# PyPSA-earth / Bolivia setup Log:

## Installation and tutorial run

* Followed the installation tutorial available on pypsa-earth’s GitHub and on the readme file available on the repository
  + Clone repository
  + Setup virtual env
  + Adapting config.yaml file based on default values (config.default.yaml)
  + Run the model on an anaconda prompt opened as administrator (snakemake -j 1 solve\_all\_networks -n )
* Error appeared due to conflicts on the “build\_powerplants” rule:

INFO:snakemake.logging:6 of 21 steps (29%) done

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Fri Feb 10 09:39:14 2023]

INFO:snakemake.logging:[Fri Feb 10 09:39:14 2023]

rule build\_powerplants:

input: networks/base.nc, configs/powerplantmatching\_config.yaml, data/custom\_powerplants.csv, resources/osm/clean/all\_clean\_generators.csv, resources/shapes/gadm\_shapes.geojson

output: resources/powerplants.csv, resources/powerplants\_osm2pm.csv

log: logs/build\_powerplants.log

jobid: 16

benchmark: benchmarks/build\_powerplants

reason: Missing output files: resources/powerplants.csv; Input files updated by another job: networks/base.nc, resources/osm/clean/all\_clean\_generators.csv, resources/shapes/gadm\_shapes.geojson, data/custom\_powerplants.csv

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=500, mem\_mib=477

INFO:snakemake.logging:rule build\_powerplants:

input: networks/base.nc, configs/powerplantmatching\_config.yaml, data/custom\_powerplants.csv, resources/osm/clean/all\_clean\_generators.csv, resources/shapes/gadm\_shapes.geojson

output: resources/powerplants.csv, resources/powerplants\_osm2pm.csv

log: logs/build\_powerplants.log

jobid: 16

benchmark: benchmarks/build\_powerplants

reason: Missing output files: resources/powerplants.csv; Input files updated by another job: networks/base.nc, resources/osm/clean/all\_clean\_generators.csv, resources/shapes/gadm\_shapes.geojson, data/custom\_powerplants.csv

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=500, mem\_mib=477

INFO:snakemake.logging:

INFO: Could not find files for the given pattern(s).

This is the repository path: C:\Users\Lenovo\Desktop\pypsa-earth

Had to go 0 folder(s) up.

INFO:pypsa.io:Imported network base.nc has buses, lines, transformers

INFO:powerplantmatching.collection:Create combined dataset for GEO, GPD

C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\powerplantmatching\cleaning.py:170: FutureWarning: In a future version of pandas all arguments of DataFrame.any and Series.any will be keyword-only.

where = df.astype(str).apply(func).any(1)

C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\powerplantmatching\cleaning.py:170: FutureWarning: In a future version of pandas all arguments of DataFrame.any and Series.any will be keyword-only.

where = df.astype(str).apply(func).any(1)

C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\powerplantmatching\cleaning.py:170: FutureWarning: In a future version of pandas all arguments of DataFrame.any and Series.any will be keyword-only.

where = df.astype(str).apply(func).any(1)

Traceback (most recent call last):

File "C:\Users\Lenovo\Desktop\pypsa-earth\.snakemake\scripts\tmp2jfllyjx.build\_powerplants.py", line 271, in <module>

pm.powerplants(from\_url=False, update=True, config\_update=config)

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\powerplantmatching\collection.py", line 230, in powerplants

matched = collect(matching\_sources, config=config, \*\*collection\_kwargs)

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\powerplantmatching\collection.py", line 98, in collect

dfs = parmap(df\_by\_name, datasets)

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\powerplantmatching\utils.py", line 378, in parmap

return list(map(f, arg\_list))

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\powerplantmatching\collection.py", line 73, in df\_by\_name

df = get\_df(config=config)

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\powerplantmatching\data.py", line 304, in GEO

res = scale\_to\_net\_capacities(res)

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\powerplantmatching\heuristics.py", line 573, in scale\_to\_net\_capacities

factors = gross\_to\_net\_factors()

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\powerplantmatching\heuristics.py", line 544, in gross\_to\_net\_factors

df.energy\_source\_level\_2.fillna(value=df.energy\_source, inplace=True)

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\pandas\core\generic.py", line 5902, in \_\_getattr\_\_

return object.\_\_getattribute\_\_(self, name)

AttributeError: 'DataFrame' object has no attribute 'energy\_source'

[Fri Feb 10 09:39:36 2023]

INFO:snakemake.logging:[Fri Feb 10 09:39:36 2023]

Error in rule build\_powerplants:

jobid: 16

input: networks/base.nc, configs/powerplantmatching\_config.yaml, data/custom\_powerplants.csv, resources/osm/clean/all\_clean\_generators.csv, resources/shapes/gadm\_shapes.geojson

output: resources/powerplants.csv, resources/powerplants\_osm2pm.csv

log: logs/build\_powerplants.log (check log file(s) for error details)

ERROR:snakemake.logging:Error in rule build\_powerplants:

jobid: 16

input: networks/base.nc, configs/powerplantmatching\_config.yaml, data/custom\_powerplants.csv, resources/osm/clean/all\_clean\_generators.csv, resources/shapes/gadm\_shapes.geojson

output: resources/powerplants.csv, resources/powerplants\_osm2pm.csv

log: logs/build\_powerplants.log (check log file(s) for error details)

Removing output files of failed job build\_powerplants since they might be corrupted:

resources/powerplants\_osm2pm.csv

WARNING:snakemake.logging:Removing output files of failed job build\_powerplants since they might be corrupted:

resources/powerplants\_osm2pm.csv

Shutting down, this might take some time.

WARNING:snakemake.logging:Shutting down, this might take some time.

Exiting because a job execution failed. Look above for error message

ERROR:snakemake.logging:Exiting because a job execution failed. Look above for error message

Complete log: .snakemake\log\2023-02-10T092417.398723.snakemake.log

WARNING:snakemake.logging:Complete log: .snakemake\log\2023-02-10T092417.398723.snakemake.log

* To fix the problem the discussion followed on github for issue #358 (<https://github.com/pypsa-meets-earth/pypsa-earth/issues/358> ) is used and comments from the discord group (<https://discordapp.com/channels/911692131440148490/1073587647852847205> ). The following steps are done:

1) the changes in the environment.yaml file to install the most recent version on the ppm are done:

\*the envrironment.yaml file was edited in order to update the version of powerplantmatching installed (currently a problem with version is found between it and conda installation)

\*in the file environment.yaml the following line is added after the pip command:

pip:

git+https://github.com/pypsa/powerplantmatching@master

\*in the file environment.yaml, after line 15 (- pypsa>=0.21.3), the powerplantmatching line is erased

2) then, after the environment is created, the local ppm folder is deleted;

\*Local installation of files appear to have conflicting issues with data that is used (probably updated but not in the default download file)

\*To force new dowloads, erase the powerplantmatching file from local repository, in my case it was: "C:\Users\Lenovo\AppData\Roaming\powerplantmatching"

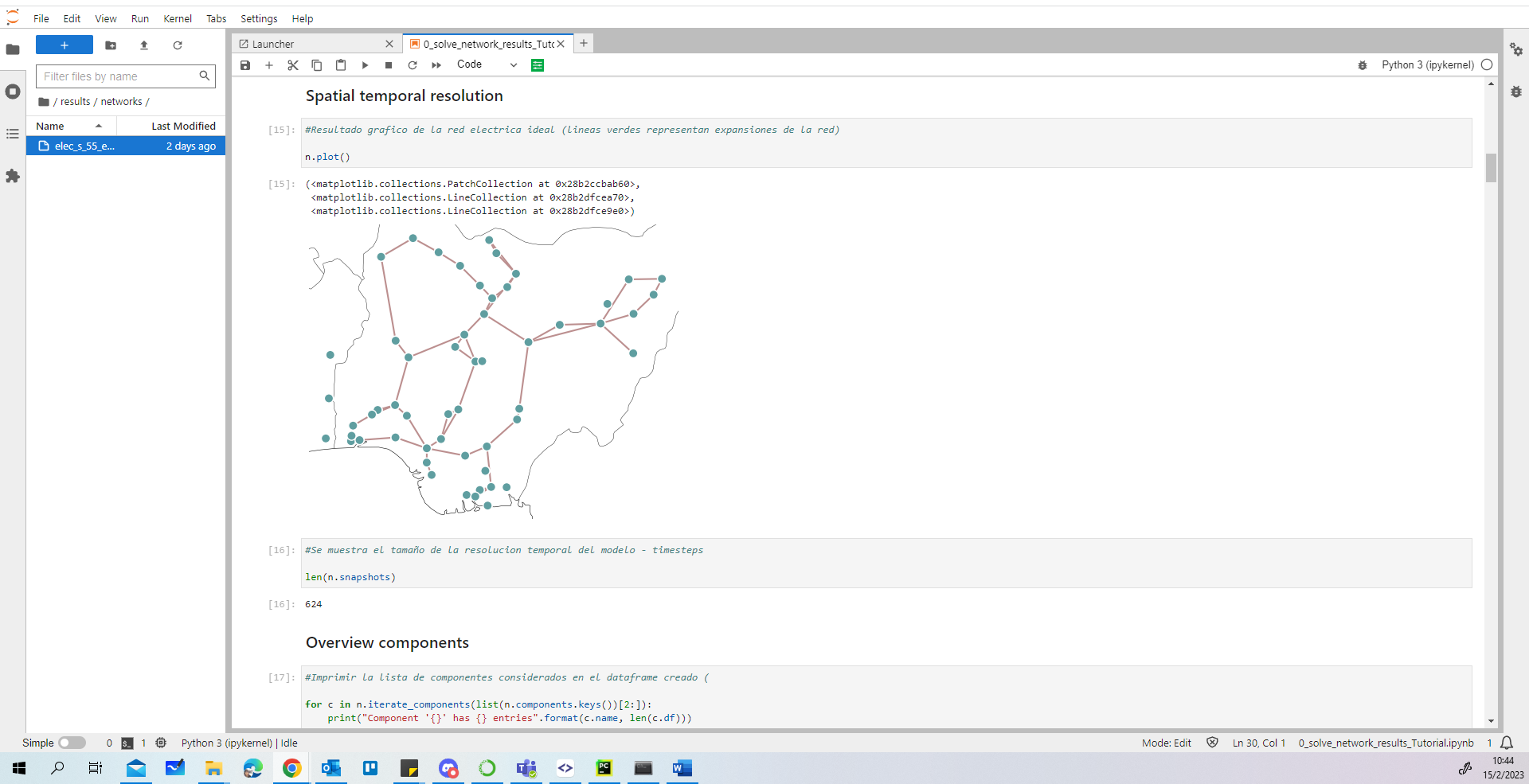
3) and the entire workflow is forced to be executed from the beginning (forceall)C:\Users\Lenovo\AppData\Roaming\powerplantmatching

\*By running only the workflow form where it got stuck problem is not solved (snakemake -j 1 solve\_all\_networks) and a total rerun is required.

\*to force the total rerun use the command forceall in snakemake: "snakemake --cores all solve\_all\_networks --forceall"

After all this, the problem was solved

* A quick exercise was done to check general results with a pre-made file for Bolivia in previous runs with pypsa-africa. Everything seems to be running smoothly



## Modified model to run Bolivia

### A quick review of available material online was made:

<https://github.com/pypsa-meets-earth/documentation/tree/main/hackathon>

<https://github.com/pypsa-meets-earth/documentation/blob/main/hackathon/5_how_to_incorporate_new_regions.ipynb>

All the material has been downloaded locally in the file: C:\Users\Lenovo\Documents\2023\Doctorado\pypsa-earth\_info

### Modifications were made to run the model for Bolivia and Argentina:

* \*The "NG" and "BJ" names have been replaced by "BO" and "AR" in the line 24 - countries in the config.yaml file
* \*mentions of the cutout "africa-2013-era5" have been replaced by "southamerica-2013-era5"
* \*the build\_cutout has been adapted to create a cutout for south america instead of africa (cutout="southamerica-2013-era5) in line 109
* \*Files like the WDPA\_WDOECM\_Feb2022\_Public\_SA\_shp\_0 have been replaced in the landcover file (C:\Users\Lenovo\Desktop\pypsa-africa\data\raw\landcover), dowloaded from https://www.protectedplanet.net/en/thematic-areas/wdpa?tab=WDPA
* \*An account in the CDS platform (https://cds.climate.copernicus.eu/#!/home) has been created to allow the model to download new files to create the new cutout
* After these things were done, the entire workflow was forced to run from the beginning with the command “snakemake --cores all solve\_all\_networks --forceall”
* While some rules were executed (3/23), the run freezes after the rule “build\_shapes” is excuted:

INFO:snakemake.logging:[Wed Feb 15 15:00:39 2023]

rule build\_shapes:

input: data/eez/eez\_v11.gpkg

output: resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, resources/shapes/africa\_shape.geojson, resources/shapes/gadm\_shapes.geojson

log: logs/build\_shapes.log

jobid: 12

benchmark: benchmarks/build\_shapes

reason: Input files updated by another job: data/eez/eez\_v11.gpkg

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=500, mem\_mib=477

INFO:snakemake.logging:rule build\_shapes:

input: data/eez/eez\_v11.gpkg

output: resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, resources/shapes/africa\_shape.geojson, resources/shapes/gadm\_shapes.geojson

log: logs/build\_shapes.log

jobid: 12

benchmark: benchmarks/build\_shapes

reason: Input files updated by another job: data/eez/eez\_v11.gpkg

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=500, mem\_mib=477

INFO:snakemake.logging:

This is the repository path: C:\Users\Lenovo\Desktop\pypsa-earth

Had to go 0 folder(s) up.

INFO:\_\_main\_\_:Stage 1 of 4: Create country shapes

WARNING:\_\_main\_\_:Stage 4/4: gadm41\_BOL of country Bolivia does not exist, downloading to C:\Users\Lenovo\Desktop\pypsa-earth\data\gadm\gadm41\_BOL\gadm41\_BOL.gpkg

WARNING:\_\_main\_\_:Stage 4/4: gadm41\_ARG of country Argentina does not exist, downloading to C:\Users\Lenovo\Desktop\pypsa-earth\data\gadm\gadm41\_ARG\gadm41\_ARG.gpkg

INFO:\_\_main\_\_:Stage 2 of 4: Create offshore shapes

C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\geopandas\base.py:31: UserWarning: The indices of the two GeoSeries are different.

warn("The indices of the two GeoSeries are different.")

INFO:\_\_main\_\_:Stage 4/4: Creation GADM GeoDataFrame

INFO:\_\_main\_\_:Stage 4/4 POP: Add population data to GADM GeoDataFrame

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Download WorldPop : 100%|████████████████████████████████████████████████████████| 2/2 [00:18<00:00, 9.42s/ countries]

Compute population : 0%| | 0/3 [00:00<?, ?it/s]ERROR 2: D:\bld\gdal-split\_1673844302847\work\gcore\gdalnodatamaskband.cpp, 258: cannot allocate 3822737280 bytes

ERROR 2: D:\bld\gdal-split\_1673844302847\work\gcore\gdalnodatamaskband.cpp, 258: cannot allocate 928321536 bytes

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Process SpawnPoolWorker-5:

Process SpawnPoolWorker-1:

Process SpawnPoolWorker-4:

Traceback (most recent call last):

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\multiprocessing\process.py", line 314, in \_bootstrap

self.run()

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\multiprocessing\process.py", line 108, in run

self.\_target(\*self.\_args, \*\*self.\_kwargs)

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\multiprocessing\pool.py", line 114, in worker

task = get()

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\multiprocessing\queues.py", line 364, in get

with self.\_rlock:

Traceback (most recent call last):

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\multiprocessing\synchronize.py", line 95, in \_\_enter\_\_

return self.\_semlock.\_\_enter\_\_()

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\multiprocessing\process.py", line 314, in \_bootstrap

self.run()

KeyboardInterrupt

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\multiprocessing\process.py", line 108, in run

self.\_target(\*self.\_args, \*\*self.\_kwargs)

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\multiprocessing\pool.py", line 114, in worker

task = get()

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\multiprocessing\queues.py", line 365, in get

res = self.\_reader.recv\_bytes()

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\multiprocessing\connection.py", line 216, in recv\_bytes

buf = self.\_recv\_bytes(maxlength)

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\multiprocessing\connection.py", line 305, in \_recv\_bytes

waitres = \_winapi.WaitForMultipleObjects(

KeyboardInterrupt

Traceback (most recent call last):

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\multiprocessing\process.py", line 314, in \_bootstrap

self.run()

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with self.\_rlock:

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\multiprocessing\synchronize.py", line 95, in \_\_enter\_\_

return self.\_semlock.\_\_enter\_\_()

KeyboardInterrupt

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This is the repository path: C:\Users\Lenovo\Desktop\pypsa-earth

Had to go 0 folder(s) up.

Process SpawnPoolWorker-7:

Process SpawnPoolWorker-8:

Process SpawnPoolWorker-6:

Traceback (most recent call last):

Traceback (most recent call last):

Traceback (most recent call last):

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\multiprocessing\process.py", line 314, in \_bootstrap

self.run()

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File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\multiprocessing\process.py", line 108, in run

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File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\multiprocessing\process.py", line 108, in run

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task = get()

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self.\_target(\*self.\_args, \*\*self.\_kwargs)

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\multiprocessing\pool.py", line 114, in worker

task = get()

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File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\multiprocessing\queues.py", line 365, in get

res = self.\_reader.recv\_bytes()

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return self.\_semlock.\_\_enter\_\_()

KeyboardInterrupt

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\multiprocessing\connection.py", line 216, in recv\_bytes

buf = self.\_recv\_bytes(maxlength)

KeyboardInterrupt

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\multiprocessing\connection.py", line 305, in \_recv\_bytes

waitres = \_winapi.WaitForMultipleObjects(

KeyboardInterrupt

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Process SpawnPoolWorker-11:

Process SpawnPoolWorker-10:

Process SpawnPoolWorker-9:

Traceback (most recent call last):

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File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\multiprocessing\process.py", line 314, in \_bootstrap

self.run()

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self.run()

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\multiprocessing\process.py", line 108, in run

self.\_target(\*self.\_args, \*\*self.\_kwargs)

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return self.\_semlock.\_\_enter\_\_()

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KeyboardInterrupt

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File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\multiprocessing\connection.py", line 305, in \_recv\_bytes

waitres = \_winapi.WaitForMultipleObjects(

KeyboardInterrupt

KeyboardInterrupt

Traceback (most recent call last):

File "<string>", line 1, in <module>

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\multiprocessing\spawn.py", line 116, in spawn\_main

exitcode = \_main(fd, parent\_sentinel)

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\multiprocessing\spawn.py", line 125, in \_main

prepare(preparation\_data)

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\multiprocessing\spawn.py", line 236, in prepare

\_fixup\_main\_from\_path(data['init\_main\_from\_path'])

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\multiprocessing\spawn.py", line 287, in \_fixup\_main\_from\_path

main\_content = runpy.run\_path(main\_path,

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\runpy.py", line 289, in run\_path

return \_run\_module\_code(code, init\_globals, run\_name,

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\runpy.py", line 96, in \_run\_module\_code

\_run\_code(code, mod\_globals, init\_globals,

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\runpy.py", line 86, in \_run\_code

exec(code, run\_globals)

File "C:\Users\Lenovo\Desktop\pypsa-earth\scripts\build\_shapes.py", line 15, in <module>

import geopandas as gpd

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\geopandas\\_\_init\_\_.py", line 1, in <module>

from geopandas.\_config import options # noqa

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\geopandas\\_config.py", line 109, in <module>

default\_value=\_default\_use\_pygeos(),

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\geopandas\\_config.py", line 95, in \_default\_use\_pygeos

import geopandas.\_compat as compat

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\geopandas\\_compat.py", line 8, in <module>

import pandas as pd

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\pandas\\_\_init\_\_.py", line 48, in <module>

from pandas.core.api import (

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\pandas\core\api.py", line 27, in <module>

from pandas.core.arrays import Categorical

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\pandas\core\arrays\\_\_init\_\_.py", line 1, in <module>

from pandas.core.arrays.arrow import ArrowExtensionArray

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\pandas\core\arrays\arrow\\_\_init\_\_.py", line 1, in <module>

from pandas.core.arrays.arrow.array import ArrowExtensionArray

File "<frozen importlib.\_bootstrap>", line 1027, in \_find\_and\_load

File "<frozen importlib.\_bootstrap>", line 1006, in \_find\_and\_load\_unlocked

File "<frozen importlib.\_bootstrap>", line 688, in \_load\_unlocked

File "<frozen importlib.\_bootstrap\_external>", line 879, in exec\_module

File "<frozen importlib.\_bootstrap\_external>", line 975, in get\_code

File "<frozen importlib.\_bootstrap\_external>", line 1074, in get\_data

KeyboardInterrupt

### Restarting the run due to frozen rule (build\_shapes):

* Various attemps were made to stop the run with the command “ctrl+C” however it didn’t work and therefore the terminal was closed and everything was run from the beginning

(base) C:\Windows\system32>cd users

The system cannot find the path specified.

(base) C:\Windows\system32>cd..

(base) C:\Windows>cd..

(base) C:\>cd users

(base) C:\Users>cd lenovo

(base) C:\Users\Lenovo>cd desktop

(base) C:\Users\Lenovo\Desktop>cd pypsa-earth

(base) C:\Users\Lenovo\Desktop\pypsa-earth>conda activate pypsa-earth

(pypsa-earth) C:\Users\Lenovo\Desktop\pypsa-earth>

* A dry-run was made (snakemake -j 1 solve\_all\_networks -n) to see if everything could continue but error measseages appeared in regards of files that were not complete

Set parameter Username

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No parameters matching '\_test' found

Building DAG of jobs...

WARNING:snakemake.logging:Building DAG of jobs...

IncompleteFilesException:

The files below seem to be incomplete. If you are sure that certain files are not incomplete, mark them as complete with

snakemake --cleanup-metadata <filenames>

To re-generate the files rerun your command with the --rerun-incomplete flag.

Incomplete files:

resources/shapes/country\_shapes.geojson

resources/shapes/offshore\_shapes.geojson

resources/shapes/africa\_shape.geojson

resources/shapes/gadm\_shapes.geojson

ERROR:snakemake.logging:IncompleteFilesException:

The files below seem to be incomplete. If you are sure that certain files are not incomplete, mark them as complete with

snakemake --cleanup-metadata <filenames>

To re-generate the files rerun your command with the --rerun-incomplete flag.

Incomplete files:

resources/shapes/country\_shapes.geojson

resources/shapes/offshore\_shapes.geojson

resources/shapes/africa\_shape.geojson

resources/shapes/gadm\_shapes.geojson

### Additional modifications (build\_shapes)

* Because of the messages from the dry-run additional changes were made to the “build\_shapes” script due to the mention of the “africa\_shape.geojon” file. In this file, every mention of africa was replaced by southamerica
* After this, to assure the rerun of rules, the suggested command is used on another dry-run (snakemake -j 1 solve\_all\_networks -n --rerun-incomplete)
* After rules are recognized, the command is run (snakemake -j 1 solve\_all\_networks --rerun-incomplete)
* After a this another error appeard while running the snakemake where the variable “africa\_shape” was being called still and having conflicts with the new “southamerica\_shape”:

INFO:snakemake.logging:

[Thu Feb 16 13:11:03 2023]

INFO:snakemake.logging:[Thu Feb 16 13:11:03 2023]

rule build\_shapes:

input: data/eez/eez\_v11.gpkg

output: resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, resources/shapes/africa\_shape.geojson, resources/shapes/gadm\_shapes.geojson

log: logs/build\_shapes.log

jobid: 12

benchmark: benchmarks/build\_shapes

reason: Missing output files: resources/shapes/offshore\_shapes.geojson, resources/shapes/country\_shapes.geojson, resources/shapes/gadm\_shapes.geojson, resources/shapes/africa\_shape.geojson; Input files updated by another job: data/eez/eez\_v11.gpkg

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=500, mem\_mib=477

INFO:snakemake.logging:rule build\_shapes:

input: data/eez/eez\_v11.gpkg

output: resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, resources/shapes/africa\_shape.geojson, resources/shapes/gadm\_shapes.geojson

log: logs/build\_shapes.log

jobid: 12

benchmark: benchmarks/build\_shapes

reason: Missing output files: resources/shapes/offshore\_shapes.geojson, resources/shapes/country\_shapes.geojson, resources/shapes/gadm\_shapes.geojson, resources/shapes/africa\_shape.geojson; Input files updated by another job: data/eez/eez\_v11.gpkg

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=500, mem\_mib=477

INFO:snakemake.logging:

This is the repository path: C:\Users\Lenovo\Desktop\pypsa-earth

Had to go 0 folder(s) up.

INFO:\_\_main\_\_:Stage 1 of 4: Create country shapes

INFO:\_\_main\_\_:Stage 2 of 4: Create offshore shapes

C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\geopandas\base.py:31: UserWarning: The indices of the two GeoSeries are different.

warn("The indices of the two GeoSeries are different.")

Traceback (most recent call last):

File "C:\Users\Lenovo\Desktop\pypsa-earth\.snakemake\scripts\tmpcd03qbjj.build\_shapes.py", line 918, in <module>

southamerica\_shape.reset\_index().to\_file(snakemake.output.southamerica\_shape)

AttributeError: 'OutputFiles' object has no attribute 'southamerica\_shape'

[Thu Feb 16 13:11:31 2023]

INFO:snakemake.logging:[Thu Feb 16 13:11:31 2023]

Error in rule build\_shapes:

jobid: 12

input: data/eez/eez\_v11.gpkg

output: resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, resources/shapes/africa\_shape.geojson, resources/shapes/gadm\_shapes.geojson

log: logs/build\_shapes.log (check log file(s) for error details)

ERROR:snakemake.logging:Error in rule build\_shapes:

jobid: 12

input: data/eez/eez\_v11.gpkg

output: resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, resources/shapes/africa\_shape.geojson, resources/shapes/gadm\_shapes.geojson

log: logs/build\_shapes.log (check log file(s) for error details)

Removing output files of failed job build\_shapes since they might be corrupted:

resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson

WARNING:snakemake.logging:Removing output files of failed job build\_shapes since they might be corrupted:

resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson

Shutting down, this might take some time.

WARNING:snakemake.logging:Shutting down, this might take some time.

Exiting because a job execution failed. Look above for error message

ERROR:snakemake.logging:Exiting because a job execution failed. Look above for error message

Complete log: .snakemake\log\2023-02-16T125740.267928.snakemake.log

WARNING:snakemake.logging:Complete log: .snakemake\log\2023-02-16T125740.267928.snakemake.log

### Additional modifications of name changing in file “"C:\Users\Lenovo\Desktop\pypsa-earth\.snakemake\scripts\tmpcd03qbjj.build\_shapes.py"

* In this file every instance of “africa” was replaced by “southamerica” to solve the conflict found before
* No changes found so everything was moved to the initial configuration of this file and build\_shapes using the mention of africa in the document.

