Open ENergy TRansition ANalyses for a low-Carbon Economy

The Open Modelling Platform

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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

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A suite of open models

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

IAMC
Integrated Assessment Modeling Consortium
Founded 2007

- 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

IPCC INTERGOVERNMENTAL PANEL ON climate change
EMF
EUROPEAN CLIMATE + ENERGY MODELLING FORUM
NAVIGATE
ENGAGE FEASIBILITY OF CLIMATE PATHWAYS

	A	B	C	D	E	F	G	H	
1	**Model**	**Scenario**	**Region**	**Variable**	**Unit**	**2005**	**2010**	**2015**	
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!

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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!

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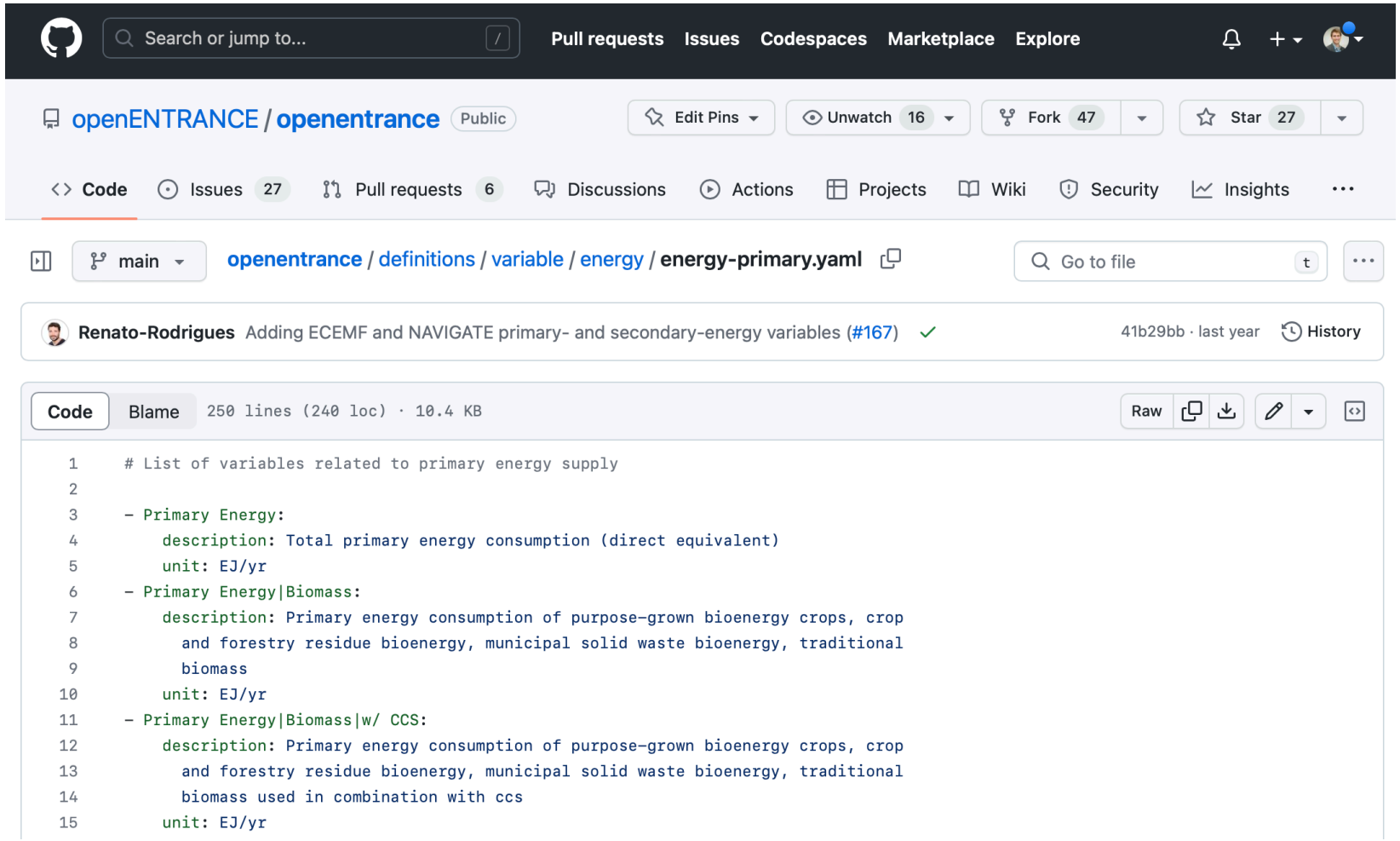
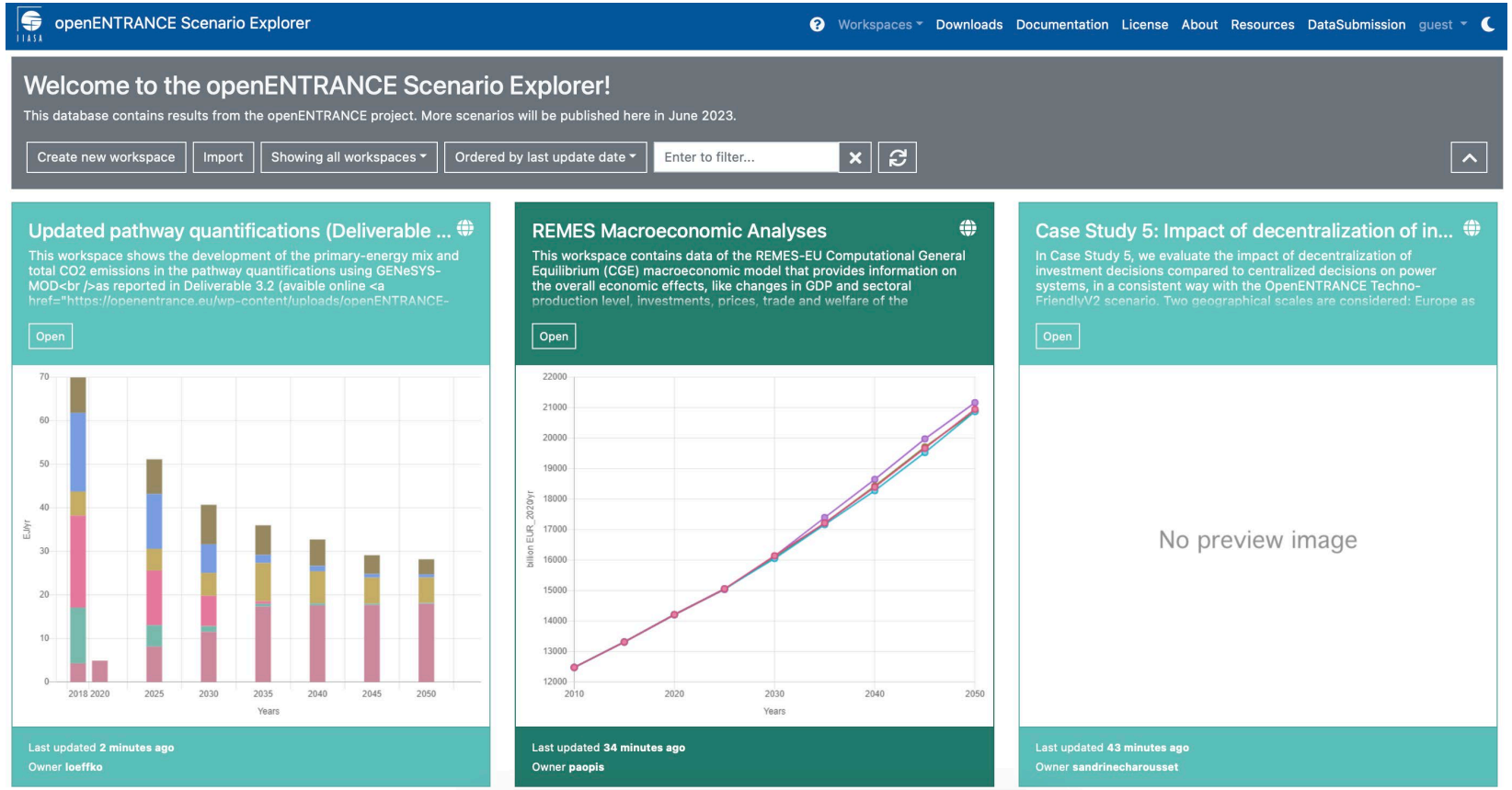
Illustration of the codelists on GitHub



