

open ENTRANCE

# Open ENERGY Transition ANALYSES for a low-Carbon Economy

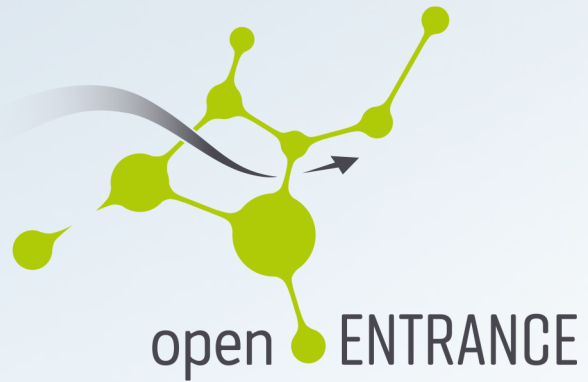
## The Open Modelling Platform

02.06.2023



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 835896





The openENTRANCE project...

... is developing, using and disseminating an open, transparent and integrated modelling platform for assessing low-carbon transition pathways in Europe.



# Agenda – The components of the Open Platform

- A suite of open models
- A common reporting data format
- The Scenario Explorer
- Workflows for linkages between models
- Tools for scenario analysis & data visualization

# A suite of open models

 **Open Energy Models**

*– Modelling Europe's energy system*

Scenario Explorer

Data format

Models

Tools

Case studies

## An open energy system modelling platform

This is an open, transparent and integrated modelling platform for assessing low-carbon transition pathways that are in line with the European climate, economic and energy targets. The platform gathers a suite of state-of-the-art models and data for covering the multiple dimensions of a clean energy transition. Models concentrating on different aspects of the energy transition are linked to each other to allow integrated analyses, moving beyond the one-dimensional analyses that the models offer separately.

Visit <https://openenergymodels.net> for more information!

# A brief overview of the open models

The openENTRANCE project used different models...

- Macro-economic models: REMES and EXIOMOD
- Multi-energy-carrier models: GENESYS-MOD and GUSTO
- Electricity-sector models: EMPIRE, OPENTEPES, PLAN4EU, FRESH:COM

Some models are computable-equilibrium models, other use a cost-minimization approach.

Most of the models can cover the entire EU, while some are focused on local energy needs.

Most of the open energy models deal with the planning of the expansion and operation of the system, while GUSTO and FRESH:COM are focused on the operation.

# A common data format

- The integrated-assessment community (IAMC) developed a tabular scenario data format
  - Used in IPCC Reports (AR6, SR15), Horizon 2020/Europe projects, ...
  - Adopted by ~100 teams globally



	A	B	C	D	E	F	G	H	
1	<b>Model</b>	<b>Scenario</b>	<b>Region</b>	<b>Variable</b>	<b>Unit</b>	<b>2005</b>	<b>2010</b>	<b>2015</b>	
2	MESSAGE	CD-LINKS 400	World	Primary Energy	EJ/y	462.5	500.7	...	

- The openENTRANCE project defined an extension to cover sub-annual time resolution.
- Check out <https://github.com/openENTRANCE/openentrance> for details!