### Rerun the model since the frozen section

* To allow the model to work, a smaller version of the model was run considering only Bolivia (“BO”) in the config.yaml file
* The model is able to bypass the problem of not allocating enough memory to the files being created a simulation continues until the rule “build\_renewable\_profiles”

INFO:snakemake.logging:

[Thu Feb 16 14:47:36 2023]

INFO:snakemake.logging:[Thu Feb 16 14:47:36 2023]

rule build\_renewable\_profiles:

input: networks/base.nc, resources/natura.tiff, data/copernicus/PROBAV\_LC100\_global\_v3.0.1\_2019-nrt\_Discrete-Classification-map\_EPSG-4326.tif, data/gebco/GEBCO\_2021\_TID.nc, resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, data/hydro\_capacities.csv, data/eia\_hydro\_annual\_generation.csv, resources/powerplants.csv, resources/bus\_regions/regions\_offshore.geojson, cutouts/southamerica-2013-era5.nc

output: resources/renewable\_profiles/profile\_offwind-ac.nc

log: logs/build\_renewable\_profile\_offwind-ac.log

jobid: 18

benchmark: benchmarks/build\_renewable\_profiles\_offwind-ac

reason: Input files updated by another job: resources/natura.tiff, resources/shapes/offshore\_shapes.geojson, cutouts/southamerica-2013-era5.nc, networks/base.nc, resources/bus\_regions/regions\_offshore.geojson, resources/shapes/country\_shapes.geojson, resources/powerplants.csv

wildcards: technology=offwind-ac

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=20000, mem\_mib=19074

INFO:snakemake.logging:rule build\_renewable\_profiles:

input: networks/base.nc, resources/natura.tiff, data/copernicus/PROBAV\_LC100\_global\_v3.0.1\_2019-nrt\_Discrete-Classification-map\_EPSG-4326.tif, data/gebco/GEBCO\_2021\_TID.nc, resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, data/hydro\_capacities.csv, data/eia\_hydro\_annual\_generation.csv, resources/powerplants.csv, resources/bus\_regions/regions\_offshore.geojson, cutouts/southamerica-2013-era5.nc

output: resources/renewable\_profiles/profile\_offwind-ac.nc

log: logs/build\_renewable\_profile\_offwind-ac.log

jobid: 18

benchmark: benchmarks/build\_renewable\_profiles\_offwind-ac

reason: Input files updated by another job: resources/natura.tiff, resources/shapes/offshore\_shapes.geojson, cutouts/southamerica-2013-era5.nc, networks/base.nc, resources/bus\_regions/regions\_offshore.geojson, resources/shapes/country\_shapes.geojson, resources/powerplants.csv

wildcards: technology=offwind-ac

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=20000, mem\_mib=19074

INFO:snakemake.logging:

INFO:\_\_main\_\_:correction\_factor is set as 0.8855

Traceback (most recent call last):

File "C:\Users\Lenovo\Desktop\pypsa-earth\.snakemake\scripts\tmpz0x0lawv.build\_renewable\_profiles.py", line 340, in <module>

assert not regions.empty, (

AssertionError: List of regions in resources/bus\_regions/regions\_offshore.geojson is empty, please disable the corresponding renewable technology

[Thu Feb 16 14:47:43 2023]

INFO:snakemake.logging:[Thu Feb 16 14:47:43 2023]

Error in rule build\_renewable\_profiles:

jobid: 18

input: networks/base.nc, resources/natura.tiff, data/copernicus/PROBAV\_LC100\_global\_v3.0.1\_2019-nrt\_Discrete-Classification-map\_EPSG-4326.tif, data/gebco/GEBCO\_2021\_TID.nc, resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, data/hydro\_capacities.csv, data/eia\_hydro\_annual\_generation.csv, resources/powerplants.csv, resources/bus\_regions/regions\_offshore.geojson, cutouts/southamerica-2013-era5.nc

output: resources/renewable\_profiles/profile\_offwind-ac.nc

log: logs/build\_renewable\_profile\_offwind-ac.log (check log file(s) for error details)

ERROR:snakemake.logging:Error in rule build\_renewable\_profiles:

jobid: 18

input: networks/base.nc, resources/natura.tiff, data/copernicus/PROBAV\_LC100\_global\_v3.0.1\_2019-nrt\_Discrete-Classification-map\_EPSG-4326.tif, data/gebco/GEBCO\_2021\_TID.nc, resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, data/hydro\_capacities.csv, data/eia\_hydro\_annual\_generation.csv, resources/powerplants.csv, resources/bus\_regions/regions\_offshore.geojson, cutouts/southamerica-2013-era5.nc

output: resources/renewable\_profiles/profile\_offwind-ac.nc

log: logs/build\_renewable\_profile\_offwind-ac.log (check log file(s) for error details)

Shutting down, this might take some time.

WARNING:snakemake.logging:Shutting down, this might take some time.

Exiting because a job execution failed. Look above for error message

ERROR:snakemake.logging:Exiting because a job execution failed. Look above for error message

Complete log: .snakemake\log\2023-02-16T135349.399340.snakemake.log

WARNING:snakemake.logging:Complete log: .snakemake\log\2023-02-16T135349.399340.snakemake.log

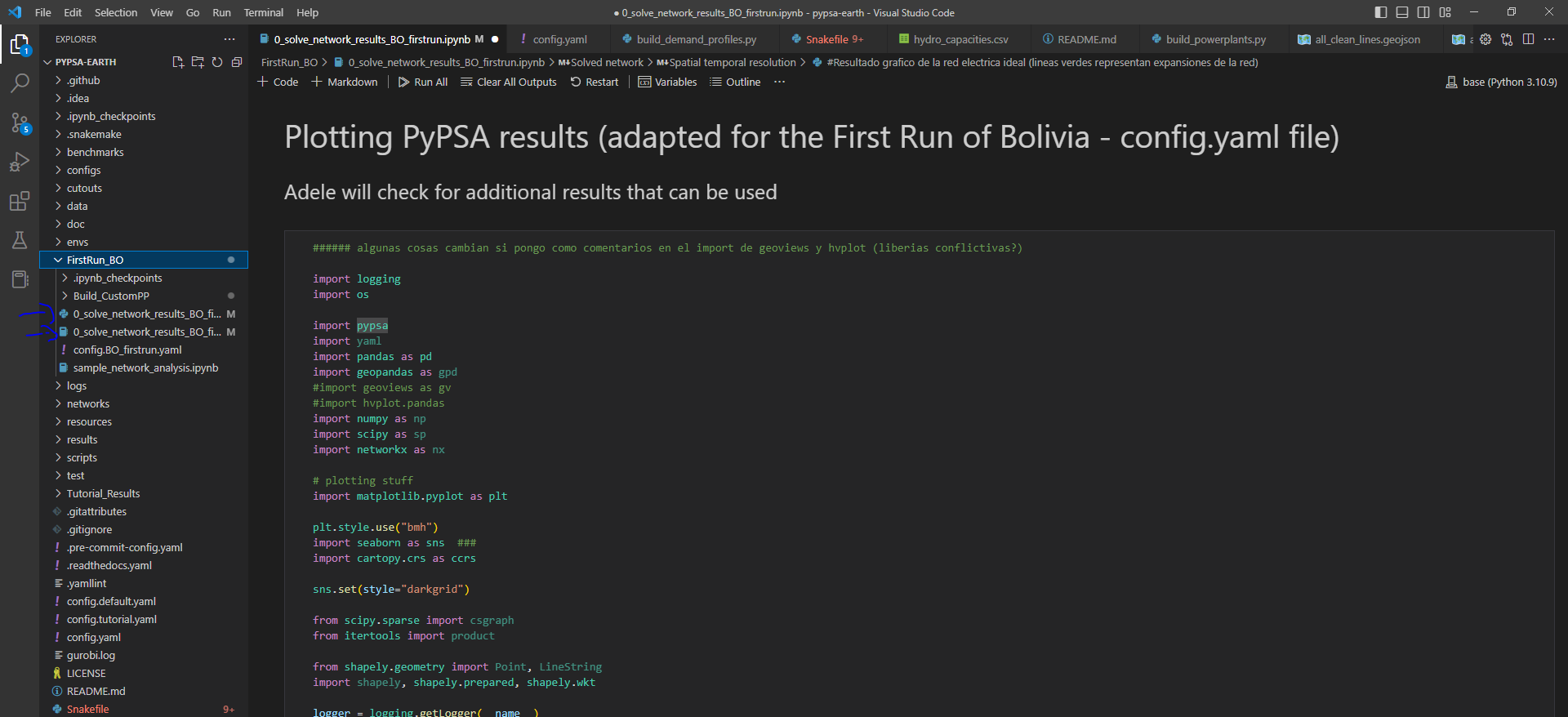
### Disabling offwind-ac and offwind-dc

* Following the suggestion in the error, offwind technologies are being “disabled” in the confing.yaml file by making the lines that are related to the technology with a ## to differentiate them in case they have to be enabled later on
* Mentions of offwind technologies were also removed from directories, dataframes, variables

Model was capable of finishing without any additional complications!!!

### Initial results from the simulation done for Bolivia (config.yaml file)

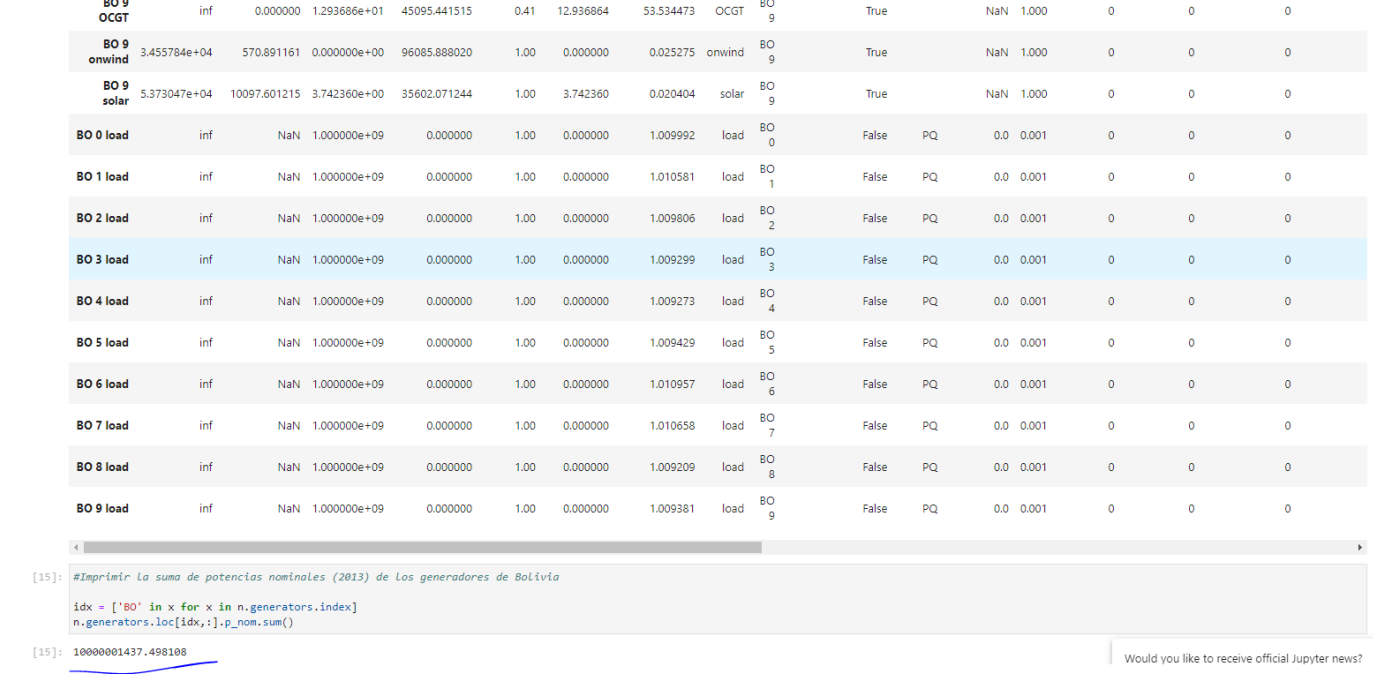
* A print of the entire workflow followed is done by excecuting the following commands in the terminal:
  + snakemake --dag solve\_all\_networks --forceall >workflow.dot (this creates a file with the rules/tasks considered for the run
  + the file created is open and the first 3 lines (warnings and references) are deleted so the file can be read after
  + dot workflow.dot -Tpng -o workflow.png (this creates the graph with the rules/tasks)
* After this, the notebook created to analyze simple outputs from the tutorial is adapted to run for the bolivian case and its stored in a new folder FirstRun\_BO. A version is made to run in VSCode/JupiterLab and Spyder.



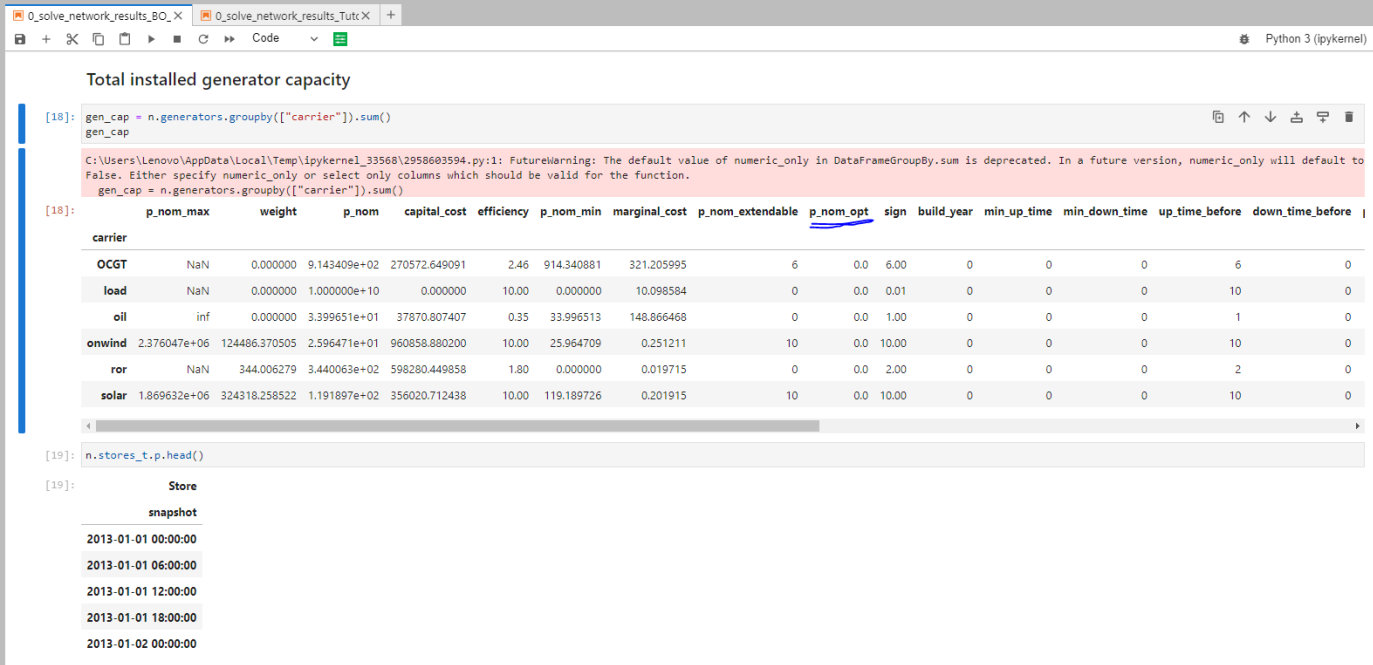
* Results seem off given the type of outputs:
  + here you can see the nan result from the objective function (n.objective) and the constraint value for CO2 emissions (which is really high even though I used the default limits for europe in the config.yaml file (e+7 and e+9)



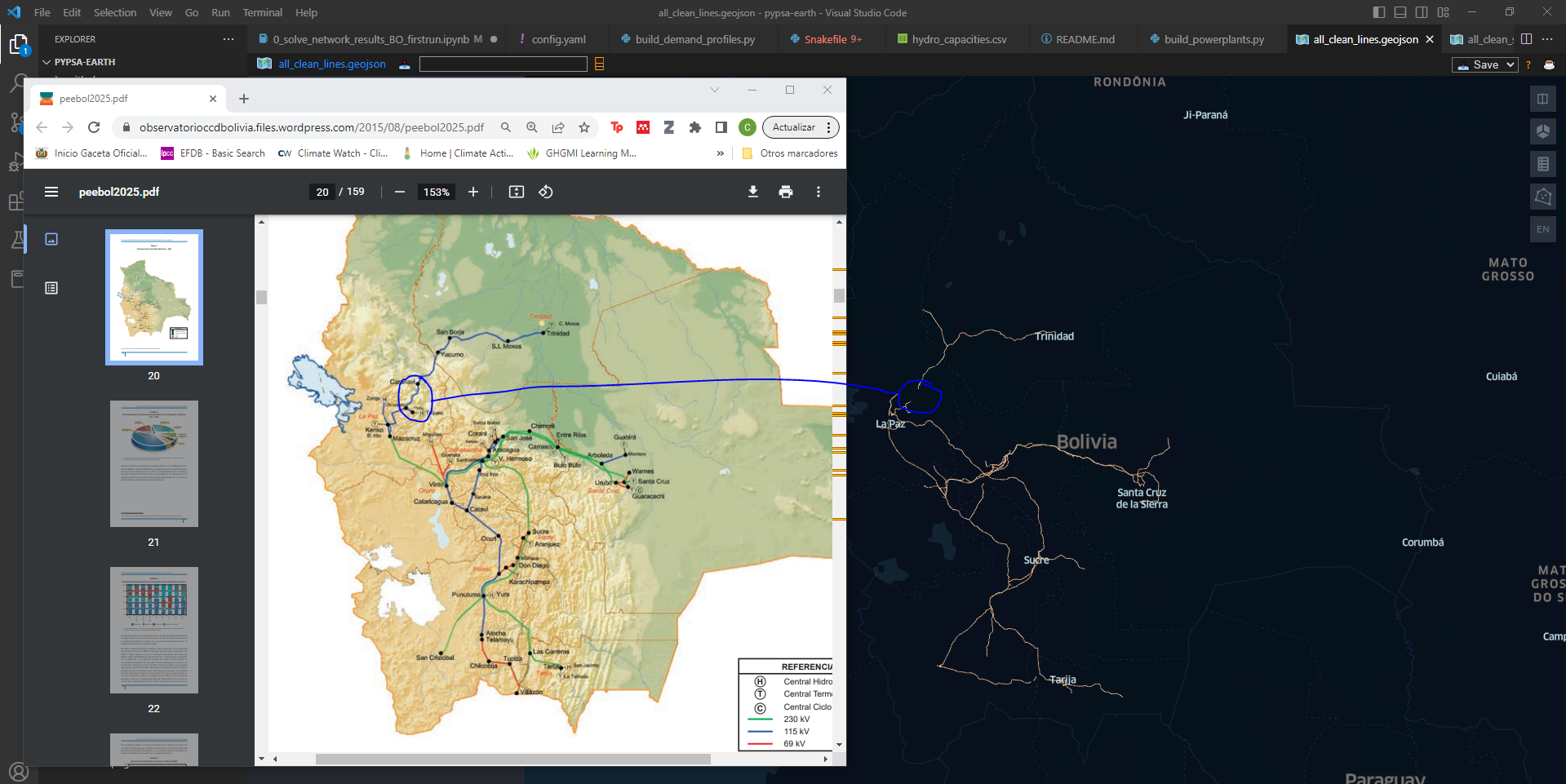
* + here I just printed the generators and the load generators that you mentioned appeared (which solved one of my doubts). However the values for them are quite low (1400 MW compared to the installed capacity of over 3000 in 2020) so I was thinking on using the custom\_powerplants file to improve this characterization. It should be just a matter of producing the csv file with the information listed right?



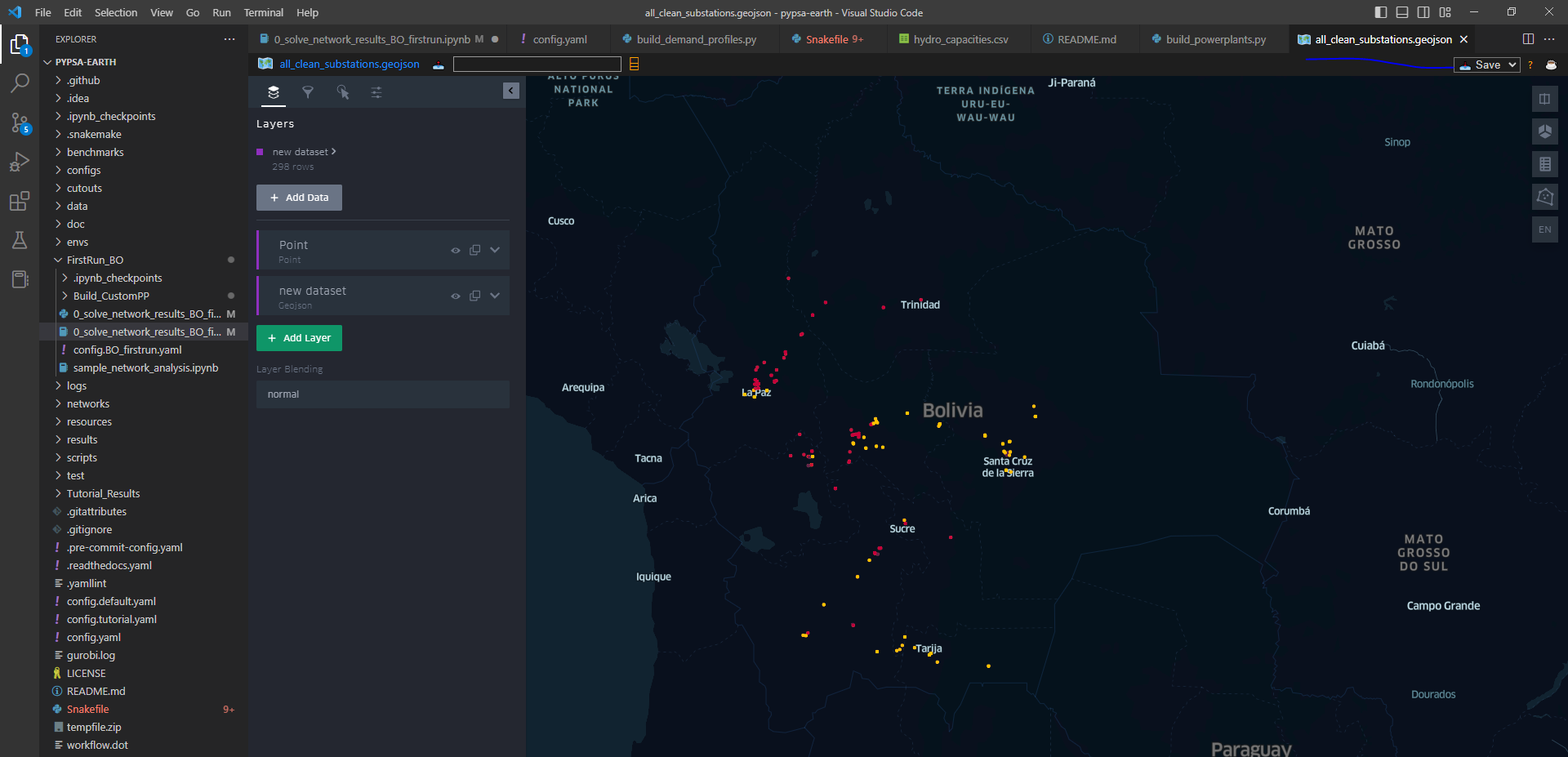
* + Here I tried looking at the total optimized capacity but, again, it seems that something went wrong because no values appear. Additionally, some of the hydropower plants are damn, providing storage capabilities, so I though I could also correct that with build\_powerplants rule and the custom\_powerplants file



* + In VSCode an extension (geo\_map\_viewer) is installed so maps can be read by right cliclinkg the files, and when reviewing the lines considered by pypsa (all\_clean\_lines.geojson) they seem to be missing updated lines infraestructure



* + Substations (all\_clean\_substations.geojson) seem to be well represented



* + But power plants are lacking a proper data base and therefore the next step should be to create a custom\_powerplant.csv file
* Because a lot of errors are found like the optimization is not done, constraints of CO2 emissions are behaving weird, powerplants are lacking representation (and others) a call with pypsa-earth staff is scheduled

### Push to online repository

* An access token was created (regenerated) on github in order to push the changes done so far (<https://docs.github.com/en/authentication/keeping-your-account-and-data-secure/creating-a-personal-access-token>): ghp\_NwwzJw8xM8ndQEJDUu0Afart3HPR6l4RDxdA
* After the pushed was tried on smartgit the following error appeared:

*C:\Users\Lenovo\Desktop\pypsa-earth> git.exe -c "credential.helper=C:/Program\ Files/SmartGit/lib/credentials.cmd" push --porcelain --progress --recurse-submodules=check origin refs/heads/main:refs/heads/main*

failed to push some refs to 'https://github.com/carlosfv92/pypsa-earth-BO.git'

hint: Updates were rejected because the remote contains work that you do

To https://github.com/carlosfv92/pypsa-earth-BO.git

hint: not have locally. This is usually caused by another repository pushing

! refs/heads/main:refs/heads/main [rejected] (fetch first)

Done

hint: to the same ref. You may want to first integrate the remote changes

hint: (e.g., 'git pull ...') before pushing again.

hint: See the 'Note about fast-forwards' in 'git push --help' for details.

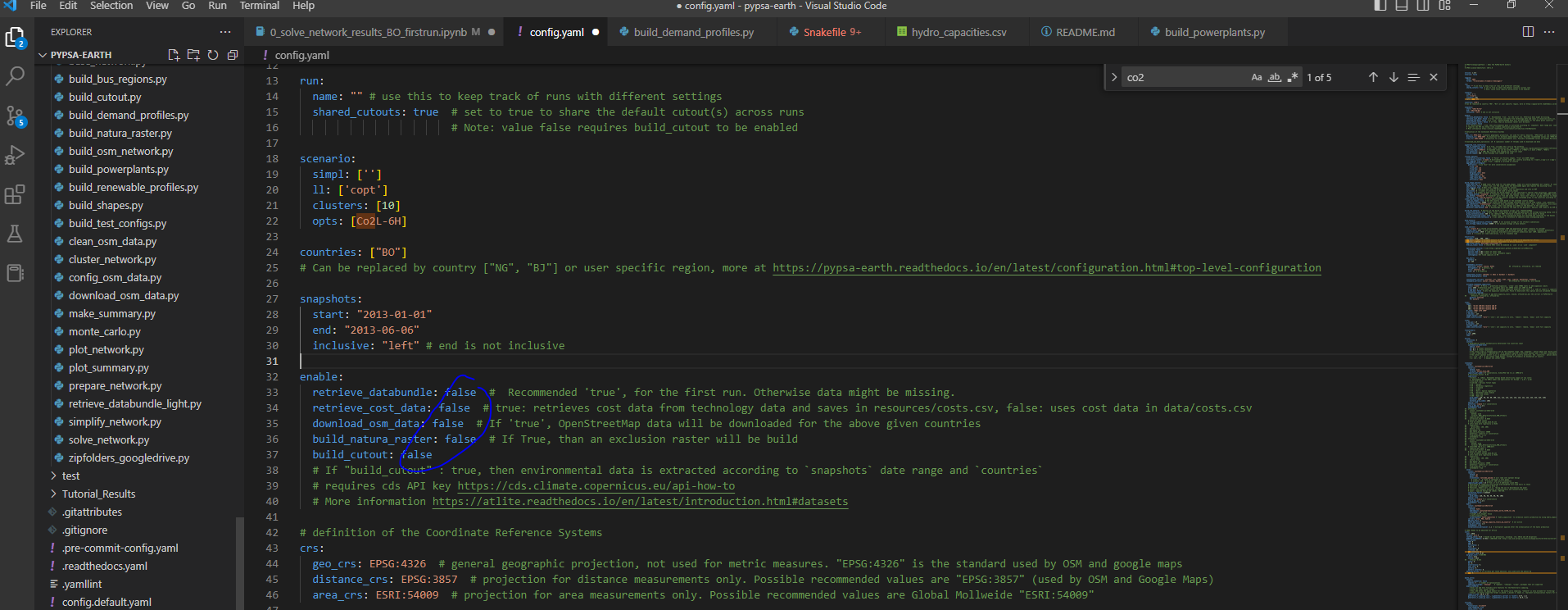
'main' rejected (non-fast-forward)

* To solve it the test1 branch was merged with the main branch and then the push was successful

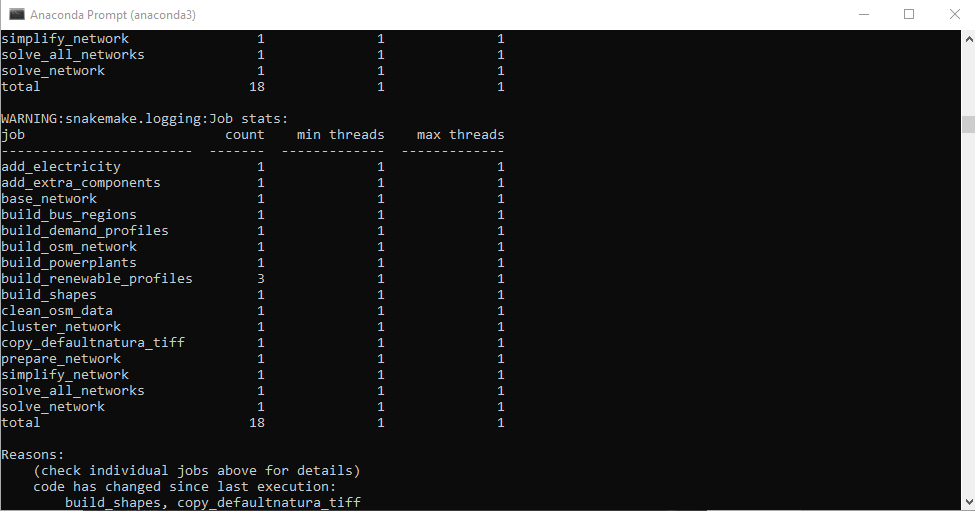
## Troubleshooting and data enrichment for the Bolivian case – Generators

### Restricting functions to avoid unnecessary functions/rules

* To avoid that data is downloaded an additional time and avoid that rules that produced data already available (for the defined scenario), the following rules are disabled changing values from true to false:



* When excecuting a dryrun (snakemake -j 1 solve\_all\_networks -n) in the model 18 rules are considered for a new solving process instead of the 23 rules considered when the total workflow is run (snakemake -j 1 solve\_all\_networks --forceall):



### Rerunning the model a second time

* After this the workflow is run another time using al cores available to allow processing of the model and to avoid the raterio allocation error in rule build\_shapes, all other programs are stopped in the computer.