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

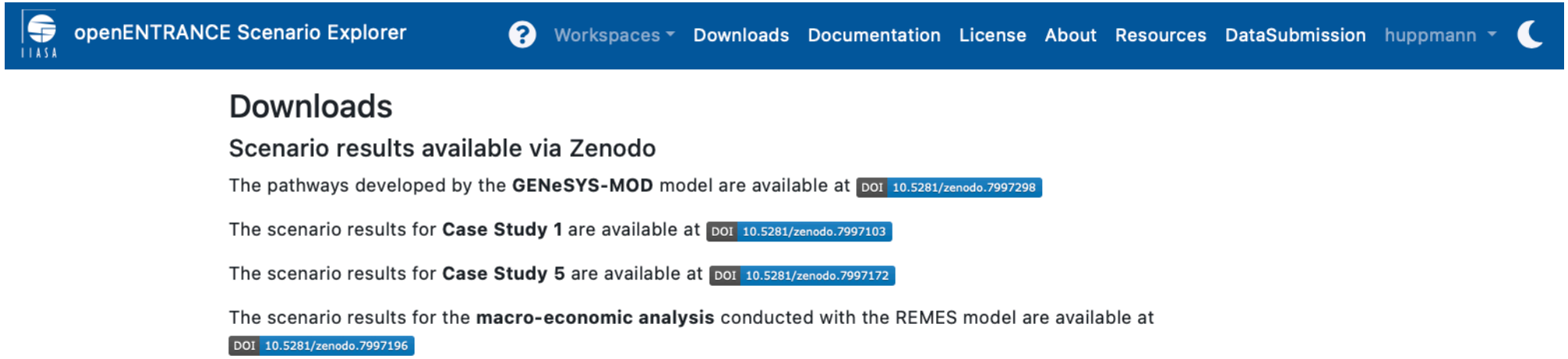
The Scenario Explorer



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

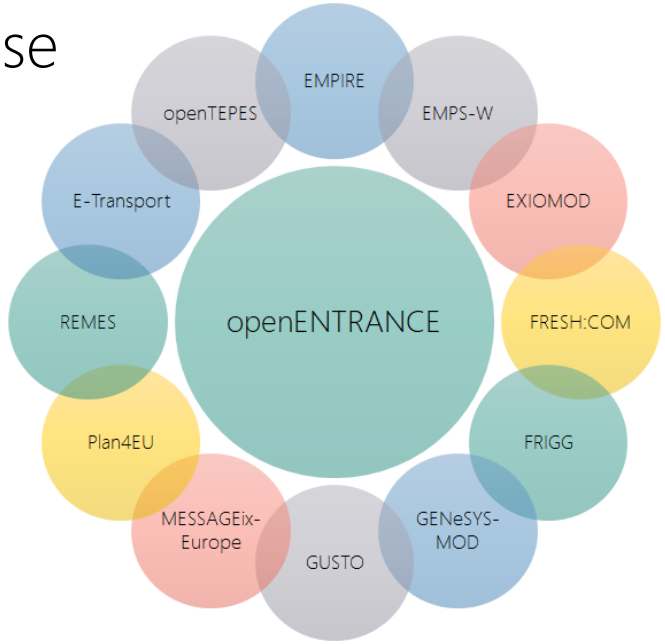
Datasets available for download via Zenodo

- 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



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

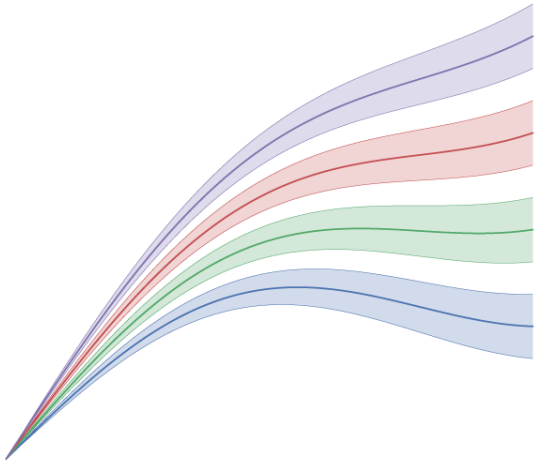


The **pyam** package for scenario analysis and validation

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 GitHub — Community supported by Groups.io slack — Documentation hosted by Read the Docs

#pyam_iamc

pyam-iamc.readthedocs.io

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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

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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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