Open ENergy TRansition ANalyses for a low-Carbon Economy

Experiences using the Platform

03.06.2023

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

Using the open platform for conducting a case study

Before carrying out the analyses, i) the objective and scope of the case study should be defined; ii) model(s) to be used should be chosen; and iii) the workflow for the CS, including the associated data exchanges, should be specified.

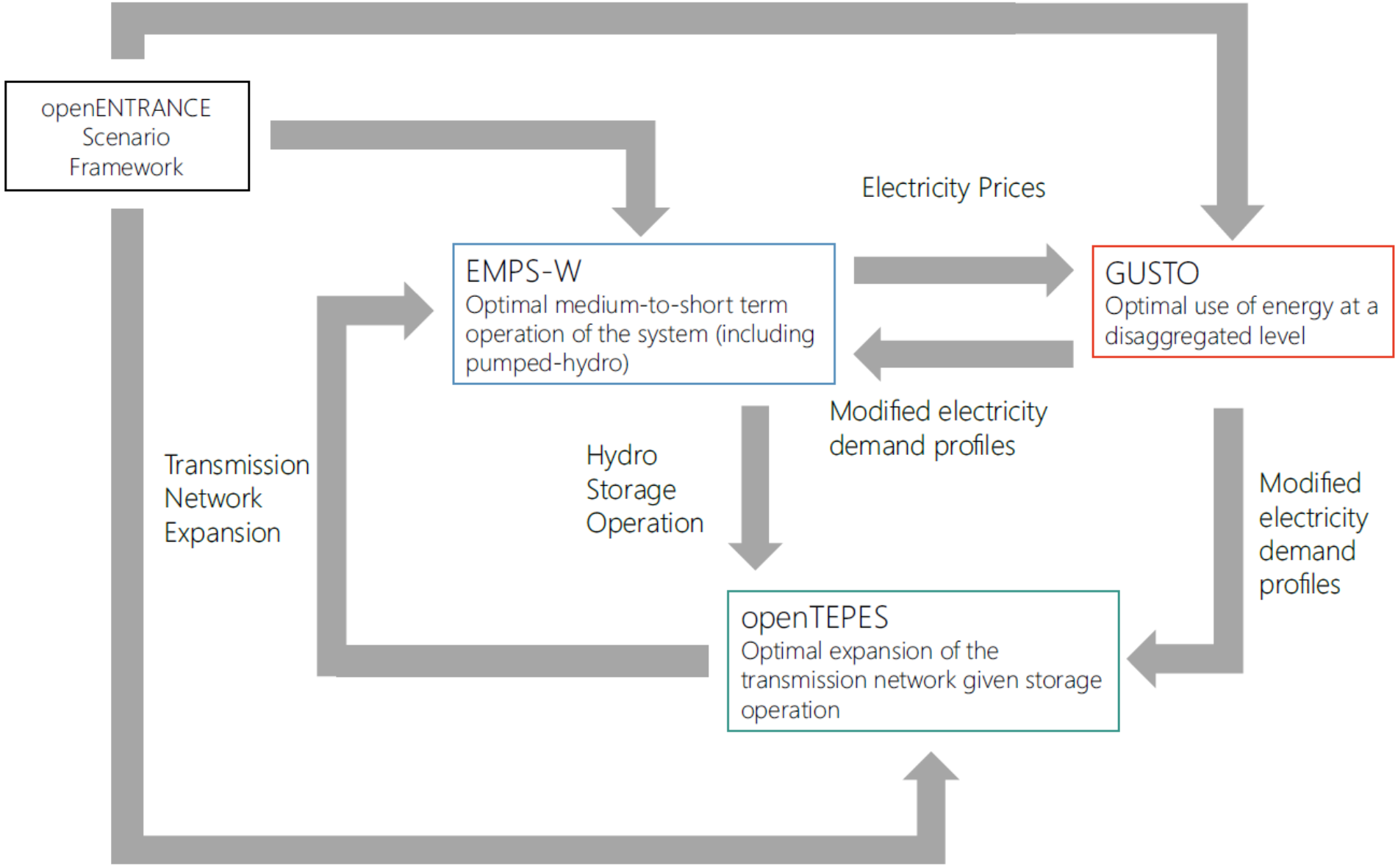
Steps to be taken concerning the platform:

1. Download the required input data from the openEntrance Platform
2. Create Models input dataset according to the openEntrance Data Format and Nomenclature
3. Run Models
4. Upload intermediate/final results to openEntrance platform

Models linkage scripts

Models linkage scripts

Example of a Case Study Workflow



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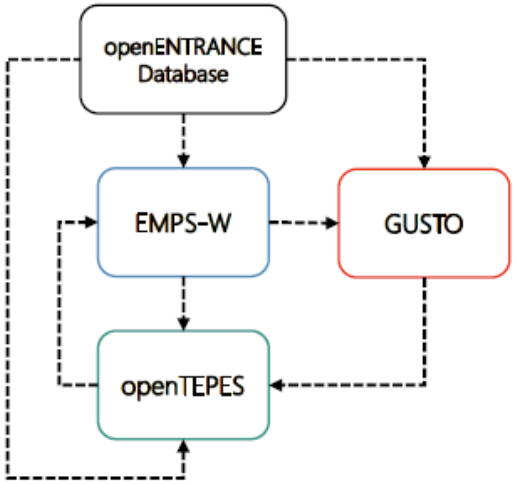
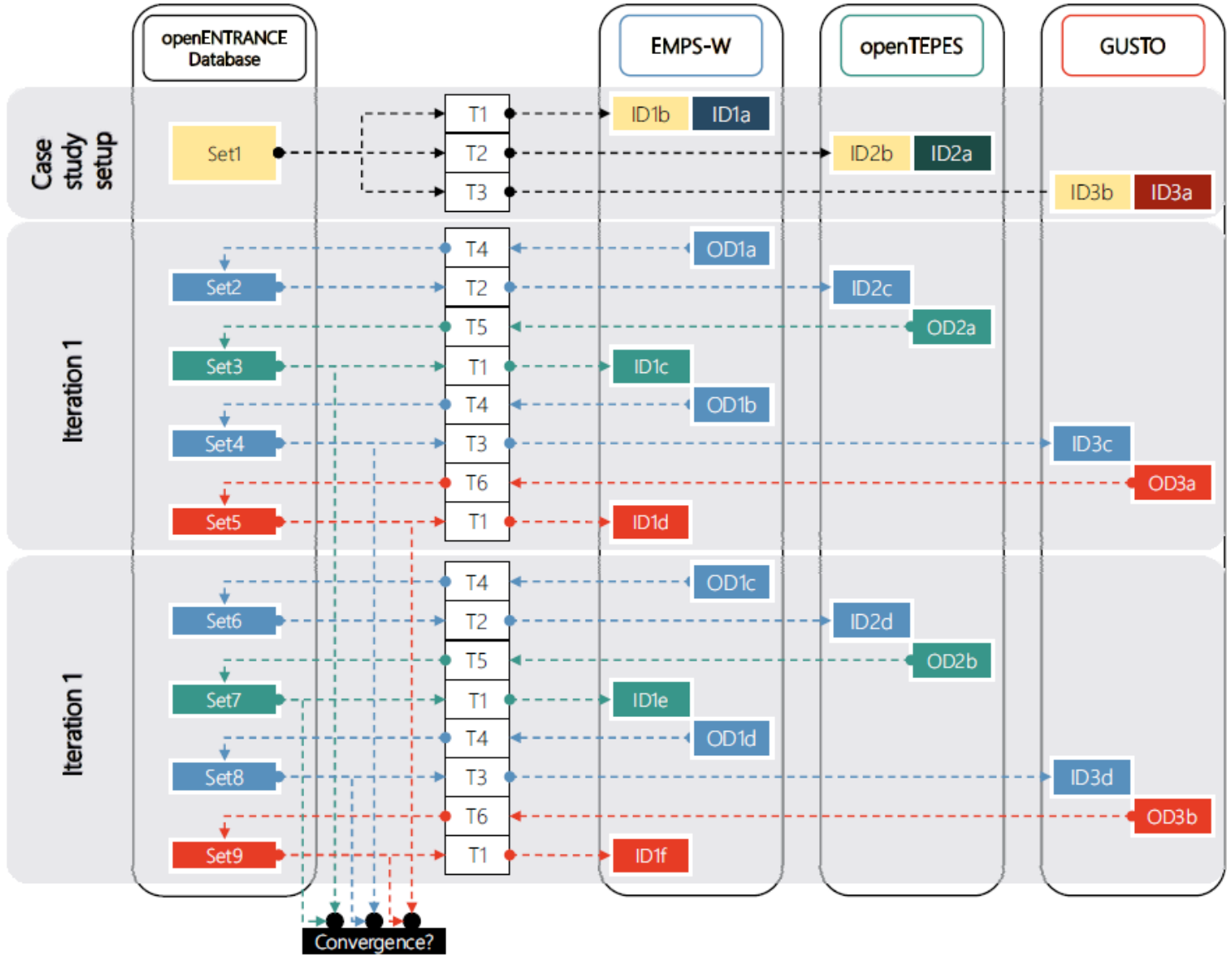
Example of a Detailed Data Workflow