(pypsa-earth) C:\Users\Lenovo\Desktop\pypsa-earth>snakemake --cores all solve\_all\_networks

Set parameter Username

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No parameters matching '\_test' found

Building DAG of jobs...

WARNING:snakemake.logging:Building DAG of jobs...

Provided cores: 16

WARNING:snakemake.logging:Provided cores: 16

Rules claiming more threads will be scaled down.

WARNING:snakemake.logging:Rules claiming more threads will be scaled down.

Job stats:

job count min threads max threads

------------------------ ------- ------------- -------------

add\_electricity 1 1 1

add\_extra\_components 1 1 1

base\_network 1 1 1

build\_bus\_regions 1 1 1

build\_demand\_profiles 1 1 1

build\_osm\_network 1 1 1

build\_powerplants 1 1 1

build\_renewable\_profiles 3 4 4

build\_shapes 1 1 1

clean\_osm\_data 1 1 1

cluster\_network 1 1 1

prepare\_network 1 1 1

simplify\_network 1 1 1

solve\_all\_networks 1 1 1

solve\_network 1 16 16

total 17 1 16

WARNING:snakemake.logging:Job stats:

job count min threads max threads

------------------------ ------- ------------- -------------

add\_electricity 1 1 1

add\_extra\_components 1 1 1

base\_network 1 1 1

build\_bus\_regions 1 1 1

build\_demand\_profiles 1 1 1

build\_osm\_network 1 1 1

build\_powerplants 1 1 1

build\_renewable\_profiles 3 4 4

build\_shapes 1 1 1

clean\_osm\_data 1 1 1

cluster\_network 1 1 1

prepare\_network 1 1 1

simplify\_network 1 1 1

solve\_all\_networks 1 1 1

solve\_network 1 16 16

total 17 1 16

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Fri Feb 24 09:21:53 2023]

INFO:snakemake.logging:[Fri Feb 24 09:21:53 2023]

rule build\_shapes:

input: data/eez/eez\_v11.gpkg

output: resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, resources/shapes/africa\_shape.geojson, resources/shapes/gadm\_shapes.geojson

log: logs/build\_shapes.log

jobid: 11

benchmark: benchmarks/build\_shapes

reason: Missing output files: resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, resources/shapes/gadm\_shapes.geojson, resources/shapes/africa\_shape.geojson

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=500, mem\_mib=477

INFO:snakemake.logging:rule build\_shapes:

input: data/eez/eez\_v11.gpkg

output: resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, resources/shapes/africa\_shape.geojson, resources/shapes/gadm\_shapes.geojson

log: logs/build\_shapes.log

jobid: 11

benchmark: benchmarks/build\_shapes

reason: Missing output files: resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, resources/shapes/gadm\_shapes.geojson, resources/shapes/africa\_shape.geojson

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=500, mem\_mib=477

INFO:snakemake.logging:

This is the repository path: C:\Users\Lenovo\Desktop\pypsa-earth

Had to go 0 folder(s) up.

INFO:\_\_main\_\_:Stage 1 of 4: Create country shapes

INFO:\_\_main\_\_:Stage 2 of 4: Create offshore shapes

C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\geopandas\base.py:31: UserWarning: The indices of the two GeoSeries are different.

warn("The indices of the two GeoSeries are different.")

C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\geopandas\io\file.py:545: UserWarning: You are attempting to write an empty DataFrame to file. For some drivers, this operation may fail.

\_to\_file\_fiona(df, filename, driver, schema, crs, mode, \*\*kwargs)

INFO:\_\_main\_\_:Stage 4/4: Creation GADM GeoDataFrame

INFO:\_\_main\_\_:Stage 4/4 POP: Add population data to GADM GeoDataFrame

This is the repository path: C:\Users\Lenovo\Desktop\pypsa-earth

Had to go 0 folder(s) up.

This is the repository path: C:\Users\Lenovo\Desktop\pypsa-earth

Had to go 0 folder(s) up.

This is the repository path: C:\Users\Lenovo\Desktop\pypsa-earth

Had to go 0 folder(s) up.

Download WorldPop : 100%|████████████████████████████████████████████████████████| 1/1 [00:00<00:00, 2.95 countries/s]

Compute population : 100%|███████████████████████████████████████████████████████████████| 3/3 [00:24<00:00, 8.22s/it]

INFO:\_\_main\_\_:Stage 4/4: Add gdp data to GADM GeoDataFrame

INFO:\_\_main\_\_:Stage 4/4: Access to GDP raster data

WARNING:\_\_main\_\_:Stage 4/4: File GDP\_PPP\_1990\_2015\_5arcmin\_v2.tif not found, the file will be produced by processing GDP\_PPP\_1990\_2015\_5arcmin\_v2.nc

INFO:\_\_main\_\_:Stage 4/4: Access to GDP raster data

WARNING:\_\_main\_\_:Stage 3/4 GDP data of year False not found, selected the most recent data (2015)

Compute GDP : 100%|█████████████████████████████████████████████████████████████| 9/9 [00:01<00:00, 5.27 geometries/s]

Benchmark: unable to collect cpu and memory benchmark statistics

CRITICAL:snakemake.logging:Benchmark: unable to collect cpu and memory benchmark statistics

[Fri Feb 24 09:23:01 2023]

INFO:snakemake.logging:[Fri Feb 24 09:23:01 2023]

Finished job 11.

INFO:snakemake.logging:Finished job 11.

1 of 17 steps (6%) done

INFO:snakemake.logging:1 of 17 steps (6%) done

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Fri Feb 24 09:23:01 2023]

INFO:snakemake.logging:[Fri Feb 24 09:23:01 2023]

rule clean\_osm\_data:

input: resources/osm/raw/all\_raw\_cables.geojson, resources/osm/raw/all\_raw\_generators.geojson, resources/osm/raw/all\_raw\_lines.geojson, resources/osm/raw/all\_raw\_substations.geojson, resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, resources/shapes/africa\_shape.geojson

output: resources/osm/clean/all\_clean\_generators.geojson, resources/osm/clean/all\_clean\_generators.csv, resources/osm/clean/all\_clean\_lines.geojson, resources/osm/clean/all\_clean\_substations.geojson

log: logs/clean\_osm\_data.log

jobid: 10

benchmark: benchmarks/clean\_osm\_data

reason: Input files updated by another job: resources/shapes/africa\_shape.geojson, resources/shapes/offshore\_shapes.geojson, resources/shapes/country\_shapes.geojson; Code has changed since last execution

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp

INFO:snakemake.logging:rule clean\_osm\_data:

input: resources/osm/raw/all\_raw\_cables.geojson, resources/osm/raw/all\_raw\_generators.geojson, resources/osm/raw/all\_raw\_lines.geojson, resources/osm/raw/all\_raw\_substations.geojson, resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, resources/shapes/africa\_shape.geojson

output: resources/osm/clean/all\_clean\_generators.geojson, resources/osm/clean/all\_clean\_generators.csv, resources/osm/clean/all\_clean\_lines.geojson, resources/osm/clean/all\_clean\_substations.geojson

log: logs/clean\_osm\_data.log

jobid: 10

benchmark: benchmarks/clean\_osm\_data

reason: Input files updated by another job: resources/shapes/africa\_shape.geojson, resources/shapes/offshore\_shapes.geojson, resources/shapes/country\_shapes.geojson; Code has changed since last execution

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp

INFO:snakemake.logging:

Benchmark: unable to collect cpu and memory benchmark statistics

CRITICAL:snakemake.logging:Benchmark: unable to collect cpu and memory benchmark statistics

[Fri Feb 24 09:23:15 2023]

INFO:snakemake.logging:[Fri Feb 24 09:23:15 2023]

Finished job 10.

INFO:snakemake.logging:Finished job 10.

2 of 17 steps (12%) done

INFO:snakemake.logging:2 of 17 steps (12%) done

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Fri Feb 24 09:23:15 2023]

INFO:snakemake.logging:[Fri Feb 24 09:23:15 2023]

rule build\_osm\_network:

input: resources/osm/clean/all\_clean\_generators.geojson, resources/osm/clean/all\_clean\_lines.geojson, resources/osm/clean/all\_clean\_substations.geojson, resources/shapes/country\_shapes.geojson

output: resources/base\_network/all\_lines\_build\_network.csv, resources/base\_network/all\_converters\_build\_network.csv, resources/base\_network/all\_transformers\_build\_network.csv, resources/base\_network/all\_buses\_build\_network.csv

log: logs/build\_osm\_network.log

jobid: 9

benchmark: benchmarks/build\_osm\_network

reason: Input files updated by another job: resources/osm/clean/all\_clean\_substations.geojson, resources/osm/clean/all\_clean\_generators.geojson, resources/shapes/country\_shapes.geojson, resources/osm/clean/all\_clean\_lines.geojson

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp

INFO:snakemake.logging:rule build\_osm\_network:

input: resources/osm/clean/all\_clean\_generators.geojson, resources/osm/clean/all\_clean\_lines.geojson, resources/osm/clean/all\_clean\_substations.geojson, resources/shapes/country\_shapes.geojson

output: resources/base\_network/all\_lines\_build\_network.csv, resources/base\_network/all\_converters\_build\_network.csv, resources/base\_network/all\_transformers\_build\_network.csv, resources/base\_network/all\_buses\_build\_network.csv

log: logs/build\_osm\_network.log

jobid: 9

benchmark: benchmarks/build\_osm\_network

reason: Input files updated by another job: resources/osm/clean/all\_clean\_substations.geojson, resources/osm/clean/all\_clean\_generators.geojson, resources/shapes/country\_shapes.geojson, resources/osm/clean/all\_clean\_lines.geojson

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp

INFO:snakemake.logging:

This is the repository path: C:\Users\Lenovo\Desktop\pypsa-earth

Had to go 0 folder(s) up.

INFO:\_\_main\_\_:Stage 1/5: Read input data

INFO:\_\_main\_\_:Stage 2/5: Add line endings to the substation datasets

INFO:\_\_main\_\_:Stage 3/5: Avoid nodes overpassing lines: enabled with tolerance

Verify lines overpassing nodes : 100%|███████████████████████████████████████████| 149/149 [00:01<00:00, 98.11 lines/s]

INFO:\_\_main\_\_:Stage 4/5: Aggregate close substations: enabled with tolerance 500 m

INFO:\_\_main\_\_:Stage 3a/4: Set substation ids with tolerance of 0.50 km

Set substation ids : 100%|█████████████████████████████████████████████████████| 596/596 [00:00<00:00, 2907.65 buses/s]

INFO:\_\_main\_\_:Stage 3b/4: Merge substations with the same id

INFO:\_\_main\_\_:Stage 3c/4: Specify the bus ids of the line endings

Set line bus ids : 100%|████████████████████████████████████████████████████████| 152/152 [00:00<00:00, 222.12 lines/s]

INFO:\_\_main\_\_:Stage 3d/4: Add converters to lines

INFO:\_\_main\_\_:Stage 5/5: Add augmented substation to country with no data

INFO:\_\_main\_\_:Save outputs

Benchmark: unable to collect cpu and memory benchmark statistics

CRITICAL:snakemake.logging:Benchmark: unable to collect cpu and memory benchmark statistics

[Fri Feb 24 09:23:22 2023]

INFO:snakemake.logging:[Fri Feb 24 09:23:22 2023]

Finished job 9.

INFO:snakemake.logging:Finished job 9.

3 of 17 steps (18%) done

INFO:snakemake.logging:3 of 17 steps (18%) done

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Fri Feb 24 09:23:22 2023]

INFO:snakemake.logging:[Fri Feb 24 09:23:22 2023]

rule base\_network:

input: resources/base\_network/all\_buses\_build\_network.csv, resources/base\_network/all\_lines\_build\_network.csv, resources/base\_network/all\_converters\_build\_network.csv, resources/base\_network/all\_transformers\_build\_network.csv, resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson

output: networks/base.nc

log: logs/base\_network.log

jobid: 8

benchmark: benchmarks/base\_network

reason: Input files updated by another job: resources/base\_network/all\_buses\_build\_network.csv, resources/base\_network/all\_transformers\_build\_network.csv, resources/base\_network/all\_lines\_build\_network.csv, resources/shapes/offshore\_shapes.geojson, resources/base\_network/all\_converters\_build\_network.csv, resources/shapes/country\_shapes.geojson

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=500, mem\_mib=477

INFO:snakemake.logging:rule base\_network:

input: resources/base\_network/all\_buses\_build\_network.csv, resources/base\_network/all\_lines\_build\_network.csv, resources/base\_network/all\_converters\_build\_network.csv, resources/base\_network/all\_transformers\_build\_network.csv, resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson

output: networks/base.nc

log: logs/base\_network.log

jobid: 8

benchmark: benchmarks/base\_network

reason: Input files updated by another job: resources/base\_network/all\_buses\_build\_network.csv, resources/base\_network/all\_transformers\_build\_network.csv, resources/base\_network/all\_lines\_build\_network.csv, resources/shapes/offshore\_shapes.geojson, resources/base\_network/all\_converters\_build\_network.csv, resources/shapes/country\_shapes.geojson

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=500, mem\_mib=477

INFO:snakemake.logging:

INFO:\_\_main\_\_:Removing buses with voltages Float64Index([], dtype='float64')

C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\shapely\predicates.py:946: RuntimeWarning: invalid value encountered in within

return lib.within(a, b, \*\*kwargs)

INFO:pypsa.io:Exported network base.nc has buses, lines, transformers

Benchmark: unable to collect cpu and memory benchmark statistics

CRITICAL:snakemake.logging:Benchmark: unable to collect cpu and memory benchmark statistics

[Fri Feb 24 09:23:31 2023]

INFO:snakemake.logging:[Fri Feb 24 09:23:31 2023]

Finished job 8.

INFO:snakemake.logging:Finished job 8.

4 of 17 steps (24%) done

INFO:snakemake.logging:4 of 17 steps (24%) done

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Fri Feb 24 09:23:31 2023]

INFO:snakemake.logging:[Fri Feb 24 09:23:31 2023]

rule build\_bus\_regions:

input: resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, networks/base.nc, resources/shapes/gadm\_shapes.geojson

output: resources/bus\_regions/regions\_onshore.geojson, resources/bus\_regions/regions\_offshore.geojson

log: logs/build\_bus\_regions.log

jobid: 14

benchmark: benchmarks/build\_bus\_regions

reason: Input files updated by another job: networks/base.nc, resources/shapes/offshore\_shapes.geojson, resources/shapes/gadm\_shapes.geojson, resources/shapes/country\_shapes.geojson

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=1000, mem\_mib=954

INFO:snakemake.logging:rule build\_bus\_regions:

input: resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, networks/base.nc, resources/shapes/gadm\_shapes.geojson

output: resources/bus\_regions/regions\_onshore.geojson, resources/bus\_regions/regions\_offshore.geojson

log: logs/build\_bus\_regions.log

jobid: 14

benchmark: benchmarks/build\_bus\_regions

reason: Input files updated by another job: networks/base.nc, resources/shapes/offshore\_shapes.geojson, resources/shapes/gadm\_shapes.geojson, resources/shapes/country\_shapes.geojson

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=1000, mem\_mib=954

INFO:snakemake.logging:

[Fri Feb 24 09:23:31 2023]

INFO:snakemake.logging:[Fri Feb 24 09:23:31 2023]

rule build\_powerplants:

input: networks/base.nc, configs/powerplantmatching\_config.yaml, data/custom\_powerplants.csv, resources/osm/clean/all\_clean\_generators.csv, resources/shapes/gadm\_shapes.geojson

output: resources/powerplants.csv, resources/powerplants\_osm2pm.csv

log: logs/build\_powerplants.log

jobid: 13

benchmark: benchmarks/build\_powerplants

reason: Input files updated by another job: networks/base.nc, resources/shapes/gadm\_shapes.geojson, resources/osm/clean/all\_clean\_generators.csv

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=500, mem\_mib=477

INFO:snakemake.logging:rule build\_powerplants:

input: networks/base.nc, configs/powerplantmatching\_config.yaml, data/custom\_powerplants.csv, resources/osm/clean/all\_clean\_generators.csv, resources/shapes/gadm\_shapes.geojson

output: resources/powerplants.csv, resources/powerplants\_osm2pm.csv

log: logs/build\_powerplants.log

jobid: 13

benchmark: benchmarks/build\_powerplants

reason: Input files updated by another job: networks/base.nc, resources/shapes/gadm\_shapes.geojson, resources/osm/clean/all\_clean\_generators.csv

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=500, mem\_mib=477

INFO:snakemake.logging:

This is the repository path: C:\Users\Lenovo\Desktop\pypsa-earth

Had to go 0 folder(s) up.

INFO:pypsa.io:Imported network base.nc has buses, lines, transformers

WARNING:\_\_main\_\_:No off-shore shapes for BO

C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\geopandas\io\file.py:545: UserWarning: You are attempting to write an empty DataFrame to file. For some drivers, this operation may fail.

\_to\_file\_fiona(df, filename, driver, schema, crs, mode, \*\*kwargs)

Benchmark: unable to collect cpu and memory benchmark statistics

CRITICAL:snakemake.logging:Benchmark: unable to collect cpu and memory benchmark statistics

[Fri Feb 24 09:23:40 2023]

INFO:snakemake.logging:[Fri Feb 24 09:23:40 2023]

Finished job 14.

INFO:snakemake.logging:Finished job 14.

5 of 17 steps (29%) done

INFO:snakemake.logging:5 of 17 steps (29%) done

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Fri Feb 24 09:23:40 2023]

INFO:snakemake.logging:[Fri Feb 24 09:23:40 2023]

rule build\_demand\_profiles:

input: networks/base.nc, resources/bus\_regions/regions\_onshore.geojson, data/ssp2-2.6/2030/era5\_2013/SouthAmerica.nc, resources/shapes/gadm\_shapes.geojson

output: resources/demand\_profiles.csv

log: logs/build\_demand\_profiles.log

jobid: 17

benchmark: benchmarks/build\_demand\_profiles

reason: Missing output files: resources/demand\_profiles.csv; Input files updated by another job: networks/base.nc, resources/shapes/gadm\_shapes.geojson, resources/bus\_regions/regions\_onshore.geojson

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=3000, mem\_mib=2862

INFO:snakemake.logging:rule build\_demand\_profiles:

input: networks/base.nc, resources/bus\_regions/regions\_onshore.geojson, data/ssp2-2.6/2030/era5\_2013/SouthAmerica.nc, resources/shapes/gadm\_shapes.geojson

output: resources/demand\_profiles.csv

log: logs/build\_demand\_profiles.log

jobid: 17

benchmark: benchmarks/build\_demand\_profiles

reason: Missing output files: resources/demand\_profiles.csv; Input files updated by another job: networks/base.nc, resources/shapes/gadm\_shapes.geojson, resources/bus\_regions/regions\_onshore.geojson

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=3000, mem\_mib=2862

INFO:snakemake.logging:

INFO:pypsa.io:Imported network base.nc has buses, lines, transformers

INFO:powerplantmatching.collection:Create combined dataset for GEO, GPD

INFO:powerplantmatching.cleaning:Aggregating blocks in data source 'GEO'.

INFO:powerplantmatching.cleaning:Aggregating blocks in data source 'GPD'.

INFO:pypsa.io:Imported network base.nc has buses, lines, transformers

INFO:powerplantmatching.matching:Comparing data sources `GEO` and `GPD`

INFO:\_\_main\_\_:Load data scaled with scaling factor 1.

WARNING:powerplantmatching.matching:No matches found

INFO:\_\_main\_\_:Demand\_profiles csv file created for the corrisponding snapshots.

Benchmark: unable to collect cpu and memory benchmark statistics

CRITICAL:snakemake.logging:Benchmark: unable to collect cpu and memory benchmark statistics

[Fri Feb 24 09:23:56 2023]

INFO:snakemake.logging:[Fri Feb 24 09:23:56 2023]

Finished job 17.

INFO:snakemake.logging:Finished job 17.

6 of 17 steps (35%) done

INFO:snakemake.logging:6 of 17 steps (35%) done

INFO:powerplantmatching.cleaning:Aggregating blocks in data source 'GEO'.

INFO:powerplantmatching.cleaning:Aggregating blocks in data source 'GPD'.

INFO:powerplantmatching.core:Adding stored geo-position from C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\powerplantmatching\package\_data\parsed\_locations.csv

Benchmark: unable to collect cpu and memory benchmark statistics

CRITICAL:snakemake.logging:Benchmark: unable to collect cpu and memory benchmark statistics

[Fri Feb 24 09:24:01 2023]

INFO:snakemake.logging:[Fri Feb 24 09:24:01 2023]

Finished job 13.

INFO:snakemake.logging:Finished job 13.

7 of 17 steps (41%) done

INFO:snakemake.logging:7 of 17 steps (41%) done

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Fri Feb 24 09:24:01 2023]

INFO:snakemake.logging:[Fri Feb 24 09:24:01 2023]

rule build\_renewable\_profiles:

input: networks/base.nc, resources/natura.tiff, data/copernicus/PROBAV\_LC100\_global\_v3.0.1\_2019-nrt\_Discrete-Classification-map\_EPSG-4326.tif, data/gebco/GEBCO\_2021\_TID.nc, resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, data/hydro\_capacities.csv, data/eia\_hydro\_annual\_generation.csv, resources/powerplants.csv, resources/bus\_regions/regions\_onshore.geojson, cutouts/southamerica-2013-era5.nc

output: resources/renewable\_profiles/profile\_solar.nc

log: logs/build\_renewable\_profile\_solar.log

jobid: 15

benchmark: benchmarks/build\_renewable\_profiles\_solar

reason: Input files updated by another job: resources/bus\_regions/regions\_onshore.geojson, resources/shapes/offshore\_shapes.geojson, resources/powerplants.csv, networks/base.nc, resources/shapes/country\_shapes.geojson

wildcards: technology=solar

threads: 4

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=20000, mem\_mib=19074

INFO:snakemake.logging:rule build\_renewable\_profiles:

input: networks/base.nc, resources/natura.tiff, data/copernicus/PROBAV\_LC100\_global\_v3.0.1\_2019-nrt\_Discrete-Classification-map\_EPSG-4326.tif, data/gebco/GEBCO\_2021\_TID.nc, resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, data/hydro\_capacities.csv, data/eia\_hydro\_annual\_generation.csv, resources/powerplants.csv, resources/bus\_regions/regions\_onshore.geojson, cutouts/southamerica-2013-era5.nc

output: resources/renewable\_profiles/profile\_solar.nc

log: logs/build\_renewable\_profile\_solar.log

jobid: 15

benchmark: benchmarks/build\_renewable\_profiles\_solar

reason: Input files updated by another job: resources/bus\_regions/regions\_onshore.geojson, resources/shapes/offshore\_shapes.geojson, resources/powerplants.csv, networks/base.nc, resources/shapes/country\_shapes.geojson

wildcards: technology=solar

threads: 4

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=20000, mem\_mib=19074

INFO:snakemake.logging:

[Fri Feb 24 09:24:01 2023]

INFO:snakemake.logging:[Fri Feb 24 09:24:01 2023]

rule build\_renewable\_profiles:

input: networks/base.nc, resources/natura.tiff, data/copernicus/PROBAV\_LC100\_global\_v3.0.1\_2019-nrt\_Discrete-Classification-map\_EPSG-4326.tif, data/gebco/GEBCO\_2021\_TID.nc, resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, data/hydro\_capacities.csv, data/eia\_hydro\_annual\_generation.csv, resources/powerplants.csv, resources/bus\_regions/regions\_onshore.geojson, cutouts/southamerica-2013-era5.nc

output: resources/renewable\_profiles/profile\_hydro.nc

log: logs/build\_renewable\_profile\_hydro.log

jobid: 16

benchmark: benchmarks/build\_renewable\_profiles\_hydro

reason: Input files updated by another job: resources/bus\_regions/regions\_onshore.geojson, resources/shapes/offshore\_shapes.geojson, resources/powerplants.csv, networks/base.nc, resources/shapes/country\_shapes.geojson

wildcards: technology=hydro

threads: 4

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=20000, mem\_mib=19074

INFO:snakemake.logging:rule build\_renewable\_profiles:

input: networks/base.nc, resources/natura.tiff, data/copernicus/PROBAV\_LC100\_global\_v3.0.1\_2019-nrt\_Discrete-Classification-map\_EPSG-4326.tif, data/gebco/GEBCO\_2021\_TID.nc, resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, data/hydro\_capacities.csv, data/eia\_hydro\_annual\_generation.csv, resources/powerplants.csv, resources/bus\_regions/regions\_onshore.geojson, cutouts/southamerica-2013-era5.nc

output: resources/renewable\_profiles/profile\_hydro.nc

log: logs/build\_renewable\_profile\_hydro.log

jobid: 16

benchmark: benchmarks/build\_renewable\_profiles\_hydro

reason: Input files updated by another job: resources/bus\_regions/regions\_onshore.geojson, resources/shapes/offshore\_shapes.geojson, resources/powerplants.csv, networks/base.nc, resources/shapes/country\_shapes.geojson

wildcards: technology=hydro

threads: 4

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=20000, mem\_mib=19074

INFO:snakemake.logging:

[Fri Feb 24 09:24:01 2023]

INFO:snakemake.logging:[Fri Feb 24 09:24:01 2023]

rule build\_renewable\_profiles:

input: networks/base.nc, resources/natura.tiff, data/copernicus/PROBAV\_LC100\_global\_v3.0.1\_2019-nrt\_Discrete-Classification-map\_EPSG-4326.tif, data/gebco/GEBCO\_2021\_TID.nc, resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, data/hydro\_capacities.csv, data/eia\_hydro\_annual\_generation.csv, resources/powerplants.csv, resources/bus\_regions/regions\_onshore.geojson, cutouts/southamerica-2013-era5.nc

output: resources/renewable\_profiles/profile\_onwind.nc

log: logs/build\_renewable\_profile\_onwind.log

jobid: 7

benchmark: benchmarks/build\_renewable\_profiles\_onwind

reason: Input files updated by another job: resources/bus\_regions/regions\_onshore.geojson, resources/shapes/offshore\_shapes.geojson, resources/powerplants.csv, networks/base.nc, resources/shapes/country\_shapes.geojson

wildcards: technology=onwind

threads: 4

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=20000, mem\_mib=19074

INFO:snakemake.logging:rule build\_renewable\_profiles:

input: networks/base.nc, resources/natura.tiff, data/copernicus/PROBAV\_LC100\_global\_v3.0.1\_2019-nrt\_Discrete-Classification-map\_EPSG-4326.tif, data/gebco/GEBCO\_2021\_TID.nc, resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, data/hydro\_capacities.csv, data/eia\_hydro\_annual\_generation.csv, resources/powerplants.csv, resources/bus\_regions/regions\_onshore.geojson, cutouts/southamerica-2013-era5.nc

output: resources/renewable\_profiles/profile\_onwind.nc

log: logs/build\_renewable\_profile\_onwind.log

jobid: 7

benchmark: benchmarks/build\_renewable\_profiles\_onwind

reason: Input files updated by another job: resources/bus\_regions/regions\_onshore.geojson, resources/shapes/offshore\_shapes.geojson, resources/powerplants.csv, networks/base.nc, resources/shapes/country\_shapes.geojson

wildcards: technology=onwind

threads: 4

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=20000, mem\_mib=19074

INFO:snakemake.logging:

INFO:\_\_main\_\_:correction\_factor is set as 0.854337

INFO:\_\_main\_\_:Calculate landuse availabilities...

