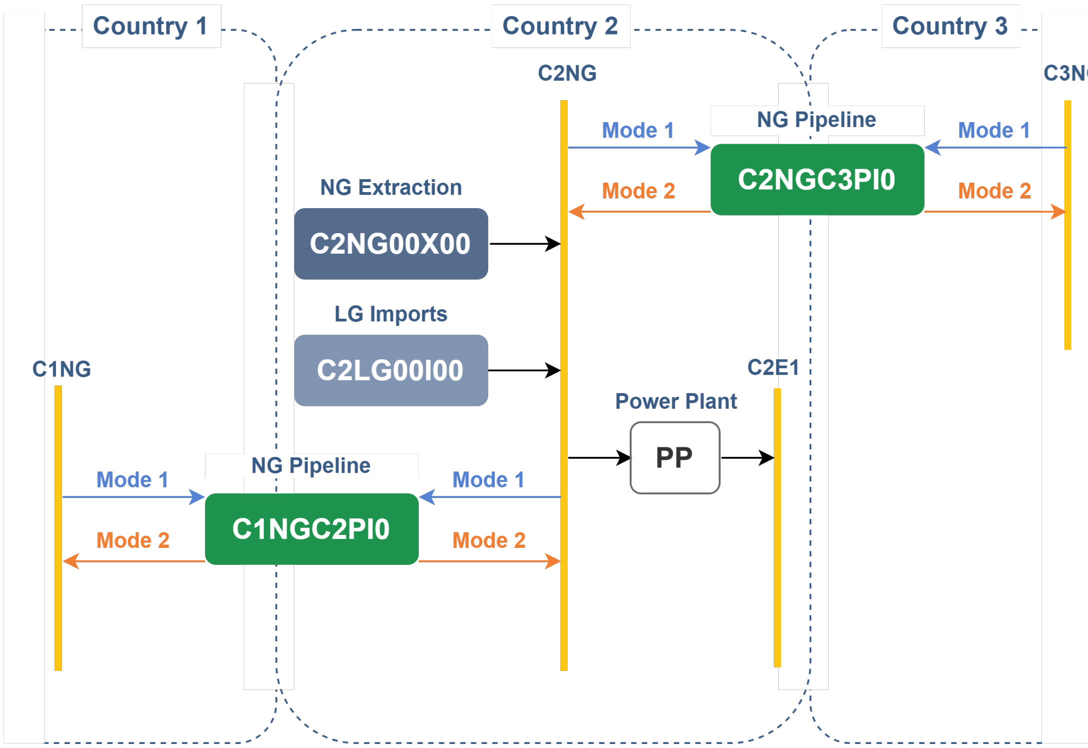
- **Mode 1:** Charging (from grid/plant → storage).
- **Mode 2:** Discharging (from storage → grid/plant).




### Natural Gas Network Structure

The model represents natural gas flows through **pipelines**, **LNG terminals** and **domestic extraction technologies**.

- Pipelines are modeled as **bidirectional links** (Mode 1 = export, Mode 2 = import).
- LNG imports and exports are included as separate technologies.
- Domestic extraction is captured explicitly via NG00X00 technologies.




### 4.2.3 Naming Manual

This manual explains the **AETOS naming conventions** for technologies, fuels, backstops, and infrastructure. Codes are **systematic, compact, and interpretable**, ensuring reproducibility and transparency.

#### Technologies

**Technology Structure**

COUNTRY FUEL TECHNOLOGY CLASS

### Fuel Codes

| Fuel Code | Fuel Name |
|---|---|
| NU | Nuclear |
| CO | Coal |
| LI | Lignite |
| NG | Natural Gas |
| SO | Solar |
| WI | Wind |
| HYD | Hydropower |
| BM | Biomass |
| BATT | Battery |
| WS | Waste |
| DG | Derived Gas |
| HF | Fuel Oil / Heavy Fuel |
| LF | Light Fuel |
| RG | Refinery Gas |
| DS | Diesel Oil |
| GO | Geothermal |
| TID | Tidal |
| OCWV | Ocean / Wave |