Color codes:

- Data from scenarios
- Data from the own EMPS-W's database
- Data from the own openTEPES's database
- Data from the own GUSTO's database
- Data produced/used by EMPS-W
- Data produced/used by openTEPES
- Data produced/used by GUSTO

openEntrance data Format and Nomenclature

Scenario	Region	Variable	Unit	2018	2025	2030	2035	2040	2045	2050
Techno-Friendly 2.0	Austria	Capacity|Electricity|Hydro|Run of River	MW	6014	6014	6014	6014	6014	6014	6014
Techno-Friendly 2.0	Austria	Capacity|Electricity|Solar|PV	MW	1438	10567	14480	20333	23634	23634	27577
Techno-Friendly 2.0	Belgium	Capacity|Electricity|Hydro|Run of River	MW	119.17	119.17	119.17	119.17	119.17	119.17	119.17
Techno-Friendly 2.0	Belgium	Capacity|Electricity|Nuclear	MW	5060	3500.1	3500.1	0	0	0	0
Techno-Friendly 2.0	Belgium	Capacity|Electricity|Solar|PV	MW	4075	10396	15502	21824	27246	27246	27246
Techno-Friendly 2.0	Bulgaria	Capacity|Electricity|Hydro|Run of River	MW	2333	2333	2333	2333	2333	2333	2333
Techno-Friendly 2.0	Bulgaria	Capacity|Electricity|Nuclear	MW	2200	2200	2200	2200	1100	0	0
Techno-Friendly 2.0	Bulgaria	Capacity|Electricity|Solar|PV	MW	1188	4933.7	8490.8	8434.9	11736	11736	11638

openEntrance data Format and Nomenclature

[openentrance/definitions at main · openENTRANCE/openentrance · GitHub]

Describes in particular all variables and regions:

```
- country:
  - Albania:
      eu_member: false
      iso2: AL
      iso3: ALB
  - Andorra:
      eu_member: false
      iso2: AD
      iso3: AND
  - Austria:
      eu_member: true
      iso2: AT
      iso3: AUT
```

```
- Capacity|Electricity:
    description: Total installed electricity generation capacity
    unit: GW
- Capacity|Electricity|{Electricity Input}:
    description: Total installed electricity generation capacity from {Electricity Input}
    unit: GW
```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Steps 1-2-4 Linkage Scripts

Each model is 'soft-linked' to the openEntrance database (the Scenario Explorer) by linkage scripts (python), based on the pyam package.