INFO:\_\_main\_\_:Calculate landuse availabilities...

INFO:\_\_main\_\_:Hydro normalization mode hydro\_capacities

INFO:\_\_main\_\_:Completed availability calculation (69.31s)

INFO:atlite.convert:Convert and aggregate 'pv'.

[########################################] | 100% Completed | 2.32 s

INFO:atlite.convert:Convert and aggregate 'pv'.

INFO:\_\_main\_\_:Calculating maximal capacity per bus (method 'simple')

INFO:\_\_main\_\_:Calculate average distances.

Benchmark: unable to collect cpu and memory benchmark statistics

CRITICAL:snakemake.logging:Benchmark: unable to collect cpu and memory benchmark statistics

[Fri Feb 24 09:25:27 2023]

INFO:snakemake.logging:[Fri Feb 24 09:25:27 2023]

Finished job 15.

INFO:snakemake.logging:Finished job 15.

8 of 17 steps (47%) done

INFO:snakemake.logging:8 of 17 steps (47%) done

INFO:\_\_main\_\_:Completed availability calculation (79.15s)

INFO:atlite.convert:Convert and aggregate 'wind'.

INFO:atlite.convert:Convert and aggregate 'wind'.

INFO:\_\_main\_\_:Calculating maximal capacity per bus (method 'simple')

INFO:\_\_main\_\_:Calculate average distances.

Benchmark: unable to collect cpu and memory benchmark statistics

CRITICAL:snakemake.logging:Benchmark: unable to collect cpu and memory benchmark statistics

[Fri Feb 24 09:25:32 2023]

INFO:snakemake.logging:[Fri Feb 24 09:25:32 2023]

Finished job 7.

INFO:snakemake.logging:Finished job 7.

9 of 17 steps (53%) done

INFO:snakemake.logging:9 of 17 steps (53%) done

Determine upstream basins per plant: 112it [00:00, 229.34it/s]

INFO:atlite.convert:Convert and aggregate 'runoff'.

Shift and aggregate runoff by plant: 112it [00:00, 186.02it/s]

C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\atlite\convert.py:876: RuntimeWarning: invalid value encountered in double\_scalars

default\_factor = tot\_common\_yearly / tot\_common\_runoff

WARNING:atlite.convert:Missing countries in the normalization dataframe: BO. Default value used

Benchmark: unable to collect cpu and memory benchmark statistics

CRITICAL:snakemake.logging:Benchmark: unable to collect cpu and memory benchmark statistics

[Fri Feb 24 09:25:36 2023]

INFO:snakemake.logging:[Fri Feb 24 09:25:36 2023]

Finished job 16.

INFO:snakemake.logging:Finished job 16.

10 of 17 steps (59%) done

INFO:snakemake.logging:10 of 17 steps (59%) done

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Fri Feb 24 09:25:37 2023]

INFO:snakemake.logging:[Fri Feb 24 09:25:37 2023]

rule add\_electricity:

input: resources/renewable\_profiles/profile\_onwind.nc, resources/renewable\_profiles/profile\_solar.nc, resources/renewable\_profiles/profile\_hydro.nc, networks/base.nc, data/costs.csv, resources/powerplants.csv, resources/shapes/gadm\_shapes.geojson, data/hydro\_capacities.csv, resources/demand\_profiles.csv

output: networks/elec.nc

log: logs/add\_electricity.log

jobid: 6

benchmark: benchmarks/add\_electricity

reason: Input files updated by another job: resources/renewable\_profiles/profile\_solar.nc, resources/shapes/gadm\_shapes.geojson, resources/demand\_profiles.csv, resources/powerplants.csv, networks/base.nc, resources/renewable\_profiles/profile\_hydro.nc, resources/renewable\_profiles/profile\_onwind.nc

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=3000, mem\_mib=2862

INFO:snakemake.logging:rule add\_electricity:

input: resources/renewable\_profiles/profile\_onwind.nc, resources/renewable\_profiles/profile\_solar.nc, resources/renewable\_profiles/profile\_hydro.nc, networks/base.nc, data/costs.csv, resources/powerplants.csv, resources/shapes/gadm\_shapes.geojson, data/hydro\_capacities.csv, resources/demand\_profiles.csv

output: networks/elec.nc

log: logs/add\_electricity.log

jobid: 6

benchmark: benchmarks/add\_electricity

reason: Input files updated by another job: resources/renewable\_profiles/profile\_solar.nc, resources/shapes/gadm\_shapes.geojson, resources/demand\_profiles.csv, resources/powerplants.csv, networks/base.nc, resources/renewable\_profiles/profile\_hydro.nc, resources/renewable\_profiles/profile\_onwind.nc

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=3000, mem\_mib=2862

INFO:snakemake.logging:

INFO:pypsa.io:Imported network base.nc has buses, lines, transformers

INFO:\_\_main\_\_:Adding 9 generators with capacities [GW]

carrier

OCGT 0.91

oil 0.03

Name: p\_nom, dtype: float64

WARNING:\_\_main\_\_:Assuming max\_hours=6 for hydro reservoirs in the countries: BO

INFO:\_\_main\_\_:Heuristics applied to distribute renewable capacities [MW] Country

BO 147.32

Name: Capacity, dtype: float64

INFO:\_\_main\_\_:Scaling capacity stats to 100.00% of installed capacity acquired from stats.

INFO:\_\_main\_\_:Scaling capacity stats to 100.00% of installed capacity acquired from stats.

INFO:pypsa.io:Exported network elec.nc has carriers, loads, storage\_units, buses, lines, transformers, generators

Benchmark: unable to collect cpu and memory benchmark statistics

CRITICAL:snakemake.logging:Benchmark: unable to collect cpu and memory benchmark statistics

[Fri Feb 24 09:25:54 2023]

INFO:snakemake.logging:[Fri Feb 24 09:25:54 2023]

Finished job 6.

INFO:snakemake.logging:Finished job 6.

11 of 17 steps (65%) done

INFO:snakemake.logging:11 of 17 steps (65%) done

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Fri Feb 24 09:25:54 2023]

INFO:snakemake.logging:[Fri Feb 24 09:25:54 2023]

rule simplify\_network:

input: networks/elec.nc, data/costs.csv, resources/bus\_regions/regions\_onshore.geojson, resources/bus\_regions/regions\_offshore.geojson

output: networks/elec\_s.nc, resources/bus\_regions/regions\_onshore\_elec\_s.geojson, resources/bus\_regions/regions\_offshore\_elec\_s.geojson, resources/bus\_regions/busmap\_elec\_s.csv, resources/bus\_regions/connection\_costs\_s.csv

log: logs/simplify\_network/elec\_s.log

jobid: 5

benchmark: benchmarks/simplify\_network/elec\_s

reason: Input files updated by another job: resources/bus\_regions/regions\_offshore.geojson, networks/elec.nc, resources/bus\_regions/regions\_onshore.geojson

wildcards: simpl=

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=4000, mem\_mib=3815

INFO:snakemake.logging:rule simplify\_network:

input: networks/elec.nc, data/costs.csv, resources/bus\_regions/regions\_onshore.geojson, resources/bus\_regions/regions\_offshore.geojson

output: networks/elec\_s.nc, resources/bus\_regions/regions\_onshore\_elec\_s.geojson, resources/bus\_regions/regions\_offshore\_elec\_s.geojson, resources/bus\_regions/busmap\_elec\_s.csv, resources/bus\_regions/connection\_costs\_s.csv

log: logs/simplify\_network/elec\_s.log

jobid: 5

benchmark: benchmarks/simplify\_network/elec\_s

reason: Input files updated by another job: resources/bus\_regions/regions\_offshore.geojson, networks/elec.nc, resources/bus\_regions/regions\_onshore.geojson

wildcards: simpl=

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=4000, mem\_mib=3815

INFO:snakemake.logging:

This is the repository path: C:\Users\Lenovo\Desktop\pypsa-earth

Had to go 0 folder(s) up.

INFO:pypsa.io:Imported network elec.nc has buses, carriers, generators, lines, loads, storage\_units, transformers

INFO:\_\_main\_\_:Mapping all network lines onto a single 380kV layer

INFO:\_\_main\_\_:Simplifying connected link components

INFO:\_\_main\_\_:Removing stubs

INFO:pypsa.io:Exported network elec\_s.nc has buses, lines, carriers, loads, generators, storage\_units

C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\geopandas\io\file.py:545: UserWarning: You are attempting to write an empty DataFrame to file. For some drivers, this operation may fail.

\_to\_file\_fiona(df, filename, driver, schema, crs, mode, \*\*kwargs)

Benchmark: unable to collect cpu and memory benchmark statistics

CRITICAL:snakemake.logging:Benchmark: unable to collect cpu and memory benchmark statistics

[Fri Feb 24 09:26:04 2023]

INFO:snakemake.logging:[Fri Feb 24 09:26:04 2023]

Finished job 5.

INFO:snakemake.logging:Finished job 5.

12 of 17 steps (71%) done

INFO:snakemake.logging:12 of 17 steps (71%) done

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Fri Feb 24 09:26:04 2023]

INFO:snakemake.logging:[Fri Feb 24 09:26:04 2023]

rule cluster\_network:

input: networks/elec\_s.nc, resources/shapes/country\_shapes.geojson, resources/bus\_regions/regions\_onshore\_elec\_s.geojson, resources/bus\_regions/regions\_offshore\_elec\_s.geojson, resources/shapes/gadm\_shapes.geojson, data/costs.csv

output: networks/elec\_s\_10.nc, resources/bus\_regions/regions\_onshore\_elec\_s\_10.geojson, resources/bus\_regions/regions\_offshore\_elec\_s\_10.geojson, resources/bus\_regions/busmap\_elec\_s\_10.csv, resources/bus\_regions/linemap\_elec\_s\_10.csv

log: logs/cluster\_network/elec\_s\_10.log

jobid: 4

benchmark: benchmarks/cluster\_network/elec\_s\_10

reason: Input files updated by another job: resources/bus\_regions/regions\_offshore\_elec\_s.geojson, resources/shapes/gadm\_shapes.geojson, resources/bus\_regions/regions\_onshore\_elec\_s.geojson, networks/elec\_s.nc, resources/shapes/country\_shapes.geojson

wildcards: simpl=, clusters=10

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=3000, mem\_mib=2862

INFO:snakemake.logging:rule cluster\_network:

input: networks/elec\_s.nc, resources/shapes/country\_shapes.geojson, resources/bus\_regions/regions\_onshore\_elec\_s.geojson, resources/bus\_regions/regions\_offshore\_elec\_s.geojson, resources/shapes/gadm\_shapes.geojson, data/costs.csv

output: networks/elec\_s\_10.nc, resources/bus\_regions/regions\_onshore\_elec\_s\_10.geojson, resources/bus\_regions/regions\_offshore\_elec\_s\_10.geojson, resources/bus\_regions/busmap\_elec\_s\_10.csv, resources/bus\_regions/linemap\_elec\_s\_10.csv

log: logs/cluster\_network/elec\_s\_10.log

jobid: 4

benchmark: benchmarks/cluster\_network/elec\_s\_10

reason: Input files updated by another job: resources/bus\_regions/regions\_offshore\_elec\_s.geojson, resources/shapes/gadm\_shapes.geojson, resources/bus\_regions/regions\_onshore\_elec\_s.geojson, networks/elec\_s.nc, resources/shapes/country\_shapes.geojson

wildcards: simpl=, clusters=10

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=3000, mem\_mib=2862

INFO:snakemake.logging:

This is the repository path: C:\Users\Lenovo\Desktop\pypsa-earth

Had to go 0 folder(s) up.

INFO:pypsa.io:Imported network elec\_s.nc has buses, carriers, generators, lines, loads, storage\_units

INFO:pypsa.io:Exported network elec\_s\_10.nc has generators, buses, carriers, loads, storage\_units, lines

C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\geopandas\io\file.py:545: UserWarning: You are attempting to write an empty DataFrame to file. For some drivers, this operation may fail.

\_to\_file\_fiona(df, filename, driver, schema, crs, mode, \*\*kwargs)

Benchmark: unable to collect cpu and memory benchmark statistics

CRITICAL:snakemake.logging:Benchmark: unable to collect cpu and memory benchmark statistics

[Fri Feb 24 09:26:16 2023]

INFO:snakemake.logging:[Fri Feb 24 09:26:16 2023]

Finished job 4.

INFO:snakemake.logging:Finished job 4.

13 of 17 steps (76%) done

INFO:snakemake.logging:13 of 17 steps (76%) done

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Fri Feb 24 09:26:16 2023]

INFO:snakemake.logging:[Fri Feb 24 09:26:16 2023]

rule add\_extra\_components:

input: networks/elec\_s\_10.nc, data/costs.csv

output: networks/elec\_s\_10\_ec.nc

log: logs/add\_extra\_components/elec\_s\_10.log

jobid: 3

benchmark: benchmarks/add\_extra\_components/elec\_s\_10\_ec

reason: Input files updated by another job: networks/elec\_s\_10.nc

wildcards: simpl=, clusters=10

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=3000, mem\_mib=2862

INFO:snakemake.logging:rule add\_extra\_components:

input: networks/elec\_s\_10.nc, data/costs.csv

output: networks/elec\_s\_10\_ec.nc

log: logs/add\_extra\_components/elec\_s\_10.log

jobid: 3

benchmark: benchmarks/add\_extra\_components/elec\_s\_10\_ec

reason: Input files updated by another job: networks/elec\_s\_10.nc

wildcards: simpl=, clusters=10

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=3000, mem\_mib=2862

INFO:snakemake.logging:

INFO:pypsa.io:Imported network elec\_s\_10.nc has buses, carriers, generators, lines, loads, storage\_units

INFO:pypsa.io:Exported network elec\_s\_10\_ec.nc has carriers, loads, lines, storage\_units, buses, stores, generators, links

Benchmark: unable to collect cpu and memory benchmark statistics

CRITICAL:snakemake.logging:Benchmark: unable to collect cpu and memory benchmark statistics

[Fri Feb 24 09:26:25 2023]

INFO:snakemake.logging:[Fri Feb 24 09:26:25 2023]

Finished job 3.

INFO:snakemake.logging:Finished job 3.

14 of 17 steps (82%) done

INFO:snakemake.logging:14 of 17 steps (82%) done

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Fri Feb 24 09:26:25 2023]

INFO:snakemake.logging:[Fri Feb 24 09:26:25 2023]

rule prepare\_network:

input: networks/elec\_s\_10\_ec.nc, data/costs.csv

output: networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

log: logs/prepare\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H.log

jobid: 2

benchmark: benchmarks/prepare\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H

reason: Input files updated by another job: networks/elec\_s\_10\_ec.nc

wildcards: simpl=, clusters=10, ll=copt, opts=Co2L-6H

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=4000, mem\_mib=3815

INFO:snakemake.logging:rule prepare\_network:

input: networks/elec\_s\_10\_ec.nc, data/costs.csv

output: networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

log: logs/prepare\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H.log

jobid: 2

benchmark: benchmarks/prepare\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H

reason: Input files updated by another job: networks/elec\_s\_10\_ec.nc

wildcards: simpl=, clusters=10, ll=copt, opts=Co2L-6H

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=4000, mem\_mib=3815

INFO:snakemake.logging:

INFO:pypsa.io:Imported network elec\_s\_10\_ec.nc has buses, carriers, generators, lines, links, loads, storage\_units, stores

INFO:\_\_main\_\_:N-1 security margin of lines set to 0.7

INFO:\_\_main\_\_:Resampling the network to 6H

INFO:\_\_main\_\_:Setting CO2 limit according to config value.

INFO:pypsa.io:Exported network elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc has loads, storage\_units, carriers, buses, global\_constraints, generators, links, lines, stores

Benchmark: unable to collect cpu and memory benchmark statistics

CRITICAL:snakemake.logging:Benchmark: unable to collect cpu and memory benchmark statistics

[Fri Feb 24 09:26:35 2023]

INFO:snakemake.logging:[Fri Feb 24 09:26:35 2023]

Finished job 2.

INFO:snakemake.logging:Finished job 2.

15 of 17 steps (88%) done

INFO:snakemake.logging:15 of 17 steps (88%) done

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Fri Feb 24 09:26:35 2023]

INFO:snakemake.logging:[Fri Feb 24 09:26:35 2023]

rule solve\_network:

input: networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

output: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

log: logs\solve\_network\elec\_s\_10\_ec\_lcopt\_Co2L-6H\_solver.log, logs/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H\_python.log, logs/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H\_memory.log

jobid: 1

benchmark: benchmarks/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H

reason: Input files updated by another job: networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

wildcards: simpl=, clusters=10, ll=copt, opts=Co2L-6H

threads: 16

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem=5975

INFO:snakemake.logging:rule solve\_network:

input: networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

output: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

log: logs\solve\_network\elec\_s\_10\_ec\_lcopt\_Co2L-6H\_solver.log, logs/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H\_python.log, logs/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H\_memory.log

jobid: 1

benchmark: benchmarks/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H

reason: Input files updated by another job: networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

wildcards: simpl=, clusters=10, ll=copt, opts=Co2L-6H

threads: 16

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem=5975

INFO:snakemake.logging:

Traceback (most recent call last):

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\snakemake\\_\_init\_\_.py", line 760, in snakemake

success = workflow.execute(

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\snakemake\workflow.py", line 1095, in execute

raise e

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\snakemake\workflow.py", line 1091, in execute

success = self.scheduler.schedule()

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\snakemake\scheduler.py", line 592, in schedule

self.run(runjobs)

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\snakemake\scheduler.py", line 641, in run

executor.run\_jobs(

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\snakemake\executors\\_\_init\_\_.py", line 155, in run\_jobs

self.run(

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\snakemake\executors\\_\_init\_\_.py", line 536, in run

future = self.run\_single\_job(job)

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\snakemake\executors\\_\_init\_\_.py", line 589, in run\_single\_job

self.cached\_or\_run, job, run\_wrapper, \*self.job\_args\_and\_prepare(job)

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\snakemake\executors\\_\_init\_\_.py", line 541, in job\_args\_and\_prepare

job.prepare()

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\snakemake\jobs.py", line 911, in prepare

os.symlink(os.path.abspath(source), link)

OSError: [WinError 1314] A required privilege is not held by the client: 'C:\\Users\\Lenovo\\Desktop\\pypsa-earth\\.git' -> 'C:\\Users\\Lenovo\\Desktop\\pypsa-earth\\.snakemake\\shadow\\tmpin0f3f17\\.git'

* The model stopped because the prompt wasn’t open with administrator rights. After doing this, the final 2 rules are run:

(pypsa-earth) C:\Users\Lenovo\Desktop\pypsa-earth>snakemake -j 1 solve\_all\_networks

Set parameter Username

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No parameters matching '\_test' found

Building DAG of jobs...

WARNING:snakemake.logging:Building DAG of jobs...

Provided cores: 1 (use --cores to define parallelism)

WARNING:snakemake.logging:Provided cores: 1 (use --cores to define parallelism)

Rules claiming more threads will be scaled down.

WARNING:snakemake.logging:Rules claiming more threads will be scaled down.

Job stats:

job count min threads max threads

------------------ ------- ------------- -------------

solve\_all\_networks 1 1 1

solve\_network 1 1 1

total 2 1 1

WARNING:snakemake.logging:Job stats:

job count min threads max threads

------------------ ------- ------------- -------------

solve\_all\_networks 1 1 1

solve\_network 1 1 1

total 2 1 1

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Fri Feb 24 09:38:08 2023]

INFO:snakemake.logging:[Fri Feb 24 09:38:08 2023]

rule solve\_network:

input: networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

output: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

log: logs\solve\_network\elec\_s\_10\_ec\_lcopt\_Co2L-6H\_solver.log, logs/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H\_python.log, logs/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H\_memory.log

jobid: 1

benchmark: benchmarks/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H

reason: Missing output files: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc; Updated input files: networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

wildcards: simpl=, clusters=10, ll=copt, opts=Co2L-6H

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem=5975

INFO:snakemake.logging:rule solve\_network:

input: networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

output: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

log: logs\solve\_network\elec\_s\_10\_ec\_lcopt\_Co2L-6H\_solver.log, logs/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H\_python.log, logs/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H\_memory.log

jobid: 1

benchmark: benchmarks/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H

reason: Missing output files: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc; Updated input files: networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

wildcards: simpl=, clusters=10, ll=copt, opts=Co2L-6H

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem=5975

INFO:snakemake.logging:

Changing to shadow directory: C:\Users\Lenovo\Desktop\pypsa-earth\.snakemake\shadow\tmpzrm3\_ua1

WARNING:snakemake.logging:Changing to shadow directory: C:\Users\Lenovo\Desktop\pypsa-earth\.snakemake\shadow\tmpzrm3\_ua1

INFO:pypsa.io:Imported network elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc has buses, carriers, generators, global\_constraints, lines, links, loads, storage\_units, stores

INFO:pypsa.linopf:Prepare linear problem

INFO:pypsa.linopf:Total preparation time: 2.31s

INFO:pypsa.linopf:Solve linear problem using Gurobi solver

Set parameter Username

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Read LP format model from file C:\Users\Lenovo\AppData\Local\Temp\pypsa-problem-duadhac6.lp

Reading time = 0.60 seconds

obj: 174731 rows, 84335 columns, 348863 nonzeros

Set parameter Threads to value 4

Set parameter Method to value 2

Set parameter Crossover to value 0

Set parameter BarConvTol to value 1e-05

Set parameter AggFill to value 0

Set parameter PreDual to value 0

Set parameter GURO\_PAR\_BARDENSETHRESH to value 200

Set parameter LogFile to value "logs\solve\_network\elec\_s\_10\_ec\_lcopt\_Co2L-6H\_solver.log"

Gurobi Optimizer version 10.0.1 build v10.0.1rc0 (win64)

CPU model: AMD Ryzen 7 5700U with Radeon Graphics, instruction set [SSE2|AVX|AVX2]

Thread count: 8 physical cores, 16 logical processors, using up to 4 threads

Optimize a model with 174731 rows, 84335 columns and 348863 nonzeros

Model fingerprint: 0xa3582d52

Coefficient statistics:

Matrix range [1e-03, 5e+02]

Objective range [1e-01, 1e+05]

Bounds range [2e-01, 1e+09]

RHS range [2e+00, 1e+10]

Warning: Model contains large rhs

Warning: Model contains large bounds

Consider reformulating model or setting NumericFocus parameter

to avoid numerical issues.