### Technology Codes

| Tech Code | Description |
|---|---|
| CHP | Combined Heat & Power |
| STP | Steam Turbine Plant |
| CCP | Combined Cycle Plant |
| GCP | Gas Turbine Plant |
| GCC | Gas Combined Cycle |
| HPF | Internal Combustion Engine |
| CCS | Carbon Capture Storage |
| ON | Wind Onshore |
| OF | Wind Offshore |
| UTP / U1P | Solar Utility Plant |
| STH / C1P | Solar Thermal |
| MP / MS | Hydro Reservoir |
| SP | Pumped Storage |
| RP | Hydro Run-of-River |
| RCP | Reciprocating Engine |
| CVP | Geothermal |
| SCP | Sub-critical Pulverised Coal |
| NDP | Wind (Africa) |

### Class Codes

| Class Code | Meaning |
|---|---|
| H1 | Historical |
| N1 | New |

**Example**

CY SO UTP H1 = Cyprus, Solar Utility Plant, Historical

### Backstops

**Backstops Structure**

COUNTRY BACKSTOP_TYPE

**Backstop Codes**

| Backstop | Meaning |
|---|---|
| BACKSTOP | Technology capacity issues |
| CO2BACKSTOP | Emissions issues |
| NGBACKSTOP | Natural gas supply issue |

**Example** CY CO2BACKSTOP = Cyprus, $CO_2$ emissions backstop

### Feed-in Fuel Technologies

**Feed-in-Fuels Structure**

COUNTRY FUEL 00I00

**Example** CY NG 00I00 = Cyprus, Natural Gas Import node

### Transmission

**Transmission Structure**

COUNTRY EL00T00

**Example** CY EL00T00 = Cyprus, Electricity Transmission

### Distribution

**Distribution Structure**

COUNTRY EL00D00

**Example** CY EL00D00 = Cyprus, Electricity Distribution

### LNG Imports

**LNG Imports Structure**

COUNTRYLG00I00

**Example** CY LG00I00 = Cyprus LNG Import

### LNG Exports

**LNG Exports Structure**

COUNTRY LG00E00

**Example** CY LG00E00 = Cyprus LNG Export

### Natural Gas Extraction

**Natural Gas Extraction Structure**

COUNTRY NG00X00

**Example** DZ NG00X00 = Algeria, NG Extraction

### Natural Gas Pipelines

**Natural Gas Pipelines Structure**

COUNTRY1 NG COUNTRY2 PI0

**Example** DZ NG IT PI0 = Algeria → Italy NG Pipeline

### Grid Interconnections

**Grid Interconnections Structure**

COUNTRY1 EL COUNTRY2 PH1

**Example** AO EL NA PH1 = Angola  Namibia Electricity Interconnection

### Storages

**Storage Structure**

COUNTRY STORAGE_TYPE CLASS

| Storage Code | Description |
|---|---|
| BATT | Battery Storage |
| HYDSP | Hydrogen Storage |
| HYDSS | Hydro Reservoir Storage |

**Example** MA BATT N1 = Morocco, Battery, New

### Fuels

**Fuels Structure**

COUNTRY FUEL

**Fuel Codes**

| Fuel Code | Description |
|---|---|
| E1 | Electricity Transmission |
| E2 | Electricity Distribution |
| E3 | Electricity Supply |
| BATF | Battery Fuel |
| NGE | Natural Gas Export |

**Example** CY E1 = Cyprus, Electricity Transmission

### Emissions

**Emissions Structure**

COUNTRYCO2

**Example** CY CO2 = Cyprus, $CO_2$ emissions

## 4.3 Datasets

The **AETOS** model is built on openly available and institutional datasets, processed into a consistent OSeMOSYS-ready format to support transparent and reproducible analysis.