❑Input linkage script:

- Download input data from platform
- Proceed to data transformations
- Write model native input data

❑Output linkage script:

- Post-treat model native output data
- Write openEntrance format outputs in the openEntrance database

Standard linkage scripts for every open model linked to the platform available on the platform

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Example of (Input) linkage script treatment (steps 1-2)

- Connect to platform

```
pyam.iiasa.set_config(cfg['user'],cfg['password'])
pyam.iiasa.Connection('openentrance')
```

- Download data from Scenarios and from Flexibility potentials

```
DataScenario = pyam.read_iiasa('openentrance',model='GENeSYS-MOD 3.1', variable=['Capacity|Electricity|Nuclear',...],
region=['France','Germany',...],year=[2045,2050], scenario='Techno-Friendly 2.0')
```

- Convert Units

```
DataScenario = DataScenario.convert_unit('EJ/yr', to='MWh/yr')
```

- Aggregate some regions and filter

```
DataScenario.aggregate_region(region='Scandinavia', subregions=['Norway','Sweden','Finland','Denmark'],append=True)

DataScenario = DataScenario.filter(region='Scandinavia')
```

- Check the dataset is correct

```
DataScenario.validate()
```


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Step 3 – Run model(s)

- 9 open models available (soon) on the openEntrance platform via links to models repository (including documentation)
- 1 non open model was also used
- New models can be added in the future

MODEL	LEAD PARTNER	DESCRIPTION	EL	HEAT	GAS	TRAN-SPORT
GENeSYS-MOD	TU Berlin	Energy system model, cost-optmizing linear program, focusing on long-term development	X	X	X	X
EXIMOD	TNO	Multisector multi region CGE model measures the environmental and econmic impacts of policies	X	X	X	X
REMES	NTNU	Regional economic model with focus on the energy system	X	X		X
EMPIRE	NTNU	Power sector investment model	X			
openTEPES	Comillas	Power sector investment model	X			
Plan4EU	EDF	Modelling suit for the electricity system i) a capacity expansion model ii) a seasonal storage evaluation tool iii) an European operational dispatch model	X			
GUSTO	TU Wien	Optimizing the energy technology investment and the dispatch on a local level	X	X		
FRESH:COM	TU Wien	FaiR Energy Sharing in local COMunities	X			X
FRIGG	DTU	Models demand flexibility realistically and is interoperable with major energy system models.	X			

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Example of (Output) linkage script treatment (step 4)

- Connect to platform

```
pyam.iiasa.set_config(cfg['user'],cfg['password'])
pyam.iiasa.Connection('openentrance')
```

- Read model outputs as pandas, do your treatments

```
OutputData=pd.read_csv('\MyOutput.csv',index_col=0)
OutputData= ……
```

- Create IamDataFrame

Example for hourly timeseries of Nuclear generation in France

```
OutputDF=pyam.IamDataFrame(data=pd.DataFrame(OutputData),model=MyModel, scenario=MyScenario, unit='MWh',
variable='Active Power| Electricity| Nuclear')
```

- Convert Units

```
OutputDF.convert_unit('MWh', to='GWh')
```

- Change subannual format

```
OutputDF.swap_time_for_year(subannual=True)
```

- Check it works

```
OutputDF.validate()
```

- Create xlsx files for upload to database

```
OutputDF.to_excel(myDir, sheet_name='data', iamc_index=False, include_meta=True)
```