Presolve removed 97327 rows and 23072 columns

Presolve time: 0.24s

Presolved: 77404 rows, 61263 columns, 227217 nonzeros

Ordering time: 0.02s

Barrier statistics:

Dense cols : 81

Free vars : 4992

AA' NZ : 2.347e+05

Factor NZ : 1.322e+06 (roughly 70 MB of memory)

Factor Ops : 4.780e+07 (less than 1 second per iteration)

Threads : 4

Objective Residual

Iter Primal Dual Primal Dual Compl Time

0 2.71377910e+14 -1.16270460e+16 3.46e+10 3.31e+03 4.17e+12 0s

1 2.47315227e+14 -9.51556138e+15 2.82e+10 5.33e+04 1.48e+12 0s

2 1.52634455e+14 -7.63069931e+15 1.28e+10 9.63e+03 4.75e+11 0s

3 1.16407196e+14 -4.60734136e+15 6.87e+09 2.11e+03 1.95e+11 1s

4 8.59785463e+13 -2.14810448e+15 2.14e+09 2.66e+02 5.62e+10 1s

5 7.56549041e+13 -5.48334595e+14 6.94e+08 2.38e+01 1.46e+10 1s

6 5.42068340e+13 -8.91710735e+13 2.02e+07 1.40e+00 1.44e+09 1s

7 1.53325979e+13 -2.23987341e+13 1.02e+06 4.53e+00 3.21e+08 1s

8 1.64283007e+12 -3.50050581e+12 4.33e+04 1.71e+00 4.23e+07 1s

9 9.81600874e+11 -9.18912742e+11 5.77e+03 5.29e-01 1.56e+07 1s

10 5.76363201e+11 -5.31302223e+11 1.84e+01 3.35e-01 9.06e+06 1s

11 3.50558388e+11 -3.09718267e+11 9.43e+00 6.98e-01 5.40e+06 1s

12 2.75410185e+11 -1.45319627e+11 6.60e+00 3.49e-01 3.44e+06 1s

13 9.47419511e+10 -7.07746665e+10 1.47e+00 1.88e-01 1.35e+06 1s

14 3.54869820e+10 -2.71318605e+10 3.75e-01 7.13e-02 5.11e+05 1s

15 3.19089416e+10 -2.71908865e+10 3.25e-01 7.23e-02 4.83e+05 1s

16 1.43013595e+10 -1.19614332e+10 1.06e-01 6.93e-02 2.14e+05 1s

17 4.69084944e+09 -5.96406161e+09 2.76e-02 3.60e-02 8.70e+04 1s

18 3.05417470e+09 -2.00364793e+09 1.66e-02 1.42e-02 4.13e+04 1s

19 2.50502098e+09 -1.12784098e+09 1.27e-02 9.48e-03 2.97e+04 1s

20 2.12615019e+09 -6.65455758e+08 1.02e-02 6.94e-03 2.28e+04 1s

21 1.66255614e+09 1.39289345e+08 7.25e-03 3.38e-03 1.24e+04 1s

22 1.16427873e+09 2.56697448e+08 4.07e-03 2.65e-03 7.41e+03 1s

23 1.01842582e+09 2.80531916e+08 3.14e-03 2.38e-03 6.03e+03 1s

24 8.26491349e+08 3.60136719e+08 2.01e-03 1.74e-03 3.81e+03 1s

25 7.77744363e+08 3.74531525e+08 1.67e-03 1.56e-03 3.29e+03 1s

26 6.82351888e+08 4.21993518e+08 1.10e-03 1.47e-03 2.13e+03 2s

27 5.97104067e+08 4.48726996e+08 5.97e-04 8.48e-04 1.21e+03 2s

28 5.49296349e+08 4.58510839e+08 3.41e-04 5.59e-04 7.41e+02 2s

29 5.40561454e+08 4.61125602e+08 2.94e-04 5.05e-04 6.49e+02 2s

30 5.33678739e+08 4.64766883e+08 2.57e-04 4.29e-04 5.63e+02 2s

31 5.15230817e+08 4.69025642e+08 1.56e-04 3.35e-04 3.77e+02 2s

32 5.08014934e+08 4.71704315e+08 1.16e-04 3.08e-04 2.97e+02 2s

33 5.02642712e+08 4.76122540e+08 8.75e-05 2.49e-04 2.17e+02 2s

34 4.96084675e+08 4.79248795e+08 5.16e-05 1.72e-04 1.37e+02 2s

35 4.93676984e+08 4.81275055e+08 3.86e-05 1.44e-04 1.01e+02 2s

36 4.92948875e+08 4.82291545e+08 3.47e-05 1.33e-04 8.70e+01 2s

37 4.91061778e+08 4.83439774e+08 2.46e-05 9.26e-05 6.22e+01 2s

38 4.90097374e+08 4.83841102e+08 1.94e-05 8.49e-05 5.11e+01 2s

39 4.88927847e+08 4.85277558e+08 1.33e-05 6.23e-05 2.98e+01 2s

40 4.88482650e+08 4.85750231e+08 1.11e-05 4.59e-05 2.23e+01 2s

41 4.87607011e+08 4.85854155e+08 6.41e-06 3.95e-05 1.43e+01 2s

42 4.87327805e+08 4.85908413e+08 4.95e-06 3.48e-05 1.16e+01 2s

43 4.87137332e+08 4.86020923e+08 3.97e-06 2.51e-05 9.12e+00 2s

44 4.86830901e+08 4.86111857e+08 2.44e-06 1.78e-05 5.87e+00 2s

45 4.86789087e+08 4.86136530e+08 2.23e-06 1.59e-05 5.33e+00 3s

46 4.86639103e+08 4.86167344e+08 1.50e-06 1.34e-05 3.85e+00 3s

47 4.86535894e+08 4.86272322e+08 9.64e-07 1.05e-05 2.15e+00 3s

48 4.86454075e+08 4.86279605e+08 5.75e-07 1.02e-05 1.42e+00 3s

49 4.86366176e+08 4.86322361e+08 1.48e-07 7.35e-06 3.58e-01 3s

50 4.86357607e+08 4.86326617e+08 1.10e-07 1.53e-05 2.53e-01 3s

51 4.86341854e+08 4.86329715e+08 4.26e-08 6.95e-05 9.91e-02 3s

52 4.86335098e+08 4.86331033e+08 1.44e-08 9.59e-05 3.32e-02 3s

53 4.86332448e+08 4.86331242e+08 4.12e-09 1.09e-04 9.87e-03 3s

54 4.86331524e+08 4.86331273e+08 1.76e-09 1.08e-04 2.07e-03 4s

55 4.86331327e+08 4.86331287e+08 2.32e-10 4.48e-05 3.26e-04 4s

56 4.86331298e+08 4.86331289e+08 5.48e-11 1.38e-05 6.99e-05 4s

57 4.86331290e+08 4.86331290e+08 9.81e-11 3.01e-06 3.43e-06 4s

Barrier solved model in 57 iterations and 3.95 seconds (2.48 work units)

Optimal objective 4.86331290e+08

INFO:pypsa.linopf:Optimization successful. Objective value: 4.86e+08

INFO:pypsa.io:Exported network elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc has lines, generators, stores, carriers, global\_constraints, links, loads, buses, storage\_units

INFO:\_\_main\_\_:Maximum memory usage: (432.21875, 1677227917.9143844)

Benchmark: unable to collect cpu and memory benchmark statistics

CRITICAL:snakemake.logging:Benchmark: unable to collect cpu and memory benchmark statistics

[Fri Feb 24 09:38:38 2023]

INFO:snakemake.logging:[Fri Feb 24 09:38:38 2023]

Finished job 1.

INFO:snakemake.logging:Finished job 1.

1 of 2 steps (50%) done

INFO:snakemake.logging:1 of 2 steps (50%) done

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Fri Feb 24 09:38:38 2023]

INFO:snakemake.logging:[Fri Feb 24 09:38:38 2023]

localrule solve\_all\_networks:

input: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

jobid: 0

reason: Input files updated by another job: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp

INFO:snakemake.logging:localrule solve\_all\_networks:

input: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

jobid: 0

reason: Input files updated by another job: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp

INFO:snakemake.logging:

[Fri Feb 24 09:38:38 2023]

INFO:snakemake.logging:[Fri Feb 24 09:38:38 2023]

Finished job 0.

INFO:snakemake.logging:Finished job 0.

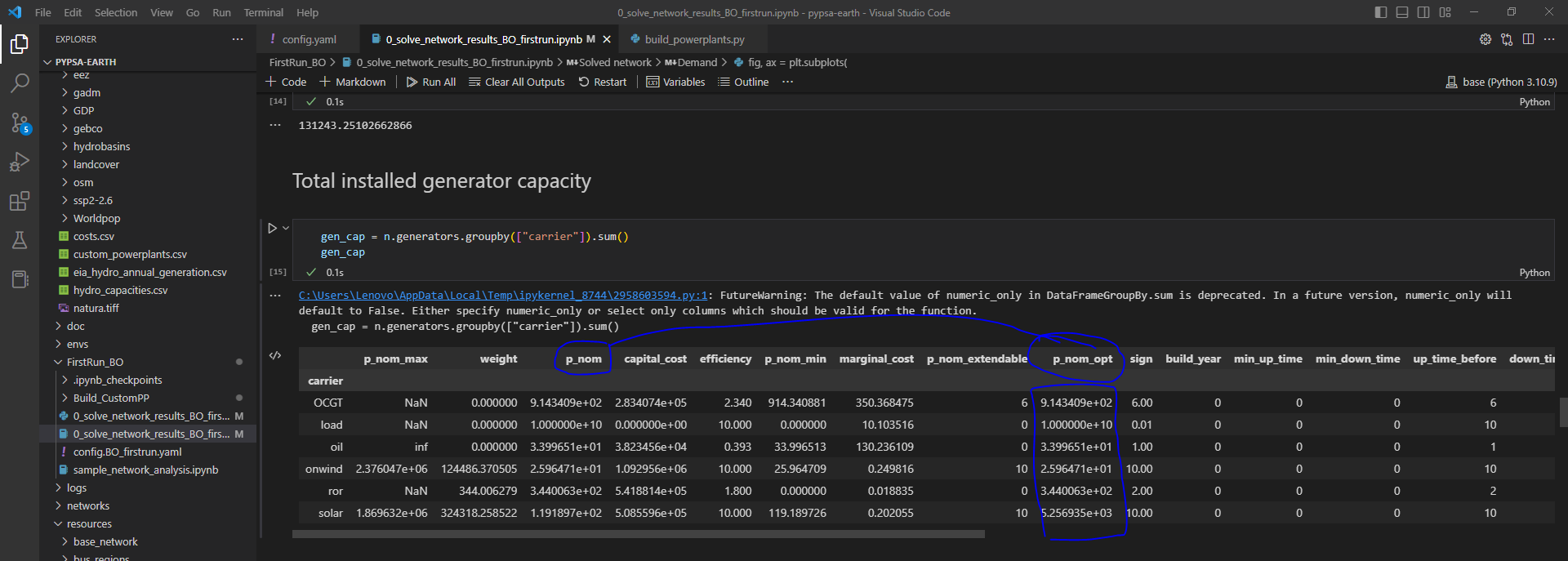
2 of 2 steps (100%) done

INFO:snakemake.logging:2 of 2 steps (100%) done

Complete log: .snakemake\log\2023-02-24T093800.495052.snakemake.log

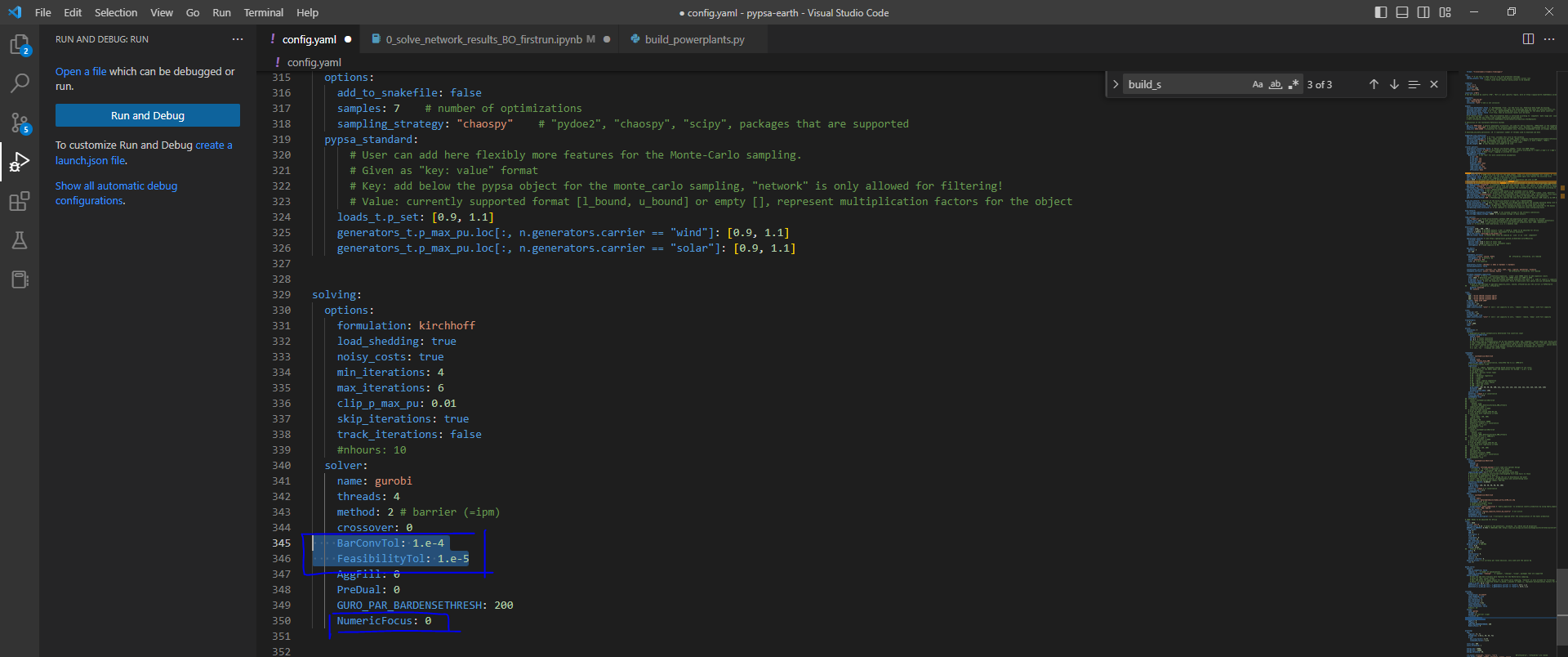
WARNING:snakemake.logging:Complete log: .snakemake\log\2023-02-24T093800.495052.snakemake.log

* There seem to be no complications with running the model and in this case a feasible solution was found for the system given that in the total installed capacity there are differences between existing power plants (P\_nom) and the newly obtained values from optimization (P\_nom\_opt). This didn’t happen in the last run.



### Adjusting optimization restrictions in the model to allow easier runs in the future

* Because the model had problems running in the first run but worked on the second run Davide suggested to look for constraint values in the solving configuration. If the model can’t find an optimal result, it might be due to constraints in gurobi.
* To reduce feasibility constraints, values were reduced by one degree in the exponentials, in the solver section (tolerances were increased) and the NumericFocus parameter was added (<https://www.gurobi.com/documentation/9.5/refman/parameter_descriptions.html>) in the config.yaml file:



* To rerun the model with the relaxed solving parameters, the file “elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc” created in the “results/networks/” folder is deleted and the workflow is run again (snakemake -j 1 solve\_all\_networks)

(pypsa-earth) C:\Users\Lenovo\Desktop\pypsa-earth>snakemake -j 1 solve\_all\_networks

Set parameter Username

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No parameters matching '\_test' found

Building DAG of jobs...

WARNING:snakemake.logging:Building DAG of jobs...

Provided cores: 1 (use --cores to define parallelism)

WARNING:snakemake.logging:Provided cores: 1 (use --cores to define parallelism)

Rules claiming more threads will be scaled down.

WARNING:snakemake.logging:Rules claiming more threads will be scaled down.

Job stats:

job count min threads max threads

------------------ ------- ------------- -------------

solve\_all\_networks 1 1 1

solve\_network 1 1 1

total 2 1 1

WARNING:snakemake.logging:Job stats:

job count min threads max threads

------------------ ------- ------------- -------------

solve\_all\_networks 1 1 1

solve\_network 1 1 1

total 2 1 1

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Fri Feb 24 12:18:30 2023]

INFO:snakemake.logging:[Fri Feb 24 12:18:30 2023]

rule solve\_network:

input: networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

output: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

log: logs\solve\_network\elec\_s\_10\_ec\_lcopt\_Co2L-6H\_solver.log, logs/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H\_python.log, logs/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H\_memory.log

jobid: 1

benchmark: benchmarks/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H

reason: Missing output files: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

wildcards: simpl=, clusters=10, ll=copt, opts=Co2L-6H

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem=5975

INFO:snakemake.logging:rule solve\_network:

input: networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

output: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

log: logs\solve\_network\elec\_s\_10\_ec\_lcopt\_Co2L-6H\_solver.log, logs/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H\_python.log, logs/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H\_memory.log

jobid: 1

benchmark: benchmarks/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H

reason: Missing output files: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

wildcards: simpl=, clusters=10, ll=copt, opts=Co2L-6H

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem=5975

INFO:snakemake.logging:

Changing to shadow directory: C:\Users\Lenovo\Desktop\pypsa-earth\.snakemake\shadow\tmpxb9o0576

WARNING:snakemake.logging:Changing to shadow directory: C:\Users\Lenovo\Desktop\pypsa-earth\.snakemake\shadow\tmpxb9o0576

INFO:pypsa.io:Imported network elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc has buses, carriers, generators, global\_constraints, lines, links, loads, storage\_units, stores

INFO:pypsa.linopf:Prepare linear problem

INFO:pypsa.linopf:Total preparation time: 1.32s

INFO:pypsa.linopf:Solve linear problem using Gurobi solver

Set parameter Username

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Read LP format model from file C:\Users\Lenovo\AppData\Local\Temp\pypsa-problem-ef347720.lp

Reading time = 0.45 seconds

obj: 174731 rows, 84335 columns, 348863 nonzeros

Set parameter Threads to value 4

Set parameter Method to value 2

Set parameter Crossover to value 0

Set parameter BarConvTol to value 0.0001

Set parameter FeasibilityTol to value 1e-05

Set parameter AggFill to value 0

Set parameter PreDual to value 0

Set parameter GURO\_PAR\_BARDENSETHRESH to value 200

Set parameter LogFile to value "logs\solve\_network\elec\_s\_10\_ec\_lcopt\_Co2L-6H\_solver.log"

Gurobi Optimizer version 10.0.1 build v10.0.1rc0 (win64)

CPU model: AMD Ryzen 7 5700U with Radeon Graphics, instruction set [SSE2|AVX|AVX2]

Thread count: 8 physical cores, 16 logical processors, using up to 4 threads

Optimize a model with 174731 rows, 84335 columns and 348863 nonzeros

Model fingerprint: 0xade5dbcb

Coefficient statistics:

Matrix range [1e-03, 5e+02]

Objective range [1e-01, 1e+05]

Bounds range [2e-01, 1e+09]

RHS range [2e+00, 1e+10]

Warning: Model contains large rhs

Warning: Model contains large bounds

Consider reformulating model or setting NumericFocus parameter

to avoid numerical issues.

Presolve removed 97327 rows and 23072 columns

Presolve time: 0.19s

Presolved: 77404 rows, 61263 columns, 227217 nonzeros

Ordering time: 0.02s

Barrier statistics:

Dense cols : 81

Free vars : 4992

AA' NZ : 2.347e+05

Factor NZ : 1.322e+06 (roughly 70 MB of memory)

Factor Ops : 4.780e+07 (less than 1 second per iteration)

Threads : 4

Objective Residual

Iter Primal Dual Primal Dual Compl Time

0 2.71370910e+14 -1.16270422e+16 3.46e+10 3.31e+03 4.17e+12 0s

1 2.47309708e+14 -9.51555809e+15 2.82e+10 5.33e+04 1.48e+12 0s

2 1.52631096e+14 -7.63069603e+15 1.28e+10 9.63e+03 4.75e+11 0s

3 1.16404775e+14 -4.60733831e+15 6.87e+09 2.11e+03 1.95e+11 0s

4 8.59769051e+13 -2.14810215e+15 2.14e+09 2.66e+02 5.62e+10 0s

5 7.56535401e+13 -5.48335817e+14 6.94e+08 2.38e+01 1.46e+10 1s

6 5.42063913e+13 -8.91878689e+13 2.02e+07 1.40e+00 1.44e+09 1s

7 1.53404212e+13 -2.24105529e+13 1.02e+06 4.55e+00 3.21e+08 1s

8 1.64358631e+12 -3.50347920e+12 4.34e+04 1.70e+00 4.24e+07 1s

9 9.81825383e+11 -9.20280634e+11 5.79e+03 5.29e-01 1.56e+07 1s

10 5.76646470e+11 -5.31616101e+11 1.85e+01 3.34e-01 9.07e+06 1s

11 3.50296790e+11 -3.09958252e+11 9.43e+00 6.97e-01 5.40e+06 1s

12 2.75734103e+11 -1.45468918e+11 6.62e+00 3.48e-01 3.44e+06 1s

13 9.47513853e+10 -7.10210423e+10 1.47e+00 1.90e-01 1.35e+06 1s

14 3.55160585e+10 -2.71781500e+10 3.75e-01 7.20e-02 5.12e+05 1s

15 3.19538118e+10 -2.72248283e+10 3.26e-01 7.28e-02 4.83e+05 1s

16 1.43049326e+10 -1.19464454e+10 1.05e-01 6.94e-02 2.14e+05 1s

17 4.68966093e+09 -5.93777710e+09 2.75e-02 3.60e-02 8.68e+04 1s

18 3.05445798e+09 -1.99743106e+09 1.66e-02 1.42e-02 4.13e+04 1s

19 2.50600549e+09 -1.12418975e+09 1.27e-02 9.50e-03 2.96e+04 1s

20 2.11593390e+09 -6.77402126e+08 1.01e-02 7.04e-03 2.28e+04 1s

21 1.64499755e+09 1.60580864e+08 7.16e-03 3.14e-03 1.21e+04 1s

22 1.15223391e+09 2.68810703e+08 4.01e-03 2.45e-03 7.21e+03 1s

23 1.00409833e+09 2.91274249e+08 3.07e-03 2.22e-03 5.82e+03 1s

24 8.25801902e+08 3.64236197e+08 2.00e-03 1.62e-03 3.77e+03 1s

25 7.92045805e+08 3.78199594e+08 1.77e-03 1.45e-03 3.38e+03 1s

26 6.85861157e+08 4.15677971e+08 1.11e-03 1.34e-03 2.21e+03 1s

27 5.92911630e+08 4.56205329e+08 5.55e-04 1.28e-03 1.12e+03 1s

28 5.50040200e+08 4.64104264e+08 3.19e-04 9.30e-04 7.02e+02 1s

29 5.41338236e+08 4.69262850e+08 2.73e-04 6.68e-04 5.89e+02 1s

30 5.29647489e+08 4.72919347e+08 2.16e-04 4.58e-04 4.63e+02 2s

31 5.12824175e+08 4.76170172e+08 1.32e-04 3.16e-04 2.99e+02 2s

32 5.05609568e+08 4.78177079e+08 9.61e-05 2.76e-04 2.24e+02 2s

33 5.04587796e+08 4.80309327e+08 9.13e-05 2.06e-04 1.98e+02 2s

34 4.97060611e+08 4.81461088e+08 5.36e-05 1.66e-04 1.27e+02 2s

35 4.95412985e+08 4.83509367e+08 4.51e-05 1.31e-04 9.72e+01 2s

36 4.92443099e+08 4.84088233e+08 2.96e-05 1.09e-04 6.82e+01 2s

37 4.90208877e+08 4.84782164e+08 1.87e-05 6.92e-05 4.43e+01 2s

38 4.88789176e+08 4.85127794e+08 1.17e-05 5.25e-05 2.99e+01 2s

39 4.88530510e+08 4.85532921e+08 1.04e-05 4.73e-05 2.45e+01 2s

40 4.88194922e+08 4.85755230e+08 8.71e-06 4.80e-05 1.99e+01 2s

41 4.87691777e+08 4.86061143e+08 6.28e-06 2.88e-05 1.33e+01 2s

42 4.86944735e+08 4.86127931e+08 2.76e-06 3.52e-05 6.67e+00 2s

43 4.86906533e+08 4.86171050e+08 2.59e-06 2.98e-05 6.01e+00 2s

44 4.86816532e+08 4.86177469e+08 2.17e-06 2.99e-05 5.22e+00 2s

45 4.86660086e+08 4.86248700e+08 1.45e-06 3.12e-05 3.36e+00 2s

46 4.86500630e+08 4.86277402e+08 7.47e-07 2.56e-05 1.82e+00 2s

47 4.86363515e+08 4.86321704e+08 1.24e-07 3.05e-05 3.41e-01 3s

48 4.86339797e+08 4.86326401e+08 3.93e-08 5.67e-05 1.09e-01 3s

49 4.86331282e+08 4.86326757e+08 1.23e-08 3.97e-05 3.70e-02 3s

50 4.86329301e+08 4.86327026e+08 6.07e-09 1.93e-05 1.86e-02 3s

Barrier solved model in 50 iterations and 3.01 seconds (2.14 work units)

Optimal objective 4.86329301e+08

INFO:pypsa.linopf:Optimization successful. Objective value: 4.86e+08

INFO:pypsa.io:Exported network elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc has lines, links, loads, global\_constraints, buses, carriers, generators, storage\_units, stores

INFO:\_\_main\_\_:Maximum memory usage: (431.3046875, 1677237529.7165194)

Benchmark: unable to collect cpu and memory benchmark statistics

CRITICAL:snakemake.logging:Benchmark: unable to collect cpu and memory benchmark statistics

[Fri Feb 24 12:18:50 2023]

INFO:snakemake.logging:[Fri Feb 24 12:18:50 2023]

Finished job 1.

INFO:snakemake.logging:Finished job 1.

1 of 2 steps (50%) done

INFO:snakemake.logging:1 of 2 steps (50%) done

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Fri Feb 24 12:18:50 2023]

INFO:snakemake.logging:[Fri Feb 24 12:18:50 2023]

localrule solve\_all\_networks:

input: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

jobid: 0

reason: Input files updated by another job: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp

INFO:snakemake.logging:localrule solve\_all\_networks:

input: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

jobid: 0

reason: Input files updated by another job: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp

INFO:snakemake.logging:

[Fri Feb 24 12:18:50 2023]

INFO:snakemake.logging:[Fri Feb 24 12:18:50 2023]

Finished job 0.

INFO:snakemake.logging:Finished job 0.