### 4.3.1 Input Assumptions

**Input Assumption Files**

The AETOS model uses a collection of Excel files for assumptions on capacity, demand, fuel supply, trade, and techno-economics. Each file is linked to openly available datasets and institutional sources.

| Category | Sources |
|---|---|
| Electricity Capacity | JRC-IDEES, ENTSO-E, ENTSO-G, IRENA, EU Reference Scenario 2020 |
| Fuel Supply & Extraction | IEA, IRENA Statistics, UN Energy Data, Africa Continental Master Plan (CMP) |
| Natural Gas & LNG | ENTSO-G, IEA Gas Market Reports, Africa CMP, IRENA |
| Interconnections | ENTSO-E TYNDP, Africa Continental Master Plan |
| Techno-economics | EU Reference Scenario 2020, IRENA, CMP, Energy Price Databases |
| Transmission & Losses | ENTSO-E, IEA Africa Energy Outlook |
| Demand | TIAM-ECN Projections, EU Reference Scenario 2020, Africa CMP |
| Climate Policy | EU ETS, European Commission Climate Targets |

**Processing Methods**

**Data Harmonization & Preparation**

The input datasets were processed into **consistent OSeMOSYS-ready formats** to ensure transparency, comparability, and reproducibility. The main steps included:

- **Unit Harmonization** → All energy and capacity data converted into consistent units (PJ, TWh, bcm, GW).
- **Code Mapping** → Alignment of national ISO codes with the OSeMOSYS regional and technology structure.
- **Gap-Filling** → Missing data filled using proxies from trusted sources (IEA, IRENA, UN datasets).
- **Transformation Pipelines** → Automated Python scripts standardize raw data into clean CSV templates ready for the model.

### 4.3.2 Zenodo Repository

**Important**

All processed datasets, model files, and scenario outputs are openly available on Zenodo: AETOS Dataset

The full model runner and source code are also available on GitHub: AETOS-model

Please cite this Zenodo record alongside the model documentation when using AETOS in your research.

## 4.4 Installation & Setup

### 4.4.1 Setup Steps

Setting up the **AETOS** model is straightforward. Follow the four steps below to get started:

**Warning**

Make sure you have Python and Miniconda installed beforehand.

**Step 1 – Clone the Github Repository**

Clone the GitHub repository, which contains everything from data editing to running and visualisation:

```
git clone https://github.com/ekousoulos/AETOS_model.git
cd AETOS_model
```

**Step 2 – Create a Python Environment**

Use **Miniconda** (or Anaconda) to create a clean Python environment for running the provided scripts:

```
conda create -n aetos python=3.11
conda activate aetos
```

**Step 3 – Install a Solver**

You need GLPK to generate the LP file, and a high-performance solver (CPLEX or Gurobi) to solve it efficiently:

- GLPK (open-source, **mandatory** for LP file creation)
- CPLEX (fast & robust, academic license available)
- Gurobi (powerful commercial solver, free academic license)
- CBC (open-source, decent performance for medium models)
- HiGHS (very fast open-source solver, promising alternative for LP/MIP)

Example installation for GLPK (Linux/Mac):

```
conda install -c conda-forge glpk
```

Example installation for CPLEX (Linux/Mac/Windows):

```
conda install -c ibmdecisionoptimization cplex
```

**Step 4 – Install Otoole**

Otoole is the main utility for handling OSeMOSYS input/output.

```
pip install otoole
```

### 4.4.2 Additional Packages for Visualisation

For plotting and analysis, you will also need **pandas**, **numpy** and **matplotlib** withing your **aetos** Pyhon environment:

```
pip install pandas numpy matplotlib
```

You're all set! After these steps, you can run the AETOS workflows, edit data, solve scenarios, and visualise results.

## 4.5 Running Model & Results

### 4.5.1 Project Structure

The AETOS GitHub repository is organised into two main components:

- **AETOS_Assumptions**, which contains all input datasets, and
- **AETOS_Runner**, the full model-runner environment.

Inside **AETOS_Runner**, you will find:

**CSVFiles** → OSeMOSYS parameters in CSV format (generated by Otoole)
**input_data** → User-edited input data in Excel format (multiple versions)
**model** → OSeMOSYS model in TXT format (used for solver runs)
**output_data** → Converted input (XLSX → TXT) for solver execution (via Otoole)

**results** → Solver output in TXT format
**scripts** → Python scripts for data processing and automation
**visualisation** → Plots and reports (PDF/PNG)
**commands_AETOS.txt** → Example command-line workflow (Miniconda + Otoole + solver)
**config_otoole_AETOS.yaml** → Otoole configuration file (parameters + defaults)

### 4.5.2 Running the Model

This section walks you through the **complete AETOS workflow** — from preparing inputs to exporting results.