# Variable and region codelists

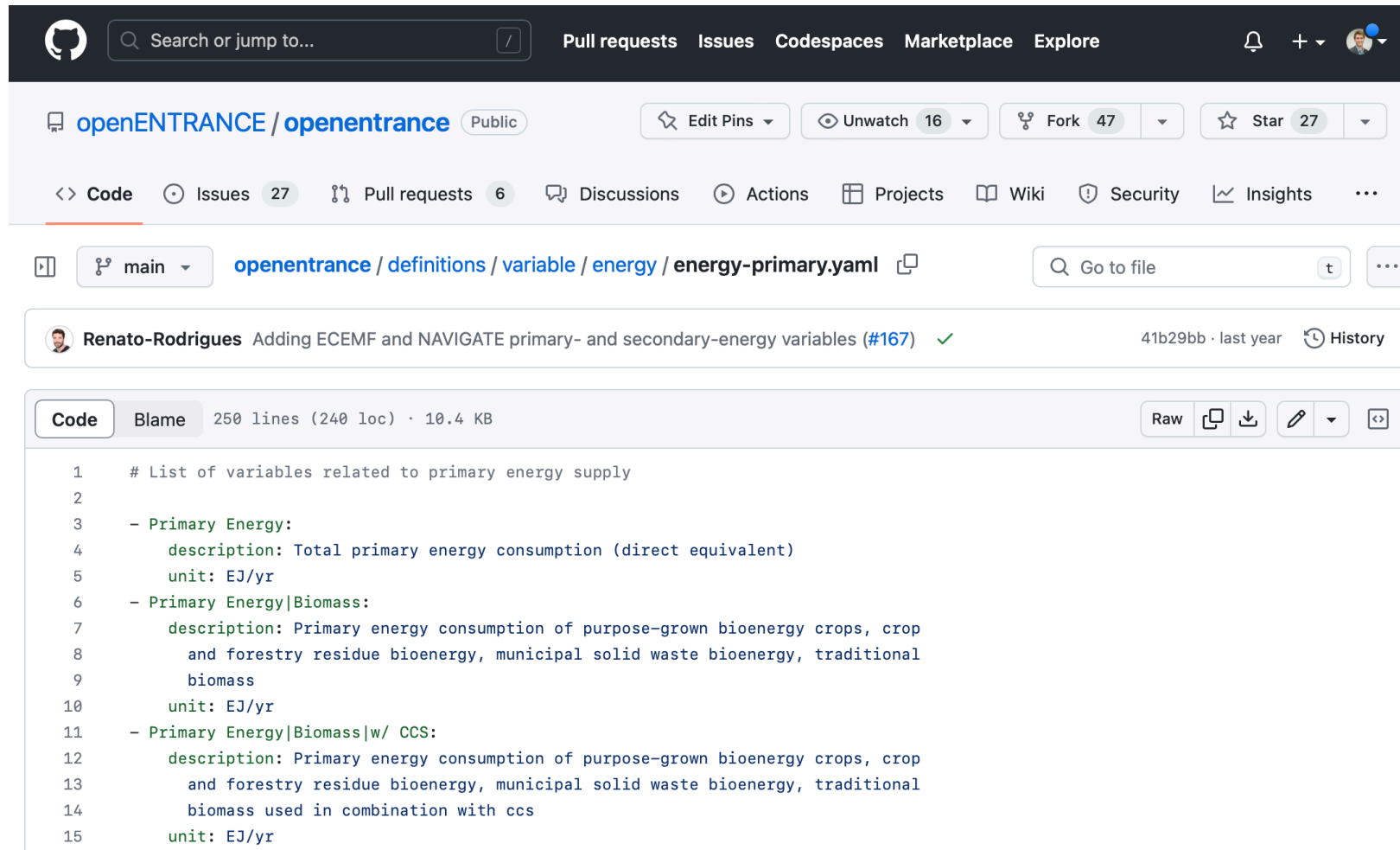
Collecting scenario data in a consistent database requires common definitions for regions and “variables” (timeseries identifiers)

Development strategy for the codelists

- Maintained on GitHub: native tools for discussion & version control
- Based on `yaml` text files: human-readable and easy to use in scripts & workflows
- Provides useful features e.g., ISO2/ISO3-to-country mappings, NUTS hierarchy mappings

Visit <https://github.com/openENTRANCE/openentrance> for details!

# Illustration of the codelists on GitHub



The screenshot shows the GitHub interface for the repository `openENTRANCE/openentrance`. The commit history shows a recent commit by Renato-Rodrigues titled "Adding ECEMF and NAVIGATE primary- and secondary-energy variables (#167)". The selected file is `energy-primary.yaml`, which contains the following YAML content:

```
1 # List of variables related to primary energy supply
2
3 - Primary Energy:
4   description: Total primary energy consumption (direct equivalent)
5   unit: EJ/yr
6 - Primary Energy|Biomass:
7   description: Primary energy consumption of purpose-grown bioenergy crops, crop
8     and forestry residue bioenergy, municipal solid waste bioenergy, traditional
9     biomass
10  unit: EJ/yr
11 - Primary Energy|Biomass|w/ CCS:
12  description: Primary energy consumption of purpose-grown bioenergy crops, crop
13    and forestry residue bioenergy, municipal solid waste bioenergy, traditional
14    biomass used in combination with ccs
15  unit: EJ/yr
```

Visit <https://github.com/openENTRANCE/openentrance> for details!