2 of 2 steps (100%) done

INFO:snakemake.logging:2 of 2 steps (100%) done

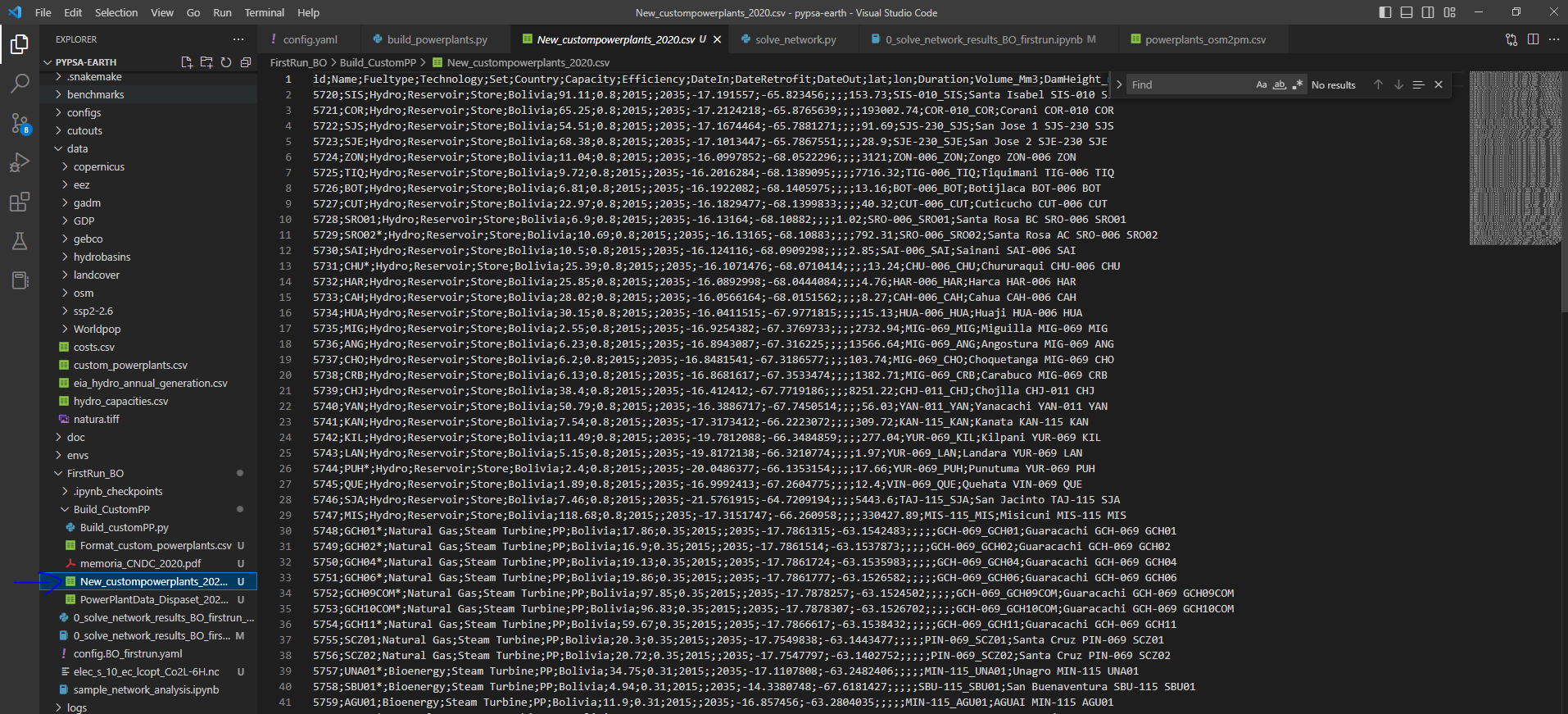
Complete log: .snakemake\log\2023-02-24T121825.572538.snakemake.log

WARNING:snakemake.logging:Complete log: .snakemake\log\2023-02-24T121825.572538.snakemake.log

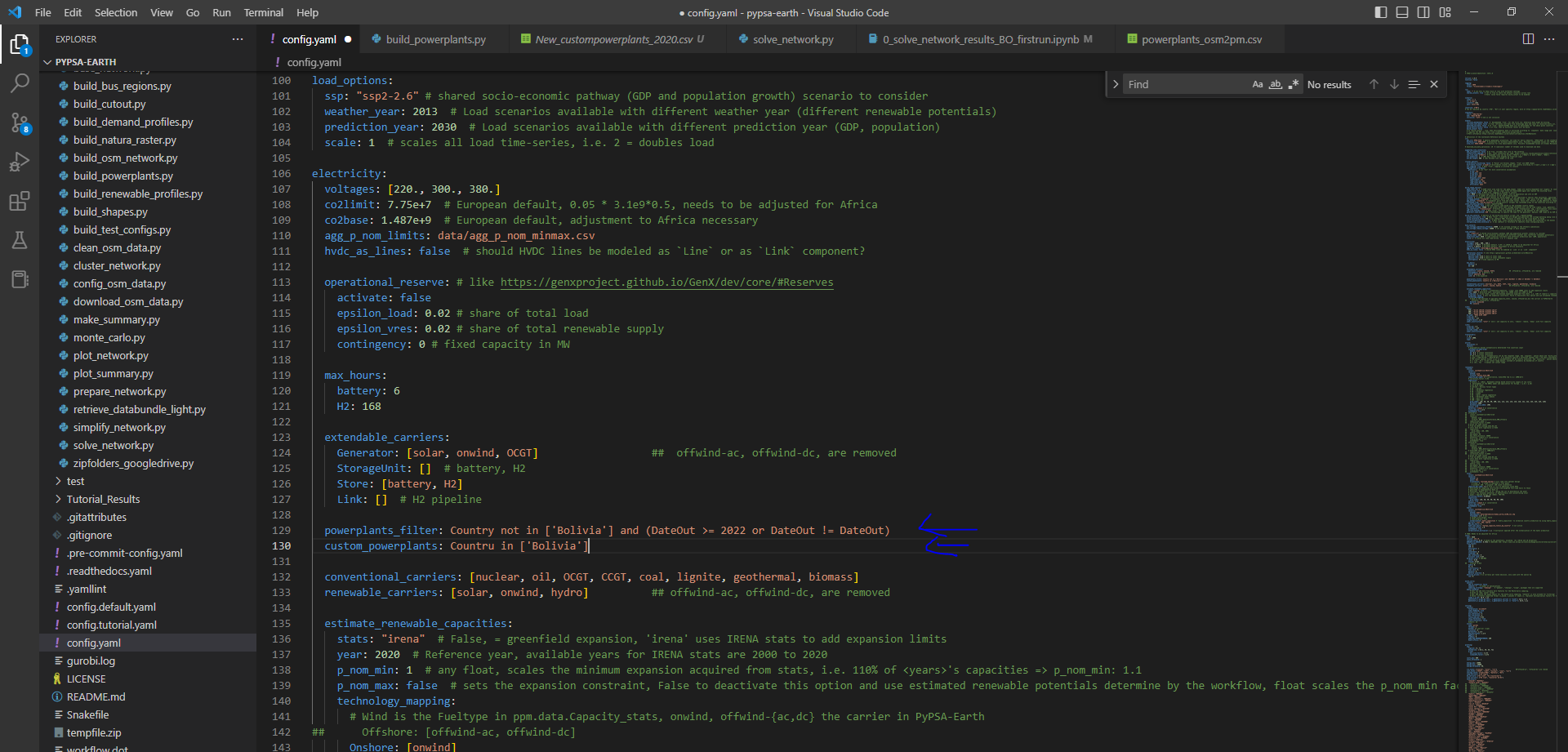
* Now the model is also capable of resolving the optimization problem and with even less iterations

### Updating power plants files with custom\_powerplats.csv option in build\_powerplants rule

* As results were analyzed with the new solved problem (0\_solve\_network\_results\_BO\_firstrun file in the FirstRun\_BO folder) power plants, lines and substations are found to be outdated (information seems to be dated from 2010-2013) and therefore updates to data bases are required
* For generators, a custom\_powerplants.csv file has been made (a new folder called “Build\_CustomPP” is created in the FirstRun\_BO folder), to be used instead of the powerplantmatching file: data from the Memorias Anuales 2020 from CNDC and data used in dispa-set from marco navia were used.
  + \*The data structure from the powerplantmatching.csv file is used to adequate data
  + \*To define approximate locations googlemaps locations were used (plants whose names are tagged with \* are not exactly define inside the power station (maybe machines are mixed) and names tagged with \*\* are defined only based on the communities they are from since no other more precise location was available
  + \*Preliminary DateIn (2015) and DateOut (2035) were given to every generator - This will have to be updated later on (when the system is givin proper results)
* Once the custom\_powerplants file is ready, it is fixed in the “data” folder, replacing the existing csv file with the same name (the new list of powerplant and its information is read in a python file and saved created as a csv file: Build\_CustomPP.py).



* The build\_powerplants rules description is used to define/use the custom\_polwerplants file (case 2) by changing parameters in the config.yaml file: powerplants\_filter (line 129) and enabling custom\_powerplants changing false to true (line 130)



* A dry-run shows that the model is rerun from the rule build\_shapes because inputs were changed (by the changes made in custom\_powerplants?)

INFO:snakemake.logging:

Job stats:

job count min threads max threads

------------------------ ------- ------------- -------------

add\_electricity 1 1 1

add\_extra\_components 1 1 1

base\_network 1 1 1

build\_bus\_regions 1 1 1

build\_demand\_profiles 1 1 1

build\_osm\_network 1 1 1

build\_powerplants 1 1 1

build\_renewable\_profiles 3 1 1

build\_shapes 1 1 1

clean\_osm\_data 1 1 1

cluster\_network 1 1 1

prepare\_network 1 1 1

simplify\_network 1 1 1

solve\_all\_networks 1 1 1

solve\_network 1 1 1

total 17 1 1

WARNING:snakemake.logging:Job stats:

job count min threads max threads

------------------------ ------- ------------- -------------

add\_electricity 1 1 1

add\_extra\_components 1 1 1

base\_network 1 1 1

build\_bus\_regions 1 1 1

build\_demand\_profiles 1 1 1

build\_osm\_network 1 1 1

build\_powerplants 1 1 1

build\_renewable\_profiles 3 1 1

build\_shapes 1 1 1

clean\_osm\_data 1 1 1

cluster\_network 1 1 1

prepare\_network 1 1 1

simplify\_network 1 1 1

solve\_all\_networks 1 1 1

solve\_network 1 1 1

total 17 1 1

Reasons:

(check individual jobs above for details)

code has changed since last execution:

build\_shapes

input files updated by another job:

add\_electricity, add\_extra\_components, base\_network, build\_bus\_regions, build\_demand\_profiles, build\_osm\_network, build\_powerplants, build\_renewable\_profiles, clean\_osm\_data, cluster\_network, prepare\_network, simplify\_network, solve\_all\_networks, solve\_network

WARNING:snakemake.logging:Reasons:

(check individual jobs above for details)

code has changed since last execution:

build\_shapes

input files updated by another job:

add\_electricity, add\_extra\_components, base\_network, build\_bus\_regions, build\_demand\_profiles, build\_osm\_network, build\_powerplants, build\_renewable\_profiles, clean\_osm\_data, cluster\_network, prepare\_network, simplify\_network, solve\_all\_networks, solve\_network

Some jobs were triggered by provenance information, see 'reason' section in the rule displays above.

If you prefer that only modification time is used to determine whether a job shall be executed, use the command line option '--rerun-triggers mtime' (also see --help).

If you are sure that a change for a certain output file (say, <outfile>) won't change the result (e.g. because you just changed the formatting of a script or environment definition), you can also wipe its metadata to skip such a trigger via 'snakemake --cleanup-metadata <outfile>'.

WARNING:snakemake.logging:Some jobs were triggered by provenance information, see 'reason' section in the rule displays above.

If you prefer that only modification time is used to determine whether a job shall be executed, use the command line option '--rerun-triggers mtime' (also see --help).

If you are sure that a change for a certain output file (say, <outfile>) won't change the result (e.g. because you just changed the formatting of a script or environment definition), you can also wipe its metadata to skip such a trigger via 'snakemake --cleanup-metadata <outfile>'.

Rules with provenance triggered jobs: build\_shapes

WARNING:snakemake.logging:Rules with provenance triggered jobs: build\_shapes

WARNING:snakemake.logging:

WARNING:snakemake.logging:

This was a dry-run (flag -n). The order of jobs does not reflect the order of execution.

WARNING:snakemake.logging:This was a dry-run (flag -n). The order of jobs does not reflect the order of execution.

* To secure a complete run, the command --forceall is included with the snakemake line and the workflow is executed and 18 rules are recognized (snakemake -j 4 solve\_all\_networks --forceall). However, several errors/warnings appear and the workflow stops at the rule “add\_electricity”:

PS C:\Users\Lenovo\Desktop\pypsa-earth> snakemake -j 4 solve\_all\_networks --forceall

Set parameter Username

Academic license - for non-commercial use only - expires 2024-02-04

No parameters matching '\_test' found

Building DAG of jobs...

WARNING:snakemake.logging:Building DAG of jobs...

Provided cores: 4

WARNING:snakemake.logging:Provided cores: 4

Rules claiming more threads will be scaled down.

WARNING:snakemake.logging:Rules claiming more threads will be scaled down.

Job stats:

job count min threads max threads

------------------------ ------- ------------- -------------

add\_electricity 1 1 1

add\_extra\_components 1 1 1

base\_network 1 1 1

build\_bus\_regions 1 1 1

build\_demand\_profiles 1 1 1

build\_osm\_network 1 1 1

build\_powerplants 1 1 1

build\_renewable\_profiles 3 4 4

build\_shapes 1 1 1

clean\_osm\_data 1 1 1

cluster\_network 1 1 1

copy\_defaultnatura\_tiff 1 1 1

prepare\_network 1 1 1

simplify\_network 1 1 1

solve\_all\_networks 1 1 1

solve\_network 1 4 4

total 18 1 4

WARNING:snakemake.logging:Job stats:

job count min threads max threads

------------------------ ------- ------------- -------------

add\_electricity 1 1 1

add\_extra\_components 1 1 1

base\_network 1 1 1

build\_bus\_regions 1 1 1

build\_demand\_profiles 1 1 1

build\_osm\_network 1 1 1

build\_powerplants 1 1 1

build\_renewable\_profiles 3 4 4

build\_shapes 1 1 1

clean\_osm\_data 1 1 1

cluster\_network 1 1 1

copy\_defaultnatura\_tiff 1 1 1

prepare\_network 1 1 1

simplify\_network 1 1 1

solve\_all\_networks 1 1 1

solve\_network 1 4 4

total 18 1 4

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Wed Mar 1 15:53:14 2023]

INFO:snakemake.logging:[Wed Mar 1 15:53:14 2023]

rule build\_shapes:

input: data/eez/eez\_v11.gpkg

output: resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, resources/shapes/africa\_shape.geojson, resources/shapes/gadm\_shapes.geojson

log: logs/build\_shapes.log

jobid: 11

benchmark: benchmarks/build\_shapes

reason: Forced execution

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=500, mem\_mib=477

INFO:snakemake.logging:rule build\_shapes:

input: data/eez/eez\_v11.gpkg

output: resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, resources/shapes/africa\_shape.geojson, resources/shapes/gadm\_shapes.geojson

log: logs/build\_shapes.log

jobid: 11

benchmark: benchmarks/build\_shapes

reason: Forced execution

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=500, mem\_mib=477

INFO:snakemake.logging:

[Wed Mar 1 15:53:14 2023]

INFO:snakemake.logging:[Wed Mar 1 15:53:14 2023]

rule copy\_defaultnatura\_tiff:

input: data/natura.tiff

output: resources/natura.tiff

jobid: 12

reason: Forced execution

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp

INFO:snakemake.logging:rule copy\_defaultnatura\_tiff:

input: data/natura.tiff

output: resources/natura.tiff

jobid: 12

reason: Forced execution

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp

INFO:snakemake.logging:

[Wed Mar 1 15:53:15 2023]

INFO:snakemake.logging:[Wed Mar 1 15:53:15 2023]

Finished job 12.

INFO:snakemake.logging:Finished job 12.

1 of 18 steps (6%) done

INFO:snakemake.logging:1 of 18 steps (6%) done

This is the repository path: C:\Users\Lenovo\Desktop\pypsa-earth

Had to go 0 folder(s) up.

INFO:\_\_main\_\_:Stage 1 of 4: Create country shapes

INFO:\_\_main\_\_:Stage 2 of 4: Create offshore shapes

C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\geopandas\base.py:31: UserWarning: The indices of the two GeoSeries are different.

warn("The indices of the two GeoSeries are different.")

C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\geopandas\io\file.py:545: UserWarning: You are attempting to write an empty DataFrame to file. For some drivers, this operation may fail.

\_to\_file\_fiona(df, filename, driver, schema, crs, mode, \*\*kwargs)

INFO:\_\_main\_\_:Stage 4/4: Creation GADM GeoDataFrame

INFO:\_\_main\_\_:Stage 4/4 POP: Add population data to GADM GeoDataFrame

This is the repository path: C:\Users\Lenovo\Desktop\pypsa-earth

Had to go 0 folder(s) up.

This is the repository path: C:\Users\Lenovo\Desktop\pypsa-earth

Had to go 0 folder(s) up.

This is the repository path: C:\Users\Lenovo\Desktop\pypsa-earth

Had to go 0 folder(s) up.

Download WorldPop : 100%|███████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████| 1/1 [00:00<00:00, 5.08 countries/s]

Compute population : 100%|██████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████| 3/3 [00:27<00:00, 9.19s/it]

INFO:\_\_main\_\_:Stage 4/4: Add gdp data to GADM GeoDataFrame

INFO:\_\_main\_\_:Stage 4/4: Access to GDP raster data

WARNING:\_\_main\_\_:Stage 4/4: File GDP\_PPP\_1990\_2015\_5arcmin\_v2.tif not found, the file will be produced by processing GDP\_PPP\_1990\_2015\_5arcmin\_v2.nc

INFO:\_\_main\_\_:Stage 4/4: Access to GDP raster data

WARNING:\_\_main\_\_:Stage 3/4 GDP data of year False not found, selected the most recent data (2015)

Compute GDP : 100%|████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████| 9/9 [00:01<00:00, 5.75 geometries/s]

Benchmark: unable to collect cpu and memory benchmark statistics

CRITICAL:snakemake.logging:Benchmark: unable to collect cpu and memory benchmark statistics

[Wed Mar 1 15:54:18 2023]

INFO:snakemake.logging:[Wed Mar 1 15:54:18 2023]

Finished job 11.

INFO:snakemake.logging:Finished job 11.

2 of 18 steps (11%) done

INFO:snakemake.logging:2 of 18 steps (11%) done

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Wed Mar 1 15:54:18 2023]

INFO:snakemake.logging:[Wed Mar 1 15:54:18 2023]

rule clean\_osm\_data:

input: resources/osm/raw/all\_raw\_cables.geojson, resources/osm/raw/all\_raw\_generators.geojson, resources/osm/raw/all\_raw\_lines.geojson, resources/osm/raw/all\_raw\_substations.geojson, resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, resources/shapes/africa\_shape.geojson

output: resources/osm/clean/all\_clean\_generators.geojson, resources/osm/clean/all\_clean\_generators.csv, resources/osm/clean/all\_clean\_lines.geojson, resources/osm/clean/all\_clean\_substations.geojson

log: logs/clean\_osm\_data.log

jobid: 10

benchmark: benchmarks/clean\_osm\_data

reason: Input files updated by another job: resources/shapes/africa\_shape.geojson, resources/shapes/offshore\_shapes.geojson, resources/shapes/country\_shapes.geojson

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp

INFO:snakemake.logging:rule clean\_osm\_data:

input: resources/osm/raw/all\_raw\_cables.geojson, resources/osm/raw/all\_raw\_generators.geojson, resources/osm/raw/all\_raw\_lines.geojson, resources/osm/raw/all\_raw\_substations.geojson, resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, resources/shapes/africa\_shape.geojson

output: resources/osm/clean/all\_clean\_generators.geojson, resources/osm/clean/all\_clean\_generators.csv, resources/osm/clean/all\_clean\_lines.geojson, resources/osm/clean/all\_clean\_substations.geojson

log: logs/clean\_osm\_data.log

jobid: 10

benchmark: benchmarks/clean\_osm\_data

reason: Input files updated by another job: resources/shapes/africa\_shape.geojson, resources/shapes/offshore\_shapes.geojson, resources/shapes/country\_shapes.geojson

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp

INFO:snakemake.logging:

Benchmark: unable to collect cpu and memory benchmark statistics

CRITICAL:snakemake.logging:Benchmark: unable to collect cpu and memory benchmark statistics

[Wed Mar 1 15:54:30 2023]

INFO:snakemake.logging:[Wed Mar 1 15:54:30 2023]

Finished job 10.

INFO:snakemake.logging:Finished job 10.

3 of 18 steps (17%) done

INFO:snakemake.logging:3 of 18 steps (17%) done

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Wed Mar 1 15:54:30 2023]

INFO:snakemake.logging:[Wed Mar 1 15:54:30 2023]

rule build\_osm\_network:

input: resources/osm/clean/all\_clean\_generators.geojson, resources/osm/clean/all\_clean\_lines.geojson, resources/osm/clean/all\_clean\_substations.geojson, resources/shapes/country\_shapes.geojson

output: resources/base\_network/all\_lines\_build\_network.csv, resources/base\_network/all\_converters\_build\_network.csv, resources/base\_network/all\_transformers\_build\_network.csv, resources/base\_network/all\_buses\_build\_network.csv

log: logs/build\_osm\_network.log

jobid: 9

benchmark: benchmarks/build\_osm\_network

reason: Input files updated by another job: resources/shapes/country\_shapes.geojson, resources/osm/clean/all\_clean\_substations.geojson, resources/osm/clean/all\_clean\_generators.geojson, resources/osm/clean/all\_clean\_lines.geojson

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp

INFO:snakemake.logging:rule build\_osm\_network:

input: resources/osm/clean/all\_clean\_generators.geojson, resources/osm/clean/all\_clean\_lines.geojson, resources/osm/clean/all\_clean\_substations.geojson, resources/shapes/country\_shapes.geojson

output: resources/base\_network/all\_lines\_build\_network.csv, resources/base\_network/all\_converters\_build\_network.csv, resources/base\_network/all\_transformers\_build\_network.csv, resources/base\_network/all\_buses\_build\_network.csv

log: logs/build\_osm\_network.log

jobid: 9

benchmark: benchmarks/build\_osm\_network

reason: Input files updated by another job: resources/shapes/country\_shapes.geojson, resources/osm/clean/all\_clean\_substations.geojson, resources/osm/clean/all\_clean\_generators.geojson, resources/osm/clean/all\_clean\_lines.geojson

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp

INFO:snakemake.logging:

This is the repository path: C:\Users\Lenovo\Desktop\pypsa-earth

Had to go 0 folder(s) up.

INFO:\_\_main\_\_:Stage 1/5: Read input data

INFO:\_\_main\_\_:Stage 2/5: Add line endings to the substation datasets

INFO:\_\_main\_\_:Stage 3/5: Avoid nodes overpassing lines: enabled with tolerance

Verify lines overpassing nodes : 100%|█████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████| 149/149 [00:01<00:00, 106.86 lines/s]

INFO:\_\_main\_\_:Stage 4/5: Aggregate close substations: enabled with tolerance 500 m

INFO:\_\_main\_\_:Stage 3a/4: Set substation ids with tolerance of 0.50 km

Set substation ids : 100%|████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████| 596/596 [00:00<00:00, 3256.10 buses/s]

INFO:\_\_main\_\_:Stage 3b/4: Merge substations with the same id

INFO:\_\_main\_\_:Stage 3c/4: Specify the bus ids of the line endings

Set line bus ids : 100%|███████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████████| 152/152 [00:00<00:00, 232.71 lines/s]

INFO:\_\_main\_\_:Stage 3d/4: Add converters to lines

INFO:\_\_main\_\_:Stage 5/5: Add augmented substation to country with no data

INFO:\_\_main\_\_:Save outputs

Benchmark: unable to collect cpu and memory benchmark statistics

CRITICAL:snakemake.logging:Benchmark: unable to collect cpu and memory benchmark statistics

[Wed Mar 1 15:54:35 2023]

INFO:snakemake.logging:[Wed Mar 1 15:54:35 2023]

Finished job 9.

INFO:snakemake.logging:Finished job 9.

4 of 18 steps (22%) done

INFO:snakemake.logging:4 of 18 steps (22%) done

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Wed Mar 1 15:54:35 2023]

INFO:snakemake.logging:[Wed Mar 1 15:54:35 2023]

rule base\_network:

input: resources/base\_network/all\_buses\_build\_network.csv, resources/base\_network/all\_lines\_build\_network.csv, resources/base\_network/all\_converters\_build\_network.csv, resources/base\_network/all\_transformers\_build\_network.csv, resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson

output: networks/base.nc

log: logs/base\_network.log

jobid: 8

benchmark: benchmarks/base\_network

reason: Input files updated by another job: resources/base\_network/all\_converters\_build\_network.csv, resources/shapes/offshore\_shapes.geojson, resources/shapes/country\_shapes.geojson, resources/base\_network/all\_lines\_build\_network.csv, resources/base\_network/all\_buses\_build\_network.csv, resources/base\_network/all\_transformers\_build\_network.csv

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=500, mem\_mib=477

INFO:snakemake.logging:rule base\_network:

input: resources/base\_network/all\_buses\_build\_network.csv, resources/base\_network/all\_lines\_build\_network.csv, resources/base\_network/all\_converters\_build\_network.csv, resources/base\_network/all\_transformers\_build\_network.csv, resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson

output: networks/base.nc

log: logs/base\_network.log

jobid: 8

benchmark: benchmarks/base\_network

reason: Input files updated by another job: resources/base\_network/all\_converters\_build\_network.csv, resources/shapes/offshore\_shapes.geojson, resources/shapes/country\_shapes.geojson, resources/base\_network/all\_lines\_build\_network.csv, resources/base\_network/all\_buses\_build\_network.csv, resources/base\_network/all\_transformers\_build\_network.csv

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=500, mem\_mib=477

INFO:snakemake.logging:

INFO:\_\_main\_\_:Removing buses with voltages Float64Index([], dtype='float64')

C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\shapely\predicates.py:946: RuntimeWarning: invalid value encountered in within

return lib.within(a, b, \*\*kwargs)

INFO:pypsa.io:Exported network base.nc has lines, buses, transformers

Benchmark: unable to collect cpu and memory benchmark statistics

CRITICAL:snakemake.logging:Benchmark: unable to collect cpu and memory benchmark statistics

[Wed Mar 1 15:54:41 2023]

INFO:snakemake.logging:[Wed Mar 1 15:54:41 2023]

Finished job 8.

INFO:snakemake.logging:Finished job 8.

5 of 18 steps (28%) done

INFO:snakemake.logging:5 of 18 steps (28%) done

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Wed Mar 1 15:54:41 2023]

INFO:snakemake.logging:[Wed Mar 1 15:54:41 2023]

rule build\_bus\_regions:

input: resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, networks/base.nc, resources/shapes/gadm\_shapes.geojson

output: resources/bus\_regions/regions\_onshore.geojson, resources/bus\_regions/regions\_offshore.geojson

log: logs/build\_bus\_regions.log

jobid: 14

benchmark: benchmarks/build\_bus\_regions

reason: Input files updated by another job: resources/shapes/gadm\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, resources/shapes/country\_shapes.geojson, networks/base.nc

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=1000, mem\_mib=954

INFO:snakemake.logging:rule build\_bus\_regions:

input: resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, networks/base.nc, resources/shapes/gadm\_shapes.geojson

output: resources/bus\_regions/regions\_onshore.geojson, resources/bus\_regions/regions\_offshore.geojson

log: logs/build\_bus\_regions.log

jobid: 14

benchmark: benchmarks/build\_bus\_regions

reason: Input files updated by another job: resources/shapes/gadm\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, resources/shapes/country\_shapes.geojson, networks/base.nc

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=1000, mem\_mib=954

INFO:snakemake.logging:

[Wed Mar 1 15:54:41 2023]

INFO:snakemake.logging:[Wed Mar 1 15:54:41 2023]

rule build\_powerplants:

input: networks/base.nc, configs/powerplantmatching\_config.yaml, data/custom\_powerplants.csv, resources/osm/clean/all\_clean\_generators.csv, resources/shapes/gadm\_shapes.geojson

output: resources/powerplants.csv, resources/powerplants\_osm2pm.csv

log: logs/build\_powerplants.log

jobid: 13

benchmark: benchmarks/build\_powerplants

reason: Input files updated by another job: resources/shapes/gadm\_shapes.geojson, networks/base.nc, resources/osm/clean/all\_clean\_generators.csv

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=500, mem\_mib=477

INFO:snakemake.logging:rule build\_powerplants:

input: networks/base.nc, configs/powerplantmatching\_config.yaml, data/custom\_powerplants.csv, resources/osm/clean/all\_clean\_generators.csv, resources/shapes/gadm\_shapes.geojson

output: resources/powerplants.csv, resources/powerplants\_osm2pm.csv

log: logs/build\_powerplants.log

jobid: 13

benchmark: benchmarks/build\_powerplants

reason: Input files updated by another job: resources/shapes/gadm\_shapes.geojson, networks/base.nc, resources/osm/clean/all\_clean\_generators.csv

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=500, mem\_mib=477

INFO:snakemake.logging:

This is the repository path: C:\Users\Lenovo\Desktop\pypsa-earth

Had to go 0 folder(s) up.

INFO:pypsa.io:Imported network base.nc has buses, lines, transformers

WARNING:\_\_main\_\_:No off-shore shapes for BO

C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\geopandas\io\file.py:545: UserWarning: You are attempting to write an empty DataFrame to file. For some drivers, this operation may fail.

\_to\_file\_fiona(df, filename, driver, schema, crs, mode, \*\*kwargs)

Benchmark: unable to collect cpu and memory benchmark statistics

CRITICAL:snakemake.logging:Benchmark: unable to collect cpu and memory benchmark statistics

[Wed Mar 1 15:54:48 2023]

INFO:snakemake.logging:[Wed Mar 1 15:54:48 2023]

Finished job 14.

INFO:snakemake.logging:Finished job 14.

6 of 18 steps (33%) done

INFO:snakemake.logging:6 of 18 steps (33%) done

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Wed Mar 1 15:54:48 2023]

INFO:snakemake.logging:[Wed Mar 1 15:54:48 2023]

rule build\_demand\_profiles:

input: networks/base.nc, resources/bus\_regions/regions\_onshore.geojson, data/ssp2-2.6/2030/era5\_2013/SouthAmerica.nc, resources/shapes/gadm\_shapes.geojson

output: resources/demand\_profiles.csv

log: logs/build\_demand\_profiles.log

jobid: 17

benchmark: benchmarks/build\_demand\_profiles

reason: Input files updated by another job: resources/shapes/gadm\_shapes.geojson, resources/bus\_regions/regions\_onshore.geojson, networks/base.nc

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=3000, mem\_mib=2862

INFO:snakemake.logging:rule build\_demand\_profiles:

input: networks/base.nc, resources/bus\_regions/regions\_onshore.geojson, data/ssp2-2.6/2030/era5\_2013/SouthAmerica.nc, resources/shapes/gadm\_shapes.geojson

output: resources/demand\_profiles.csv

log: logs/build\_demand\_profiles.log

jobid: 17

benchmark: benchmarks/build\_demand\_profiles

reason: Input files updated by another job: resources/shapes/gadm\_shapes.geojson, resources/bus\_regions/regions\_onshore.geojson, networks/base.nc

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=3000, mem\_mib=2862

INFO:snakemake.logging:

INFO:pypsa.io:Imported network base.nc has buses, lines, transformers

INFO:powerplantmatching.collection:Create combined dataset for GEO, GPD

INFO:powerplantmatching.matching:Comparing data sources `GEO` and `GPD`

WARNING:powerplantmatching.matching:No matches found

INFO:pypsa.io:Imported network base.nc has buses, lines, transformers

INFO:\_\_main\_\_:Load data scaled with scaling factor 1.