When running commands, replace <SCENARIO_NAME> with your chosen scenario tag (e.g. AETOS_BSNZ).

**Step 1 – Prepare Input Data**

Once you have edited your scenario Excel file (`.xlsx`), convert it into CSV and then into the OSeMOSYS `datafile` for solver execution:

```
otoole convert excel csv input_data/<SCENARIO_NAME>.xlsx CSVFiles config_otoole_v3_AETOS.
↪yaml

otoole convert csv datafile CSVFiles output_data/<SCENARIO_NAME>.txt config_otoole_v3_
↪AETOS.yaml
```

**Step 2 – Generate LP File (GLPK)**

Use **GLPK** to generate the LP problem file:

```
glpsol -m model/osemosys_fast_v8_AETOS.txt -d output_data/<SCENARIO_NAME>.txt --wlp␣
↪results/results.lp --check
```

**Step 3 – Solve the Model (e.g. CPLEX)**

Run **CPLEX** to solve the optimization problem:

```
cplex
read results/results.lp
optimize
write results/results.sol
quit
```

**Step 4 – Process and Sort Results**

Transform and sort the solver output:

```
python scripts/transform_31072013.py results/results.sol results/trans_results.txt
sort results/trans_results.txt > results/trans_results_sorted.txt
```

**Step 5 – Export Results to Excel**

Finally, export the processed results into Excel format for analysis and visualisation. The generated files will be saved in the `results/` folder, automatically named according to the current date and version tag.

```
python scripts/export_to_excel.py
```

## 4.6 Visualisation

### 4.6.1 Visualization & Plotting

The repository includes dedicated plotting scripts for analysing key outputs, such as **installed capacity** and **generation activity**. Run them by passing the results file and scenario tag as arguments.

Replace <RESULTS_FILE> with the name of your results file (e.g. 20250912_UNNZv1.csv), and <TAG> with the scenario tag (e.g. UNNZ):

```
python scripts/totalcapnorm.py results/<RESULTS_FILE> <TAG>

python scripts/totalactnorm.py results/<RESULTS_FILE> <TAG>
```

The first script produces **normalised capacity plots**, while the second produces **normalised activity plots**. Figures are saved automatically into the `visualisation` folder.

## 4.7 Scenario Example

This section demonstrates the full workflow of running the model with the scenario AETOS_UNNZ20250911 (*Unrestricted Trade, Net-Zero by 2050*).

The steps below show how to prepare inputs, solve the model, process results, and generate visualisations.

### 4.7.1 Step 1 – Transform Input Data

- **Input**: Excel file: `input_data/AETOS_UNNZ20250911.xlsx` & Config: `config_otoole_v3_AETOS.yaml` (defines parameter mappings, sets, and units)
- **Output**: CSV files: `CSVFiles/` & Datafile (TXT, solver-ready): `output_data/AETOS_UNNZ20250911.txt`

```
otoole convert excel csv input_data/AETOS_UNNZ20250911.xlsx CSVFiles config_otoole_v3_
↪AETOS.yaml
otoole convert csv datafile CSVFiles output_data/AETOS_UNNZ20250911.txt config_otoole_v3_
↪AETOS.yaml
```

### 4.7.2 Step 2 – Generate LP File with GLPK

Run **GLPK** to convert the OSeMOSYS model and scenario data into a **linear program (LP) file**.

- **Input**: Model: `model/osemosys_fast_v8_AETOS.txt` & Data: `output_data/AETOS_UNNZ20250911.txt`
- **Output**: LP file: `results/results.lp`

```
glpsol -m model/osemosys_fast_v8_AETOS.txt -d output_data/AETOS_UNNZ20250911.txt --wlp␣
↪results/results.lp --check
```

### 4.7.3 Step 3 – Solve the Model with CPLEX

Run **CPLEX** to solve the optimization problem from the LP file.

- **Input**: LP file: `results/results.lp` (generated in Step 2)
- **Output**: Solution file: `results/results.sol`

```
cplex
read results/results.lp
optimize
write results/results.sol
quit
```

### 4.7.4 Step 4 – Transform and Sort Results

Process the raw solver output into a readable format and sort it.