openENTRANCE Scenario Explorer (iiasa.ac.at) => DataSubmission

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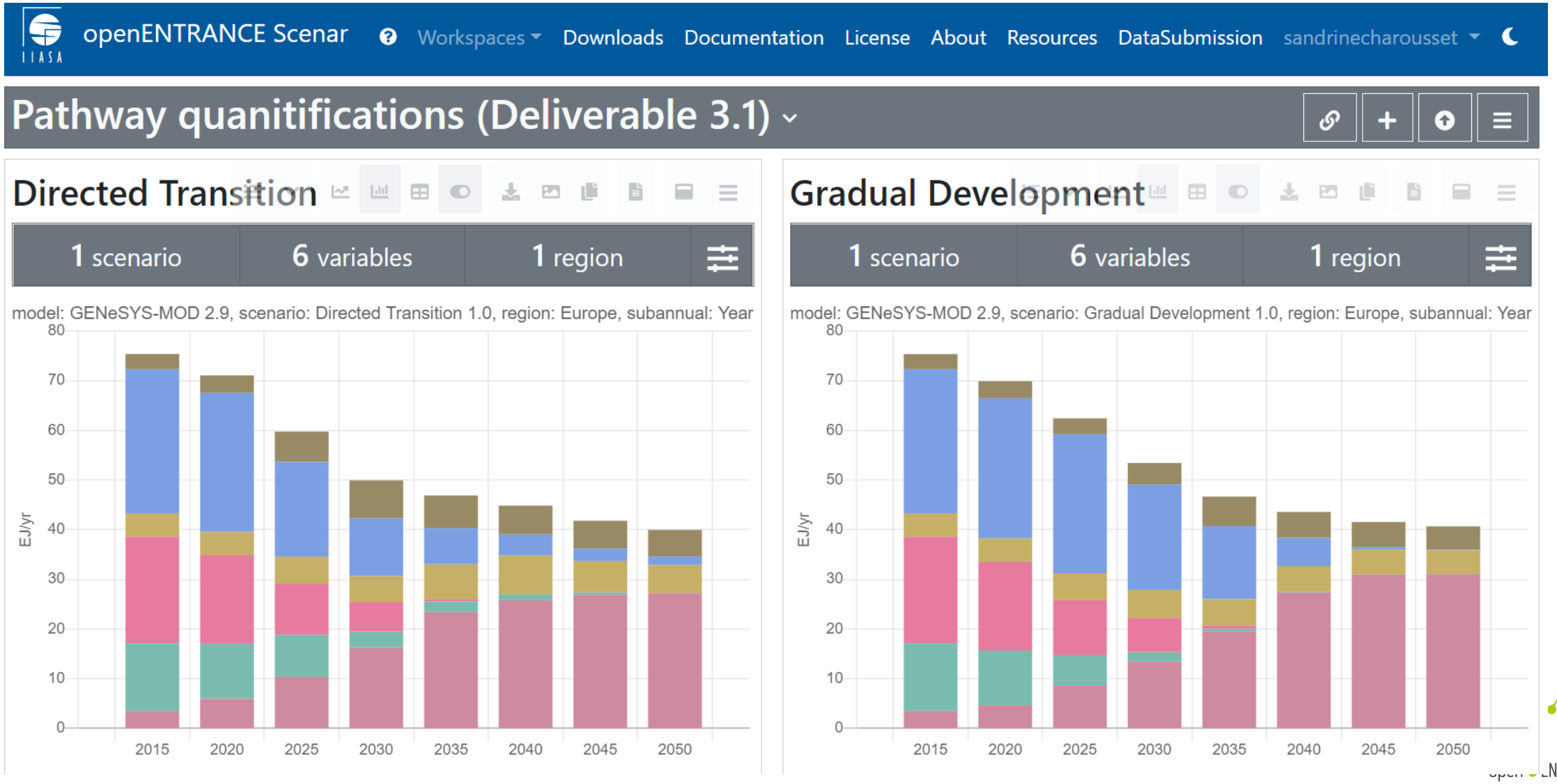
Final Step: synthetic visualisations on the platform



Summary: How to conduct a new case study with new models

- Step0: define concept of case study, choose models
- Step1: define workflow / Variables that need to be exchanged (inputs/outputs of the model)
- Step2: extend the nomenclature if necessary
- Step3: create python scripts for input/output conversions and download/upload to/from platform
- Step4: write a documentation
  - Model description + Inputs/Outputs details
  - How to download/install/run the model (if open)

Feedback on the use of the platform (possible upgrades)

- Units, subannual time stamps, (sub-
)regions, and connections among them that do not conform to the Nomenclature nee
  d to be defined in advance, before conducting the analyses. In general, the flexibility of the DataBase (Scenario Explorer) to adapt to new data types or formats is limited.
- Implementing the upload of data via script would make it easier
- The type of data files for data upload and down load could be changed: from XLSX to CSV
- A Scenario, or Run, finder could be developed based on values provided for the user for some selected MetaData

Thanks!
Gracias!

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