INFO:\_\_main\_\_:Demand\_profiles csv file created for the corrisponding snapshots.

Benchmark: unable to collect cpu and memory benchmark statistics

CRITICAL:snakemake.logging:Benchmark: unable to collect cpu and memory benchmark statistics

[Wed Mar 1 15:54:56 2023]

INFO:snakemake.logging:[Wed Mar 1 15:54:56 2023]

Finished job 17.

INFO:snakemake.logging:Finished job 17.

7 of 18 steps (39%) done

INFO:snakemake.logging:7 of 18 steps (39%) done

INFO:powerplantmatching.core:Adding stored geo-position from C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\powerplantmatching\package\_data\parsed\_locations.csv

C:\Users\Lenovo\Desktop\pypsa-earth\.snakemake\scripts\tmpdo4sic1x.build\_powerplants.py:225: FutureWarning: The frame.append method is deprecated and will be removed from pandas in a future version. Use pandas.concat instead.

return ppl.append(add\_ppls, sort=False, ignore\_index=True, verify\_integrity=True)

WARNING:root:No powerplants known in: BO

WARNING:root:Couldn't find close bus for 105 powerplants

Benchmark: unable to collect cpu and memory benchmark statistics

CRITICAL:snakemake.logging:Benchmark: unable to collect cpu and memory benchmark statistics

[Wed Mar 1 15:54:58 2023]

INFO:snakemake.logging:[Wed Mar 1 15:54:58 2023]

Finished job 13.

INFO:snakemake.logging:Finished job 13.

8 of 18 steps (44%) done

INFO:snakemake.logging:8 of 18 steps (44%) done

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Wed Mar 1 15:54:58 2023]

INFO:snakemake.logging:[Wed Mar 1 15:54:58 2023]

rule build\_renewable\_profiles:

input: networks/base.nc, resources/natura.tiff, data/copernicus/PROBAV\_LC100\_global\_v3.0.1\_2019-nrt\_Discrete-Classification-map\_EPSG-4326.tif, data/gebco/GEBCO\_2021\_TID.nc, resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, data/hydro\_capacities.csv, data/eia\_hydro\_annual\_generation.csv, resources/powerplants.csv, resources/bus\_regions/regions\_onshore.geojson, cutouts/southamerica-2013-era5.nc

output: resources/renewable\_profiles/profile\_solar.nc

log: logs/build\_renewable\_profile\_solar.log

jobid: 15

benchmark: benchmarks/build\_renewable\_profiles\_solar

reason: Input files updated by another job: resources/bus\_regions/regions\_onshore.geojson, resources/shapes/offshore\_shapes.geojson, resources/shapes/country\_shapes.geojson, resources/natura.tiff, networks/base.nc, resources/powerplants.csv

wildcards: technology=solar

threads: 4

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=20000, mem\_mib=19074

INFO:snakemake.logging:rule build\_renewable\_profiles:

input: networks/base.nc, resources/natura.tiff, data/copernicus/PROBAV\_LC100\_global\_v3.0.1\_2019-nrt\_Discrete-Classification-map\_EPSG-4326.tif, data/gebco/GEBCO\_2021\_TID.nc, resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, data/hydro\_capacities.csv, data/eia\_hydro\_annual\_generation.csv, resources/powerplants.csv, resources/bus\_regions/regions\_onshore.geojson, cutouts/southamerica-2013-era5.nc

output: resources/renewable\_profiles/profile\_solar.nc

log: logs/build\_renewable\_profile\_solar.log

jobid: 15

benchmark: benchmarks/build\_renewable\_profiles\_solar

reason: Input files updated by another job: resources/bus\_regions/regions\_onshore.geojson, resources/shapes/offshore\_shapes.geojson, resources/shapes/country\_shapes.geojson, resources/natura.tiff, networks/base.nc, resources/powerplants.csv

wildcards: technology=solar

threads: 4

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=20000, mem\_mib=19074

INFO:snakemake.logging:

INFO:\_\_main\_\_:correction\_factor is set as 0.854337

INFO:\_\_main\_\_:Calculate landuse availabilities...

INFO:\_\_main\_\_:Completed availability calculation (39.94s)

INFO:atlite.convert:Convert and aggregate 'pv'.

INFO:atlite.convert:Convert and aggregate 'pv'.

INFO:\_\_main\_\_:Calculating maximal capacity per bus (method 'simple')

INFO:\_\_main\_\_:Calculate average distances.

Benchmark: unable to collect cpu and memory benchmark statistics

CRITICAL:snakemake.logging:Benchmark: unable to collect cpu and memory benchmark statistics

[Wed Mar 1 15:55:48 2023]

INFO:snakemake.logging:[Wed Mar 1 15:55:48 2023]

Finished job 15.

INFO:snakemake.logging:Finished job 15.

9 of 18 steps (50%) done

INFO:snakemake.logging:9 of 18 steps (50%) done

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Wed Mar 1 15:55:48 2023]

INFO:snakemake.logging:[Wed Mar 1 15:55:48 2023]

rule build\_renewable\_profiles:

input: networks/base.nc, resources/natura.tiff, data/copernicus/PROBAV\_LC100\_global\_v3.0.1\_2019-nrt\_Discrete-Classification-map\_EPSG-4326.tif, data/gebco/GEBCO\_2021\_TID.nc, resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, data/hydro\_capacities.csv, data/eia\_hydro\_annual\_generation.csv, resources/powerplants.csv, resources/bus\_regions/regions\_onshore.geojson, cutouts/southamerica-2013-era5.nc

output: resources/renewable\_profiles/profile\_hydro.nc

log: logs/build\_renewable\_profile\_hydro.log

jobid: 16

benchmark: benchmarks/build\_renewable\_profiles\_hydro

reason: Input files updated by another job: resources/bus\_regions/regions\_onshore.geojson, resources/shapes/offshore\_shapes.geojson, resources/shapes/country\_shapes.geojson, resources/natura.tiff, networks/base.nc, resources/powerplants.csv

wildcards: technology=hydro

threads: 4

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=20000, mem\_mib=19074

INFO:snakemake.logging:rule build\_renewable\_profiles:

input: networks/base.nc, resources/natura.tiff, data/copernicus/PROBAV\_LC100\_global\_v3.0.1\_2019-nrt\_Discrete-Classification-map\_EPSG-4326.tif, data/gebco/GEBCO\_2021\_TID.nc, resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, data/hydro\_capacities.csv, data/eia\_hydro\_annual\_generation.csv, resources/powerplants.csv, resources/bus\_regions/regions\_onshore.geojson, cutouts/southamerica-2013-era5.nc

output: resources/renewable\_profiles/profile\_hydro.nc

log: logs/build\_renewable\_profile\_hydro.log

jobid: 16

benchmark: benchmarks/build\_renewable\_profiles\_hydro

reason: Input files updated by another job: resources/bus\_regions/regions\_onshore.geojson, resources/shapes/offshore\_shapes.geojson, resources/shapes/country\_shapes.geojson, resources/natura.tiff, networks/base.nc, resources/powerplants.csv

wildcards: technology=hydro

threads: 4

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=20000, mem\_mib=19074

INFO:snakemake.logging:

INFO:\_\_main\_\_:Hydro normalization mode hydro\_capacities

Determine upstream basins per plant: 112it [00:00, 284.82it/s]

INFO:atlite.convert:Convert and aggregate 'runoff'.

Shift and aggregate runoff by plant: 112it [00:00, 250.17it/s]

C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\atlite\convert.py:876: RuntimeWarning: invalid value encountered in double\_scalars

default\_factor = tot\_common\_yearly / tot\_common\_runoff

WARNING:atlite.convert:Missing countries in the normalization dataframe: BO. Default value used

WARNING:atlite.convert:Missing installed plants in: BO. Default value used

Benchmark: unable to collect cpu and memory benchmark statistics

CRITICAL:snakemake.logging:Benchmark: unable to collect cpu and memory benchmark statistics

[Wed Mar 1 15:56:35 2023]

INFO:snakemake.logging:[Wed Mar 1 15:56:35 2023]

Finished job 16.

INFO:snakemake.logging:Finished job 16.

10 of 18 steps (56%) done

INFO:snakemake.logging:10 of 18 steps (56%) done

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Wed Mar 1 15:56:35 2023]

INFO:snakemake.logging:[Wed Mar 1 15:56:35 2023]

rule build\_renewable\_profiles:

input: networks/base.nc, resources/natura.tiff, data/copernicus/PROBAV\_LC100\_global\_v3.0.1\_2019-nrt\_Discrete-Classification-map\_EPSG-4326.tif, data/gebco/GEBCO\_2021\_TID.nc, resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, data/hydro\_capacities.csv, data/eia\_hydro\_annual\_generation.csv, resources/powerplants.csv, resources/bus\_regions/regions\_onshore.geojson, cutouts/southamerica-2013-era5.nc

output: resources/renewable\_profiles/profile\_onwind.nc

log: logs/build\_renewable\_profile\_onwind.log

jobid: 7

benchmark: benchmarks/build\_renewable\_profiles\_onwind

reason: Input files updated by another job: resources/bus\_regions/regions\_onshore.geojson, resources/shapes/offshore\_shapes.geojson, resources/shapes/country\_shapes.geojson, resources/natura.tiff, networks/base.nc, resources/powerplants.csv

wildcards: technology=onwind

threads: 4

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=20000, mem\_mib=19074

INFO:snakemake.logging:rule build\_renewable\_profiles:

input: networks/base.nc, resources/natura.tiff, data/copernicus/PROBAV\_LC100\_global\_v3.0.1\_2019-nrt\_Discrete-Classification-map\_EPSG-4326.tif, data/gebco/GEBCO\_2021\_TID.nc, resources/shapes/country\_shapes.geojson, resources/shapes/offshore\_shapes.geojson, data/hydro\_capacities.csv, data/eia\_hydro\_annual\_generation.csv, resources/powerplants.csv, resources/bus\_regions/regions\_onshore.geojson, cutouts/southamerica-2013-era5.nc

output: resources/renewable\_profiles/profile\_onwind.nc

log: logs/build\_renewable\_profile\_onwind.log

jobid: 7

benchmark: benchmarks/build\_renewable\_profiles\_onwind

reason: Input files updated by another job: resources/bus\_regions/regions\_onshore.geojson, resources/shapes/offshore\_shapes.geojson, resources/shapes/country\_shapes.geojson, resources/natura.tiff, networks/base.nc, resources/powerplants.csv

wildcards: technology=onwind

threads: 4

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=20000, mem\_mib=19074

INFO:snakemake.logging:

INFO:\_\_main\_\_:Calculate landuse availabilities...

INFO:\_\_main\_\_:Completed availability calculation (46.11s)

INFO:atlite.convert:Convert and aggregate 'wind'.

INFO:atlite.convert:Convert and aggregate 'wind'.

INFO:\_\_main\_\_:Calculating maximal capacity per bus (method 'simple')

INFO:\_\_main\_\_:Calculate average distances.

Benchmark: unable to collect cpu and memory benchmark statistics

CRITICAL:snakemake.logging:Benchmark: unable to collect cpu and memory benchmark statistics

[Wed Mar 1 15:57:29 2023]

INFO:snakemake.logging:[Wed Mar 1 15:57:29 2023]

Finished job 7.

INFO:snakemake.logging:Finished job 7.

11 of 18 steps (61%) done

INFO:snakemake.logging:11 of 18 steps (61%) done

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Wed Mar 1 15:57:29 2023]

INFO:snakemake.logging:[Wed Mar 1 15:57:29 2023]

rule add\_electricity:

input: resources/renewable\_profiles/profile\_onwind.nc, resources/renewable\_profiles/profile\_solar.nc, resources/renewable\_profiles/profile\_hydro.nc, networks/base.nc, data/costs.csv, resources/powerplants.csv, resources/shapes/gadm\_shapes.geojson, data/hydro\_capacities.csv, resources/demand\_profiles.csv

output: networks/elec.nc

log: logs/add\_electricity.log

jobid: 6

benchmark: benchmarks/add\_electricity

reason: Missing output files: networks/elec.nc; Input files updated by another job: resources/shapes/gadm\_shapes.geojson, resources/renewable\_profiles/profile\_hydro.nc, resources/demand\_profiles.csv, networks/base.nc, resources/renewable\_profiles/profile\_solar.nc, resources/powerplants.csv, resources/renewable\_profiles/profile\_onwind.nc

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=3000, mem\_mib=2862

INFO:snakemake.logging:rule add\_electricity:

input: resources/renewable\_profiles/profile\_onwind.nc, resources/renewable\_profiles/profile\_solar.nc, resources/renewable\_profiles/profile\_hydro.nc, networks/base.nc, data/costs.csv, resources/powerplants.csv, resources/shapes/gadm\_shapes.geojson, data/hydro\_capacities.csv, resources/demand\_profiles.csv

output: networks/elec.nc

log: logs/add\_electricity.log

jobid: 6

benchmark: benchmarks/add\_electricity

reason: Missing output files: networks/elec.nc; Input files updated by another job: resources/shapes/gadm\_shapes.geojson, resources/renewable\_profiles/profile\_hydro.nc, resources/demand\_profiles.csv, networks/base.nc, resources/renewable\_profiles/profile\_solar.nc, resources/powerplants.csv, resources/renewable\_profiles/profile\_onwind.nc

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=3000, mem\_mib=2862

INFO:snakemake.logging:

INFO:pypsa.io:Imported network base.nc has buses, lines, transformers

INFO:\_\_main\_\_:Adding 21 generators with capacities [GW]

carrier

biomass 0.08

oil 0.01

solar 0.11

Name: p\_nom, dtype: float64

WARNING:pypsa.io:The following Generator have buses which are not defined:

Index(['C37', 'C38', 'C39', 'C73', 'C74', 'C75', 'C76', 'C77', 'C78', 'C79',

'C80', 'C81', 'C82', 'C83', 'C84', 'C85', 'C86', 'C99', 'C100', 'C103',

'C104'],

dtype='object')

C:\Users\Lenovo\Desktop\pypsa-earth\.snakemake\scripts\tmp79hm0a2n.add\_electricity.py:434: FutureWarning: In a future version, the Index constructor will not infer numeric dtypes when passed object-dtype sequences (matching Series behavior)

inflow\_stations = pd.Index(bus\_id[inflow\_idx])

Traceback (most recent call last):

File "C:\Users\Lenovo\Desktop\pypsa-earth\.snakemake\scripts\tmp79hm0a2n.add\_electricity.py", line 778, in <module>

attach\_hydro(n, costs, ppl)

File "C:\Users\Lenovo\Desktop\pypsa-earth\.snakemake\scripts\tmp79hm0a2n.add\_electricity.py", line 438, in attach\_hydro

f"inflow time-series for at least one bus: {', '.join(missing\_c)}"

TypeError: sequence item 0: expected str instance, float found

[Wed Mar 1 15:57:36 2023]

INFO:snakemake.logging:[Wed Mar 1 15:57:36 2023]

Error in rule add\_electricity:

jobid: 6

input: resources/renewable\_profiles/profile\_onwind.nc, resources/renewable\_profiles/profile\_solar.nc, resources/renewable\_profiles/profile\_hydro.nc, networks/base.nc, data/costs.csv, resources/powerplants.csv, resources/shapes/gadm\_shapes.geojson, data/hydro\_capacities.csv, resources/demand\_profiles.csv

output: networks/elec.nc

log: logs/add\_electricity.log (check log file(s) for error details)

ERROR:snakemake.logging:Error in rule add\_electricity:

jobid: 6

input: resources/renewable\_profiles/profile\_onwind.nc, resources/renewable\_profiles/profile\_solar.nc, resources/renewable\_profiles/profile\_hydro.nc, networks/base.nc, data/costs.csv, resources/powerplants.csv, resources/shapes/gadm\_shapes.geojson, data/hydro\_capacities.csv, resources/demand\_profiles.csv

output: networks/elec.nc

log: logs/add\_electricity.log (check log file(s) for error details)

Shutting down, this might take some time.

WARNING:snakemake.logging:Shutting down, this might take some time.

Exiting because a job execution failed. Look above for error message

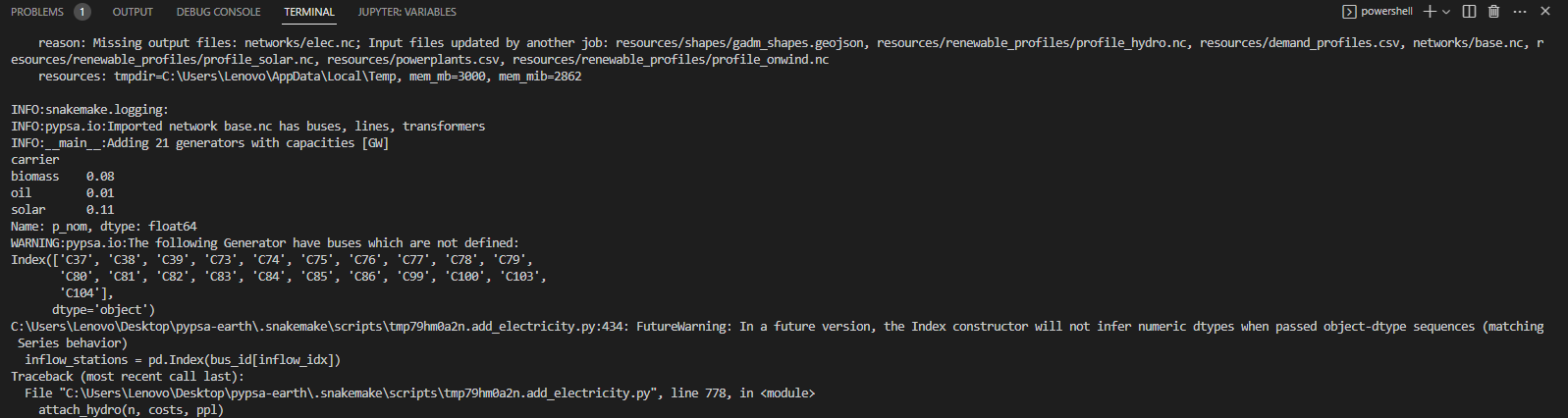
ERROR:snakemake.logging:Exiting because a job execution failed. Look above for error message

Complete log: .snakemake\log\2023-03-01T155309.759635.snakemake.log

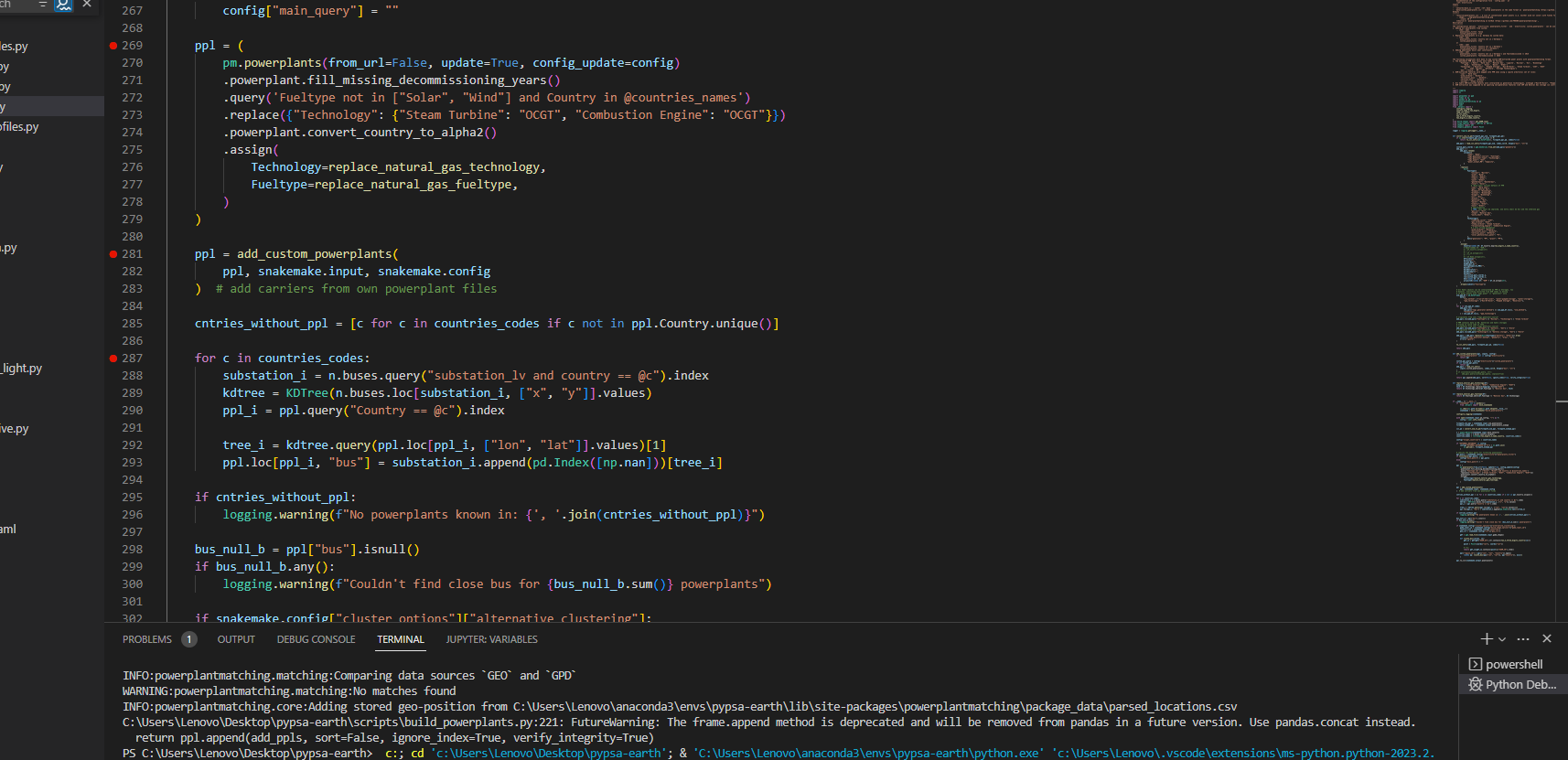
WARNING:snakemake.logging:Complete log: .snakemake\log\2023-03-01T155309.759635.snakemake.log

### Debugging custom\_powerplants function

* From errors in the execution of the workflow, the following can be found:
  + Add\_electricity cannot work with the base.nc file because it doesn’t have buses defined for the generators in the model



* + It seems there is a problem with the bus designation for the powerplants which (I think) is done in the for function at line 287 in the build\_powerplant script however that's how far I got... anyone has some time to exchange ideas on how I could deal with this?
* After running the debugger with the build\_powerplant script the problem was found: Apparently, after the predefined ppm data is used to define the ppl dataframe, line 269, they automatically change the country name to the code. Because of that, when the custom\_powerplants are added, they keep using the same country name and not the alpha2 configuration. Because of this, when buses are assigned to the index of powerplants (line 290), it doesn't recognizes the Country names... A simple "fix" can be to just make this remark on the initial documentation lines in the build\_powerplants rule and mention that when generating the custom\_powerplant file, it's important to use the alpha2 nomenclature instead of the country's name in the country column.



* After this, the values con the Country column form the custom\_powerplant.csv is modified and Bolivia is replaced by “BO”. After running the script, the powerplants.csv file now includes buses designated to each powerplant

### Rerunning the workflow

* With the debugging done and the problem fixed for introducing custom\_powerplants.csv in the model, the workflow was run from the beginning again (snakemake -j 4 solve\_all\_networks –forceall), this time using the terminal in VSCode
* This time a new error appeared consisting on

Finished job 7.

INFO:snakemake.logging:Finished job 7.

11 of 18 steps (61%) done

INFO:snakemake.logging:11 of 18 steps (61%) done

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Fri Mar 3 11:53:17 2023]

INFO:snakemake.logging:[Fri Mar 3 11:53:17 2023]

rule add\_electricity:

input: resources/renewable\_profiles/profile\_onwind.nc, resources/renewable\_profiles/profile\_solar.nc, resources/renewable\_profiles/profile\_hydro.nc, networks/base.nc, data/costs.csv, resources/powerplants.csv, resources/shapes/gadm\_shapes.geojson, data/hydro\_capacities.csv, resources/demand\_profiles.csv

output: networks/elec.nc

log: logs/add\_electricity.log

jobid: 6

benchmark: benchmarks/add\_electricity

reason: Missing output files: networks/elec.nc; Input files updated by another job: resources/renewable\_profiles/profile\_hydro.nc, resources/renewable\_profiles/profile\_onwind.nc, resources/demand\_profiles.csv, resources/powerplants.csv, resources/shapes/gadm\_shapes.geojson, resources/renewable\_profiles/profile\_solar.nc, networks/base.nc

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=3000, mem\_mib=2862

INFO:snakemake.logging:rule add\_electricity:

input: resources/renewable\_profiles/profile\_onwind.nc, resources/renewable\_profiles/profile\_solar.nc, resources/renewable\_profiles/profile\_hydro.nc, networks/base.nc, data/costs.csv, resources/powerplants.csv, resources/shapes/gadm\_shapes.geojson, data/hydro\_capacities.csv, resources/demand\_profiles.csv

output: networks/elec.nc

log: logs/add\_electricity.log

jobid: 6

benchmark: benchmarks/add\_electricity

reason: Missing output files: networks/elec.nc; Input files updated by another job: resources/renewable\_profiles/profile\_hydro.nc, resources/renewable\_profiles/profile\_onwind.nc, resources/demand\_profiles.csv, resources/powerplants.csv, resources/shapes/gadm\_shapes.geojson, resources/renewable\_profiles/profile\_solar.nc, networks/base.nc

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem\_mb=3000, mem\_mib=2862

INFO:snakemake.logging:

INFO:pypsa.io:Imported network base.nc has buses, lines, transformers

INFO:\_\_main\_\_:Adding 21 generators with capacities [GW]

carrier

biomass 0.08

oil 0.01

solar 0.11

Name: p\_nom, dtype: float64

WARNING:\_\_main\_\_:Assuming max\_hours=6 for hydro reservoirs in the countries: BO

INFO:\_\_main\_\_:Heuristics applied to distribute renewable capacities [MW] Country

BO 147.32

Name: Capacity, dtype: float64

INFO:\_\_main\_\_:Scaling capacity stats to 100.00% of installed capacity acquired from stats.