- **Input:** `results/results.sol` (CPLEX solution file)
- **Output:** - `results/trans_results.txt` (converted results) - `results/trans_results_sorted.txt` (sorted results, ready for export/analysis)

```
python scripts/transform_31072013.py results/results.sol results/trans_results.txt
sort results/trans_results.txt > results/trans_results_sorted.txt
```

### 4.7.5 Step 5 – Export Results to Excel

Convert the processed results into an Excel file for further analysis and visualisation.

- **Input:** `results/trans_results_sorted.txt`
- **Output:** `results/<DATE_TAG>_v1.xlsx` (Excel file saved in the `results` folder)

```
python scripts/export_to_excel.py
```

### 4.7.6 Step 6 – Visualise Results

Generate plots for **installed capacity** and **annual activity shares** using the provided Python scripts.

- **Input:** Processed results in CSV format (e.g. `results/20250912_UNNZv1.csv`)
- **Output:** Plots (PDF/PNG) saved in the `visualisation` folder

```
python scripts/totalcapnorm.py results/20250912_UNNZv1.csv UNNZ
python scripts/totalactnorm.py results/20250912_UNNZv1.csv UNNZ
```

## 4.8 Troubleshooting & FAQ

### 4.8.1 Troubleshooting

> **Attention**
>
> If you encounter problems, check these common issues first:

- **Solver not found** → Make sure `glpsol` (GLPK) or `cplex` is installed and available in your system `PATH`.

  *Adding to PATH:*

  - On **Linux/macOS**: edit `~/.bashrc` (or `~/.zshrc`) and add: `export PATH=$PATH:/path/to/solver`
  - On **Windows**: go to *System Properties* → *Environment Variables* → *Path* → *Edit*, then add the folder path containing `glpsol.exe` or `cplex.exe`.

    - Restart your terminal or IDE for changes to take effect.

- **Memory issues** → Try solving with CPLEX (`--solver cplex`) or increase available RAM.
- **Long runtimes** → Test the workflow with fewer years or a reduced temporal resolution before running the full scenario.
- **No LP/SOL file created** → Double-check the input/output paths and confirm that the `results/` directory exists.

> **Important**
>
> The AETOS model is computationally heavy. For a full-scale scenario such as `AETOS_UNNZ20250911`: - Generating the LP file can take **~2 hours** - Solving with CPLEX on HPC can take **~6 hours**
>
> If your run fails or hangs, it is most likely due to **insufficient memory**, not an error in the workflow. Consider reducing the problem size or running on a machine with more RAM/cores.

If issues persist, please open an issue on GitHub: Report an Issue on GitHub

When reporting an issue, please include:

- **Step** → At which stage of the workflow the error occurs (e.g. Step 1: Transform Input Data, Step 3: Solve with CPLEX)
- **Solver** → Which solver was used (e.g. CPLEX) and version if known
- **System details** → Operating system, Python version, and hardware specs (CPU/RAM, HPC vs local)
- **Logs** → Full error message, warnings, or relevant log output (copy-paste or attach)

### 4.8.2 FAQ

#### Which solver should I use?

Use **CPLEX** if available (faster, more memory-efficient).

#### Where do I find the input data?

All processed inputs are hosted on Zenodo: AETOS Dataset on Zenodo

#### How do I install the model?

Follow the steps under *Installation & Setup*. Clone the repo, create an environment, and install either GLPK or CPLEX.

#### How do I run a quick test?

Run with smaller horizon outlook, or a smaller temporal resolution to ensure everything works before attempting the full model.

#### My model run is too slow, what can I do?

Try switching solvers, reduce the horizon outlook, or run on HPC with more memory.

#### Can I contribute improvements?

**Yes! Contributions are welcome. You can:**

- Open a pull request on GitHub
- Submit an issue with your suggestion or bug report

### Can I reuse AETOS data for my own research?

Yes, the data is open under a CC-BY license. Please cite the Zenodo repository and relevant publications.

### How can I add a new country or technology?

You'll need to extend the dataset and model definition. Check the documentation on *Model Architecture* before making changes.