# The Scenario Explorer

openENTRANCE Scenario Explorer

Workspaces Downloads Documentation License About Resources DataSubmission guest

## Welcome to the openENTRANCE Scenario Explorer!

This database contains results from the openENTRANCE project. More scenarios will be published here in June 2023.

Create new workspace Import Showing all workspaces Ordered by last update date Enter to filter...

### Updated pathway quantifications (Deliverable ...)

This workspace shows the development of the primary-energy mix and total CO<sub>2</sub> emissions in the pathway quantifications using GENeSYS-MOD as reported in Deliverable 3.2 (available online <a href="https://openentrance.eu/wp-content/uploads/openENTRANCE-...>https://openentrance.eu/wp-content/uploads/openENTRANCE-...)

Open

Last updated 2 minutes ago  
Owner loeffko

### REMES Macroeconomic Analyses

This workspace contains data of the REMES-EU Computational General Equilibrium (CGE) macroeconomic model that provides information on the overall economic effects, like changes in GDP and sectoral production level, investments, prices, trade and welfare of the

Open

Last updated 34 minutes ago  
Owner paopis

### Case Study 5: Impact of decentralization of in...

In Case Study 5, we evaluate the impact of decentralization of investment decisions compared to centralized decisions on power systems, in a consistent way with the OpenENTRANCE Techno-FriendlyV2 scenario. Two geographical scales are considered: Europe as

Open

No preview image

Last updated 43 minutes ago  
Owner sandrinecharousset

Visit <https://data.ece.iiasa.ac.at/openentrance> to explore the results!

# Datasets available for download via Zenodo

- The Scenario Explorer is a tool for quick, intuitive visualization
- The datasets are available via Zenodo
  - Released under a Creative-Commons CC-BY License for simple reuse
  - Links included in the Downloads section of the Scenario Explorer



## Downloads

### Scenario results available via Zenodo

The pathways developed by the **GENeSYS-MOD** model are available at [DOI 10.5281/zenodo.7997298](https://doi.org/10.5281/zenodo.7997298)

The scenario results for **Case Study 1** are available at [DOI 10.5281/zenodo.7997103](https://doi.org/10.5281/zenodo.7997103)

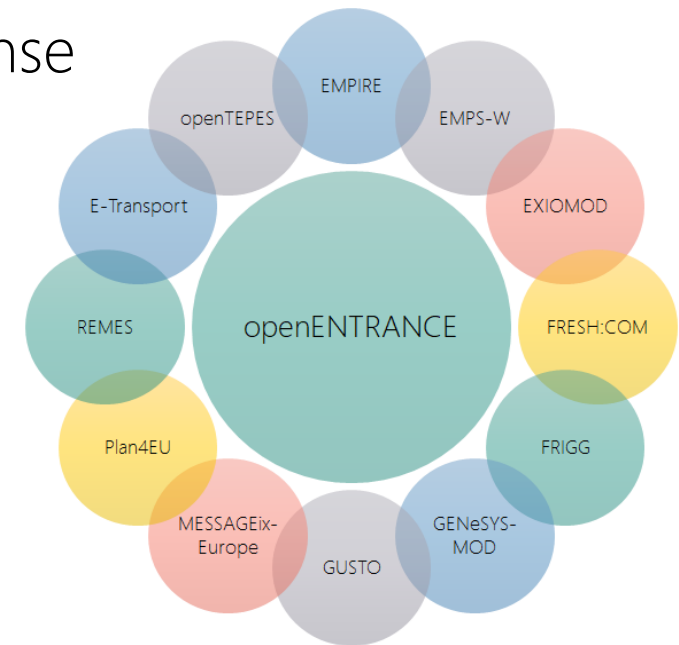
The scenario results for **Case Study 5** are available at [DOI 10.5281/zenodo.7997172](https://doi.org/10.5281/zenodo.7997172)

