CROSS Data format and model result comparison

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The research published in this report was carried out with the support of the Swiss Federal Office of Energy SFOE as part of the SWEET project CoSi

June, 2024

Contents

1 Introduction

The objective of this document is to provide guidance for any model to compare their results to those from the CROSS model comparison. We describe the CROSS Data format V2024-04 and present a guide for the use of the python code to generate the model results comparison plots.

2 File

For the model output data we use the CROSS Data format V2024-04. It is a csv file with the following columns:

Table 1: Structure model results files

Column name	Description	Type	Values		Optional
scenario	Scenario name	String			No
model	Model name	String			No
variable	Variable name	String	Foo|technology[a]		No
unit	Model name	String	TWh, GWh, MWh, GJ, GW, MW, MtCO2, GtCO2		No
timeResolution	Time resolution	String	annual,monthly, daily, hourly, typical-day-summer, typical-day-winter		No
timestep	Time step depending on the resolution	Date	timeResolution	Value	No
			annual	YYYY	
			monthly	YYYY-MM	
			daily	YYYY-MM-DD	
			hourly	YYYY-MM-DD HH:mm	
			typical-day-summer	YYYY HH:mm	
			typical-day-winter	YYYY HH:mm	
value	Value of the variable	Number			No

[a] See Section 2.1

2.1 Variables

The following Table includes a list of the variables collected in the CROSS data format V2024-04.

Table 2: Variables data format

Variable name	Comment
CO2|Net emissions	
CO2|Total captured	
CO2|Total stored	
CO2|Total utilised in fuel synthesis	
Electricity-consumption|Base	Electricity supply for appliances, lighting, ventilation, cooling, ICT, motors. Excludes trains
Electricity-consumption|Battery-in	
Electricity-consumption|Battery-vehicles	
Electricity-consumption|Electric heaters	
Electricity-consumption|Electrolysis	
Electricity-consumption|Exports	

Table 2: Variables data format (continued)

Variable name	Comment
Electricity-consumption|Grid-losses	
Electricity-consumption|Heat pumps	
Electricity-consumption|New processes	Includes the electricity needed for DAC
Electricity-consumption|PHS-in	Electricity used to pump water in the pumped hydro storage (PHS) units
Electricity-consumption|Total	
Electricity-consumption|Trains	
Electricity-supply|Battery-out	
Electricity-supply|Biogas	
Electricity-supply|Gas	
Electricity-supply|Geothermal	
Electricity-supply|Hydro Dams	
Electricity-supply|Hydro RoR	
Electricity-supply|Hydrogen	
Electricity-supply|Imports	
Electricity-supply|Nuclear	
Electricity-supply|PHS-out	Electricity produced using with pumped hydro storage (PHS) units
Electricity-supply|Solar	
Electricity-supply|Total	
Electricity-supply|Waste	
Electricity-supply|Wind	
Electricity-supply|Wood	
Hydrogen-consumption|CHP	
Hydrogen-consumption|Exports	
Hydrogen-consumption|Freight	
Hydrogen-consumption|Fuel synthesis	
Hydrogen-consumption|High temperature heat	
Hydrogen-consumption|Passenger vehicles	
Hydrogen-production|Electrolysis	
Hydrogen-production|Gasification	
Hydrogen-production|Imports	
Hydrogen-production|Steam-reforming	
Hydrogen-production|Total	
Industrial heating|Burner-Coal	
Industrial heating|Burner-Gas	
Industrial heating|Burner-Hydrogen	
Industrial heating|Burner-Oil	
Industrial heating|Burner-Waste	
Industrial heating|Burner-Wood	
Industrial heating|CHP-Gas	
Industrial heating|CHP-Hydrogen	
Industrial heating|CHP-Oil	
Industrial heating|CHP-Waste	
Industrial heating|CHP-Wood	
Industrial heating|Electric heater	
Industrial heating|Geothermal	
Industrial heating|Heat pumps	
Industrial heating|Solar thermal	
Industrial heating|Total	

Table 2: Variables data format (continued)

