

CROSS Data format and Instruction Manual for the model result comparison script

Report**Author(s):**

Marcucci, Adriana ; Guidati, Gianfranco

Publication date:

2024-06

Permanent link:

<https://doi.org/https://doi.org/10.3929/ethz-b-000690329>

Rights / license:

[Creative Commons Attribution 4.0 International](#)



CROSS Data format and Instruction Manual for the model result comparison script

**Adriana Marcucci
Gianfranco Guidati**

ETH Zurich

The report was carried out with the support of the Swiss Federal Office of Energy SFOE as part of SWEET CoSi

© SWEET-CoSi
June, 2024

Contents

- 1 Introduction** **1**

- 2 CROSS Data Format V2024-04** **1**
 - 2.1 Variables 1

- 3 Python code** **3**
 - 3.1 Structure 3
 - 3.2 Installation 4
 - 3.2.1 Installation with python virtual environment without Conda 4
 - 3.2.2 Installation with python virtual environment without Conda 4
 - 3.3 Usage 4

- 4 License** **5**

- Bibliography** **5**

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 CROSS Data Format V2024-04

The CROSS Data Format V2024-04 is a tabular time series format based on the one used by the Integrated Assessment Models to provide results to the IPCC assessment reports (Huppmann et al., 2018). 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	

^aSee 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	

Table 2: Variables data format (continued)

Variable name	Comment
Electricity-consumption Electric heaters	
Electricity-consumption Electrolysis	
Electricity-consumption Exports	
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	

Table 2: Variables data format (continued)

Variable name	Comment
Industrial heating Heat pumps	
Industrial heating Solar thermal	
Industrial heating Total	
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

We developed a script to produce: bar plots with annual production (by technology) of different energy carriers for different scenarios from various models; and hourly stacked plots for one day per model of electricity supply and demand. The repository is available at <https://github.com/sweet-cross/plots-model-comparison/> (Marcucci, 2024).

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': '#BCBD22'},
  {'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/`

4 License

Licensed under the Apache License, Version 2.0; you may not use this file except in compliance with the License. You may obtain a copy of the License at <http://www.apache.org/licenses/LICENSE-2.0>

References

- Huppmann, D., Rogelj, J., Kriegler, E., Krey, V., Riahi, K., 2018. A new scenario resource for integrated 1.5 °c research. *Nature Climate Change* 8, 1027–1030. URL: <https://doi.org/10.1038/s41558-018-0317-4>, doi:10.1038/s41558-018-0317-4.
- Marcucci, A., 2024. CROSS model comparison plots. URL: <https://github.com/sweet-cross/plots-model-comparison/>, doi:10.5905/ethz-1007-780.