The scenario results for the **macro-economic analysis** conducted with the REMES model are available at [DOI 10.5281/zenodo.7997196](https://doi.org/10.5281/zenodo.7997196)



# Workflows for linkage of models

- As part of the case studies, each modelling team implemented scripts for linking models, i.e., use results from one model as input to another model
- The scripts are available under an open-source license at <https://github.com/openENTRANCE/linkages>

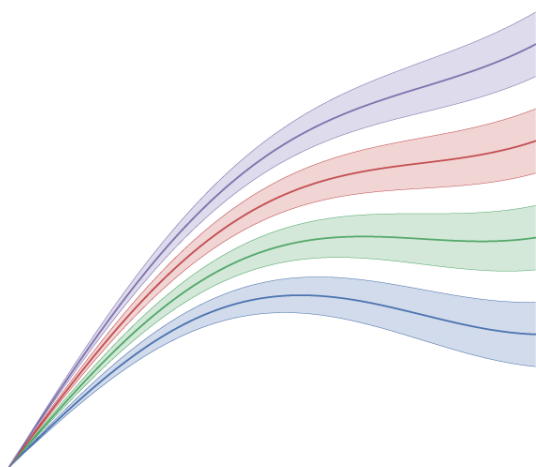


# The **pyam** package for scenario analysis and validation

## Use cases and features...

- Data processing    Aggregation, downscaling, unit conversion, I/O to xlsx, csv & frictionless ...
- Validation    Checks for validity of data, internal/external consistency, numerical plausibility ...
- Analysis & visualization    Categorization and statistics of scenario ensembles, plotting, ...

D. Huppmann et al., 2021. *Open Research Europe*, 1:74 <https://doi.org/10.12688/openreseurope.13633.2>



## ***pyam***: analysis and visualization of integrated assessment scenarios

License Apache 2.0    python ≥3.8    mail groups.io    chat Slack  
code style black    pytest passing    docs passing    codecov 95%  
DOI 10.5281/zenodo.1470400    ORE 10.12688/openreseurope.13633.2

Repository hosted on



Community supported by



Documentation hosted by



   [#pyam iamc](#)  
[pyam-iamc.readthedocs.io](https://pyam-iamc.readthedocs.io)



# The **nomenclature** package for validation

## Use cases and features

- Validation of scenarios against project-specific “codelists” (list of allowed variables, regions, ...)
- Region-aggregation from native regions to “common regions” for model comparison

## Implementation and development strategy

- Open-source Python package, docs & user guides at <https://nomenclature-iamc.readthedocs.io>
- Each project has a dedicated GitHub repository (public or accessible to consortium members)
  - “Codelists” of allowed variables/units and regions
  - Model-specific mappings for automated region processing
  - Project-specific customized workflows
- The validation & region-processing can be executed locally  
e.g., for testing before data submission to the Scenario Explorer

# Recap of platform developments in the project

- Launch <https://openenergymodels.net> as an “entry point” for open models
- Establish a **common data format** and shared list of variables & regions
  - Adopted by the H2020 project ECEMF (and soon iDesignRES & Openmod4Africa)
- A new Python package **nomenclature**
  - Standardized workflows and tools for region-processing data validation
- Several new features in the Python package **pyam**
  - Recursive aggregation, usability improvements based on user feedback

# Platform innovation recommendations (D4.5)

Platform: Overview of tools, a general “entry point” for the suite of tools & formats

- Website launched at <https://openentrance.eu/open-modelling-platform/>

Scenario Explorer infrastructure

- IIASA collected feedback from users (e.g., performance, usability)

Tools and packages for scenario analysis

- New features proposed for the **pyam** and **nomenclature** packages

GitHub repository for model linkages

- User feedback on the scripts for linking models collected at <https://github.com/openENTRANCE/linkages>





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