Variable name	Comment
Space heating, DHW|Boiler-Gas	Useful energy, i.e. how much heat is delivered by a gas boiler or a heat pump, not how much gas is used by the boiler or how much electricity is used by the heat pump.
Space heating, DHW|Boiler-Hydrogen	
Space heating, DHW|Boiler-Oil	
Space heating, DHW|Boiler-Wood	
Space heating, DHW|CHP-Gas	
Space heating, DHW|CHP-Hydrogen	
Space heating, DHW|CHP-Oil	
Space heating, DHW|CHP-Waste	
Space heating, DHW|CHP-Wood	
Space heating, DHW|Electric heater	
Space heating, DHW|Geothermal	
Space heating, DHW|Heat pumps	
Space heating, DHW|Solar thermal	
Space heating, DHW|Total	
Transport|Electricity	
Transport|Gas	
Transport|Hydrogen	
Transport|Oil	
Transport|Total	

3 Python code

The repository is available at https://github.com/sweet-cross/plots-model-comparison/.

3.1 Structure

The repository contains the following files and folders

- `distributions/plots.py` contains all the functions to upload the data and plot
- `results/` is the folder where the results are uploaded
- `plots/` is the folder where the plots are saved
- `cross_comparison.py` is the python code that interacts with `distributions/plots.py` and creates the plots
- `LICENSE` is the license for the distribution and use of the repository
- `requirements.txt` is the list of Python package requirements

3.2 Installation

3.2.1 Installation with python virtual environment without Conda

- Create virtual environment called `cross-comparison`:
  `python -m venv /path_to/cross-comparison`

- Activate the virtual environment:
  - Mac-Os X and Unix based operating systems:
    `source /path_to/cross-comparison/bin/activate`
  - Windows operating system:
    `/path_to/cross-comparison/Scripts/activate.bat`
- Install the requirements:
  - `cd` to the folder where you cloned the code
  - Install the required python packages:
    `pip install -r requirements.txt`

3.2.2 Installation with python virtual environment without Conda

- Create virtual environment called `cross-comparison`:
  `conda create -n cross-comparison`
- Activate the virtual environment:
  `conda activate cross-comparison`
- Install the requirements:
  - `cd` to the folder where you cloned the code
  - Install the required python packages:
    `pip install -r requirements.txt`

3.3 Usage

- Add your own result file to the folder `results/`. The file should comply with the format CROSS V2024-04 (see Section 2)
- Edit `cross_comparison.py`. You need to add a new element to the array `files` to load your file. The new line should contain the following fields:
  - `name`: Name of the model/study,
  - `file`: name (without extension) of the file you copied to `results/`
  - `summer`: name of the summer day reported by the model, e.g. typical day or a specific date
  - `winter`: name of the winter day reported by the model, e.g. typical day or a specific date
  - `color`: color to be used for the model in scatter plots

```
files = [
{'name':'Calliope', 'file': 'resultsCross_Calliope', 'summer':'Jul␣20', 'winter':'Feb␣08', 'color':'#D57CBE'},
{'name': 'Expanse', 'file': 'resultsCross_Expanse','summer':'Jul␣02','winter':'Jan␣01','color':'#FF7D0D'},
{'name': 'FLEXECO', 'file': 'resultsCross_flexeco','summer':'Typical␣day','winter':'Typical␣day',
    'color':'#BD21BC'},
{'name': 'Nexus–e+\nEP2050+', 'file': 'resultsCross_Nexuse–EP','summer':'Jul␣02','winter':'Feb␣08',
    'color':'#BCBD21'},
{'name': 'SecMod', 'file': 'resultsCross_Secmod','summer':'Typical␣day','winter':'Typical␣day','color':'#9565BD'},
```

```
{'name': 'SES', 'file': 'resultsCross_SES−epfl','summer':'Typical␣day','winter':'Typical␣day','color':'#1E75B3'},
{'name': 'SES−ETH', 'file': 'resultsCross_SES','summer':'Typical␣day','winter':'Typical␣day','color':'#2A9E2A'},
{'name': 'STEM', 'file': 'resultsCross_STEM','summer':'Week␣day','winter':'Week␣day','color':'#D52426'},
{'name': 'Empa', 'file': 'resultsCross_VSE','summer':'Jul␣11','winter':'Feb␣15','color':'#8B5349'},
{'name': 'EP2050+\nZero␣Basis', 'file': 'resultsCross_EP','summer':'avg.␣Aug.␣13−19','winter':'avg.␣Feb.␣7−13',
        'color':'#7F7F7F'}
]
```

- Run `cross_comparison.py`. The plots will be saved in pdf format in the folder `plots/`

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