Traceback (most recent call last):

File "C:\Users\Lenovo\Desktop\pypsa-earth\.snakemake\scripts\tmpl7v40exq.add\_electricity.py", line 780, in <module>

estimate\_renewable\_capacities\_irena(n, snakemake.config)

File "C:\Users\Lenovo\Desktop\pypsa-earth\.snakemake\scripts\tmpl7v40exq.add\_electricity.py", line 670, in estimate\_renewable\_capacities\_irena

n.generators\_t.p\_max\_pu[tech\_i].mean()

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\pandas\core\frame.py", line 3813, in \_\_getitem\_\_

indexer = self.columns.\_get\_indexer\_strict(key, "columns")[1]

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\pandas\core\indexes\base.py", line 6070, in \_get\_indexer\_strict

self.\_raise\_if\_missing(keyarr, indexer, axis\_name)

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\pandas\core\indexes\base.py", line 6133, in \_raise\_if\_missing

raise KeyError(f"{not\_found} not in index")

KeyError: "['C103', 'C104'] not in index"

[Fri Mar 3 11:53:26 2023]

INFO:snakemake.logging:[Fri Mar 3 11:53:26 2023]

Error in rule add\_electricity:

jobid: 6

input: resources/renewable\_profiles/profile\_onwind.nc, resources/renewable\_profiles/profile\_solar.nc, resources/renewable\_profiles/profile\_hydro.nc, networks/base.nc, data/costs.csv, resources/powerplants.csv, resources/shapes/gadm\_shapes.geojson, data/hydro\_capacities.csv, resources/demand\_profiles.csv

output: networks/elec.nc

log: logs/add\_electricity.log (check log file(s) for error details)

ERROR:snakemake.logging:Error in rule add\_electricity:

jobid: 6

input: resources/renewable\_profiles/profile\_onwind.nc, resources/renewable\_profiles/profile\_solar.nc, resources/renewable\_profiles/profile\_hydro.nc, networks/base.nc, data/costs.csv, resources/powerplants.csv, resources/shapes/gadm\_shapes.geojson, data/hydro\_capacities.csv, resources/demand\_profiles.csv

output: networks/elec.nc

log: logs/add\_electricity.log (check log file(s) for error details)

Shutting down, this might take some time.

WARNING:snakemake.logging:Shutting down, this might take some time.

Exiting because a job execution failed. Look above for error message

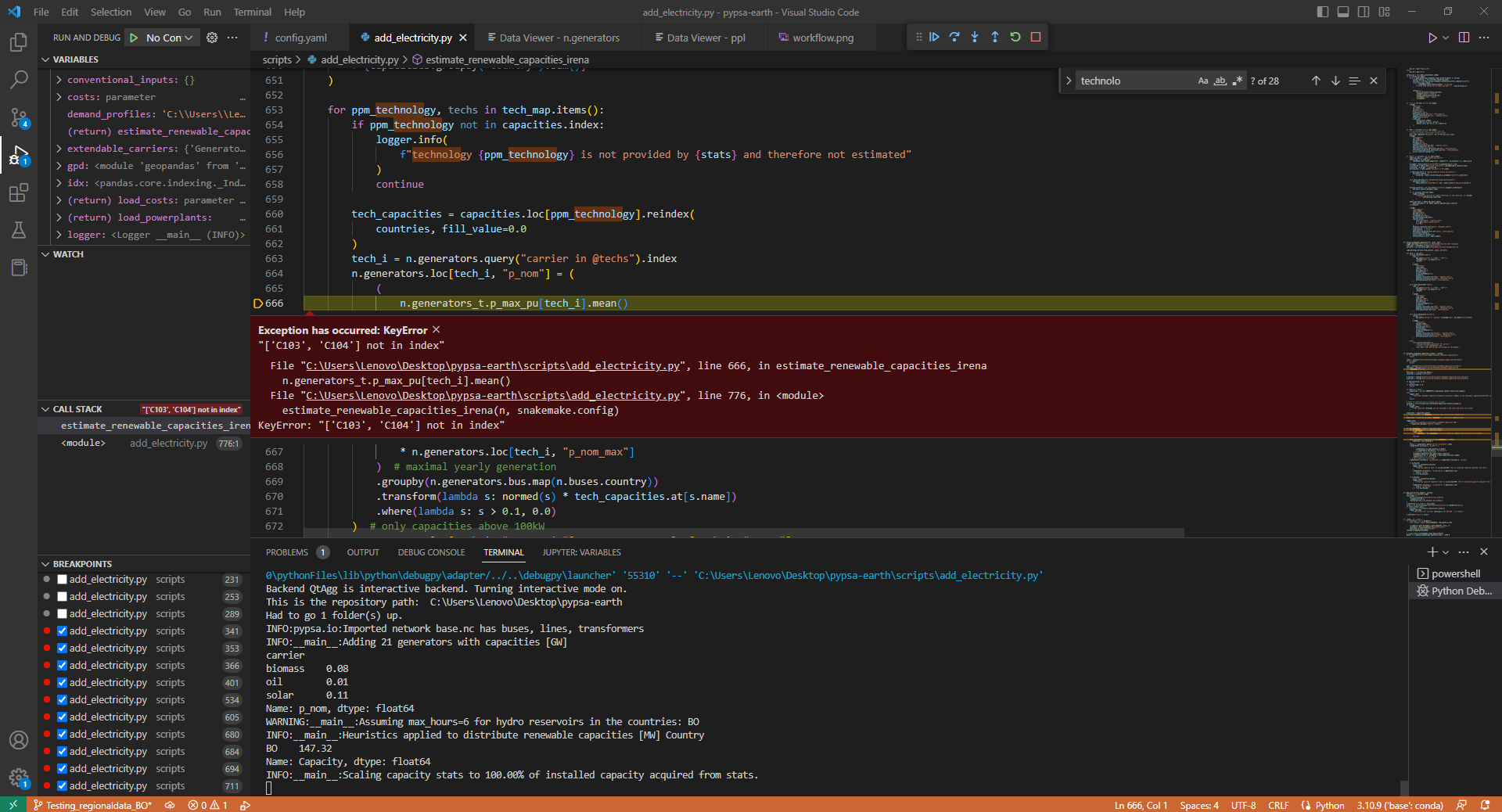
ERROR:snakemake.logging:Exiting because a job execution failed. Look above for error message

Complete log: .snakemake\log\2023-03-03T114911.422422.snakemake.log

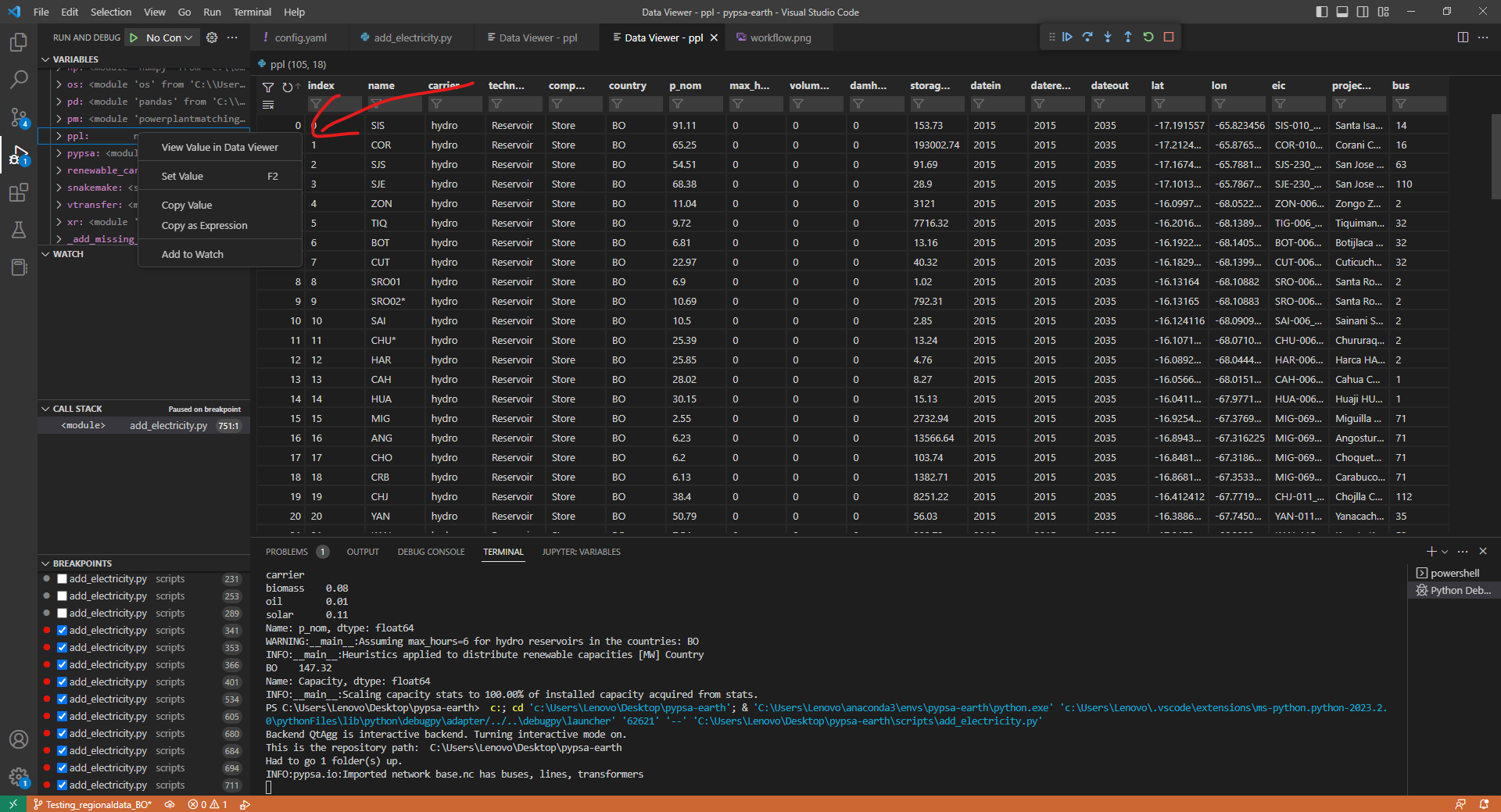
WARNING:snakemake.logging:Complete log: .snakemake\log\2023-03-03T114911.422422.snakemake.log

PS C:\Users\Lenovo\Desktop\pypsa-earth>

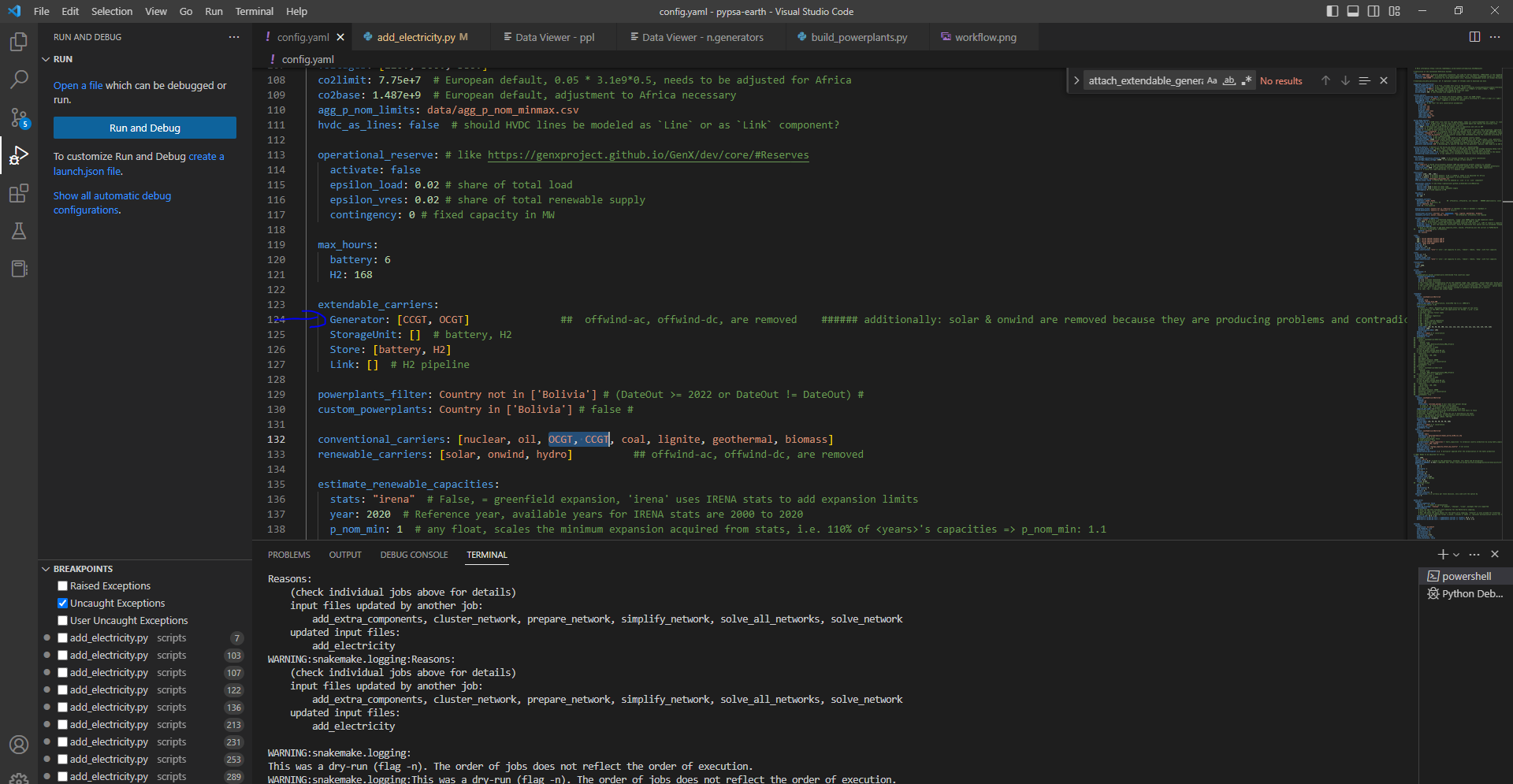
* When debugging line by line the following error is found:



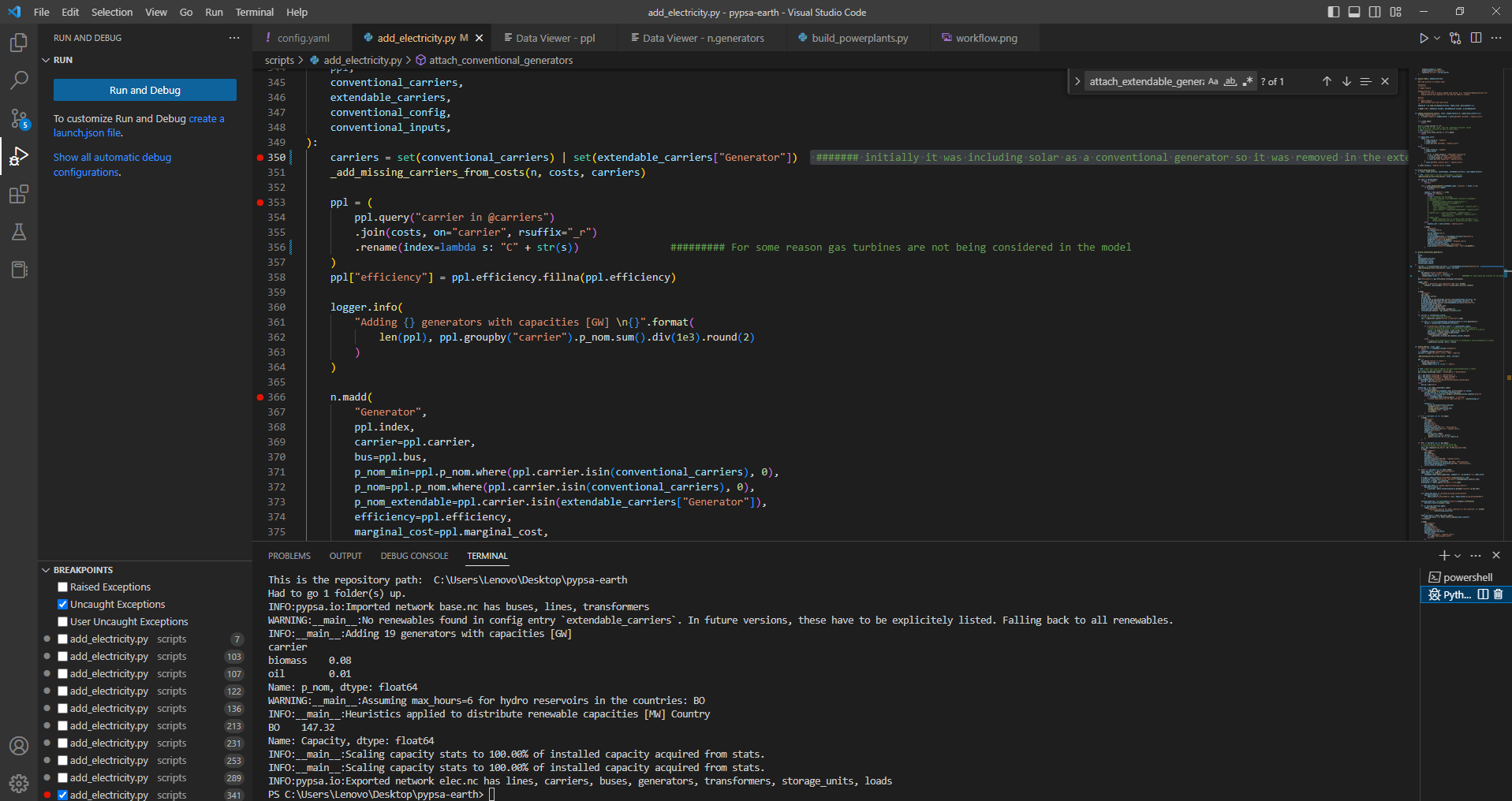
* When reviewing the processes when adding powerplants to the base network, it seems that PV plants (indexed as #103 and #104) are assigned as conventional powerplants like Oil or biomass. A check to the custom\_powerplants was made and the carries/technology used for PV plants was didn’t had the proper configuration (it had both uppercases “PV” instead of “Pv”). The values were checked using the data viewer option in VS Code



* The value was changed in the custom\_powerplant.csv file and the workflow was run from the beginning once again, however the same error appeared. Again, with the debbuger the problem is found in the same place and since the only condition for considering solar as a conventional generator is set as an extendable\_carrier (generator) in the config.yaml file, this was modified



* Additionally: solar & onwind are removed because they are producing problems and contradicting documentation and line 601 in add\_electricity.py script. A commend with this problem is added in the add\_electricity script, in line 350 (####### initially it was including solar as a conventional generator so it was removed in the extendable\_carriers (generators) from the config.yaml file)



* With this changes, the rule is solved and the workflow is again run in the terminal from where it stopped. While the rest of the rules are followed, optimization is not possible given that the problem is not run from a terminal that was opened with as an administrator:

INFO:snakemake.logging:

[Tue Mar 7 11:21:41 2023]

INFO:snakemake.logging:[Tue Mar 7 11:21:41 2023]

rule solve\_network:

input: networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

output: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

log: logs\solve\_network\elec\_s\_10\_ec\_lcopt\_Co2L-6H\_solver.log, logs/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H\_python.log, logs/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H\_memory.log

jobid: 1

benchmark: benchmarks/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H

reason: Input files updated by another job: networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

wildcards: simpl=, clusters=10, ll=copt, opts=Co2L-6H

threads: 4

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem=5975

INFO:snakemake.logging:rule solve\_network:

input: networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

output: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

log: logs\solve\_network\elec\_s\_10\_ec\_lcopt\_Co2L-6H\_solver.log, logs/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H\_python.log, logs/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H\_memory.log

jobid: 1

benchmark: benchmarks/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H

reason: Input files updated by another job: networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

wildcards: simpl=, clusters=10, ll=copt, opts=Co2L-6H

threads: 4

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem=5975

INFO:snakemake.logging:

Traceback (most recent call last):

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\snakemake\\_\_init\_\_.py", line 760, in snakemake

success = workflow.execute(

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\snakemake\workflow.py", line 1095, in execute

raise e

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\snakemake\workflow.py", line 1091, in execute

success = self.scheduler.schedule()

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\snakemake\scheduler.py", line 592, in schedule

self.run(runjobs)

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\snakemake\scheduler.py", line 641, in run

executor.run\_jobs(

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\snakemake\executors\\_\_init\_\_.py", line 155, in run\_jobs

self.run(

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\snakemake\executors\\_\_init\_\_.py", line 536, in run

future = self.run\_single\_job(job)

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\snakemake\executors\\_\_init\_\_.py", line 589, in run\_single\_job

self.cached\_or\_run, job, run\_wrapper, \*self.job\_args\_and\_prepare(job)

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\snakemake\executors\\_\_init\_\_.py", line 541, in job\_args\_and\_prepare

job.prepare()

File "C:\Users\Lenovo\anaconda3\envs\pypsa-earth\lib\site-packages\snakemake\jobs.py", line 911, in prepare

os.symlink(os.path.abspath(source), link)

OSError: [WinError 1314] A required privilege is not held by the client: 'C:\\Users\\Lenovo\\Desktop\\pypsa-earth\\.git' -> 'C:\\Users\\Lenovo\\Desktop\\pypsa-earth\\.snakemake\\shadow\\tmpvaq51pfx\\.git'

* The workflow is run in the acandonda prompt, opened as administrator, and the optimization is solved without errors:

(base) C:\Windows\system32>cd..

(base) C:\Windows>cd..

(base) C:\>cd users

(base) C:\Users>cd lenovo

(base) C:\Users\Lenovo>cd desktop

(base) C:\Users\Lenovo\Desktop>cd pypsa-earth

(base) C:\Users\Lenovo\Desktop\pypsa-earth>conda activate pypsa-earth

(pypsa-earth) C:\Users\Lenovo\Desktop\pypsa-earth>snakemake -j 4 solve\_all\_networks -n

Set parameter Username

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No parameters matching '\_test' found

Building DAG of jobs...

WARNING:snakemake.logging:Building DAG of jobs...

Job stats:

job count min threads max threads

------------------ ------- ------------- -------------

solve\_all\_networks 1 1 1

solve\_network 1 1 1

total 2 1 1

WARNING:snakemake.logging:Job stats:

job count min threads max threads

------------------ ------- ------------- -------------

solve\_all\_networks 1 1 1

solve\_network 1 1 1

total 2 1 1

INFO:snakemake.logging:

[Tue Mar 7 11:25:32 2023]

INFO:snakemake.logging:[Tue Mar 7 11:25:32 2023]

rule solve\_network:

input: networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

output: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

log: logs\solve\_network\elec\_s\_10\_ec\_lcopt\_Co2L-6H\_solver.log, logs/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H\_python.log, logs/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H\_memory.log

jobid: 1

benchmark: benchmarks/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H

reason: Missing output files: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc; Updated input files: networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

wildcards: simpl=, clusters=10, ll=copt, opts=Co2L-6H

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem=5975

INFO:snakemake.logging:rule solve\_network:

input: networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

output: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

log: logs\solve\_network\elec\_s\_10\_ec\_lcopt\_Co2L-6H\_solver.log, logs/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H\_python.log, logs/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H\_memory.log

jobid: 1

benchmark: benchmarks/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H

reason: Missing output files: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc; Updated input files: networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

wildcards: simpl=, clusters=10, ll=copt, opts=Co2L-6H

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem=5975

INFO:snakemake.logging:

[Tue Mar 7 11:25:32 2023]

INFO:snakemake.logging:[Tue Mar 7 11:25:32 2023]

localrule solve\_all\_networks:

input: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

jobid: 0

reason: Input files updated by another job: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp

INFO:snakemake.logging:localrule solve\_all\_networks:

input: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

jobid: 0

reason: Input files updated by another job: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp

INFO:snakemake.logging:

Job stats:

job count min threads max threads

------------------ ------- ------------- -------------

solve\_all\_networks 1 1 1

solve\_network 1 1 1

total 2 1 1

WARNING:snakemake.logging:Job stats:

job count min threads max threads

------------------ ------- ------------- -------------

solve\_all\_networks 1 1 1

solve\_network 1 1 1

total 2 1 1

Reasons:

(check individual jobs above for details)

input files updated by another job:

solve\_all\_networks

missing output files:

solve\_network

updated input files:

solve\_network

WARNING:snakemake.logging:Reasons:

(check individual jobs above for details)

input files updated by another job:

solve\_all\_networks

missing output files:

solve\_network

updated input files:

solve\_network

WARNING:snakemake.logging:

This was a dry-run (flag -n). The order of jobs does not reflect the order of execution.

WARNING:snakemake.logging:This was a dry-run (flag -n). The order of jobs does not reflect the order of execution.

(pypsa-earth) C:\Users\Lenovo\Desktop\pypsa-earth>snakemake -j 4 solve\_all\_networks

Set parameter Username

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No parameters matching '\_test' found

Building DAG of jobs...

WARNING:snakemake.logging:Building DAG of jobs...

Provided cores: 4

WARNING:snakemake.logging:Provided cores: 4

Rules claiming more threads will be scaled down.

WARNING:snakemake.logging:Rules claiming more threads will be scaled down.

Job stats:

job count min threads max threads

------------------ ------- ------------- -------------

solve\_all\_networks 1 1 1

solve\_network 1 4 4

total 2 1 4

WARNING:snakemake.logging:Job stats:

job count min threads max threads

------------------ ------- ------------- -------------

solve\_all\_networks 1 1 1

solve\_network 1 4 4

total 2 1 4

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Tue Mar 7 11:25:45 2023]

INFO:snakemake.logging:[Tue Mar 7 11:25:45 2023]

rule solve\_network:

input: networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

output: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

log: logs\solve\_network\elec\_s\_10\_ec\_lcopt\_Co2L-6H\_solver.log, logs/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H\_python.log, logs/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H\_memory.log

jobid: 1

benchmark: benchmarks/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H

reason: Missing output files: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc; Updated input files: networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

wildcards: simpl=, clusters=10, ll=copt, opts=Co2L-6H

threads: 4

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem=5975

INFO:snakemake.logging:rule solve\_network:

input: networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

output: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

log: logs\solve\_network\elec\_s\_10\_ec\_lcopt\_Co2L-6H\_solver.log, logs/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H\_python.log, logs/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H\_memory.log

jobid: 1

benchmark: benchmarks/solve\_network/elec\_s\_10\_ec\_lcopt\_Co2L-6H

reason: Missing output files: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc; Updated input files: networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

wildcards: simpl=, clusters=10, ll=copt, opts=Co2L-6H

threads: 4

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp, mem=5975

INFO:snakemake.logging:

Changing to shadow directory: C:\Users\Lenovo\Desktop\pypsa-earth\.snakemake\shadow\tmp\_kwivv1a

WARNING:snakemake.logging:Changing to shadow directory: C:\Users\Lenovo\Desktop\pypsa-earth\.snakemake\shadow\tmp\_kwivv1a

INFO:pypsa.io:Imported network elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc has buses, carriers, generators, global\_constraints, lines, links, loads, storage\_units, stores

INFO:pypsa.linopf:Prepare linear problem

INFO:pypsa.linopf:Total preparation time: 2.1s

INFO:pypsa.linopf:Solve linear problem using Gurobi solver

Set parameter Username

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Read LP format model from file C:\Users\Lenovo\AppData\Local\Temp\pypsa-problem-rnlb55px.lp

Reading time = 0.77 seconds

obj: 180347 rows, 88053 columns, 346340 nonzeros

Set parameter Threads to value 4

Set parameter Method to value 2

Set parameter Crossover to value 0

Set parameter BarConvTol to value 0.0001

Set parameter FeasibilityTol to value 1e-05

Set parameter AggFill to value 0

Set parameter PreDual to value 0

Set parameter GURO\_PAR\_BARDENSETHRESH to value 200

Set parameter LogFile to value "logs\solve\_network\elec\_s\_10\_ec\_lcopt\_Co2L-6H\_solver.log"

Gurobi Optimizer version 10.0.1 build v10.0.1rc0 (win64)

CPU model: AMD Ryzen 7 5700U with Radeon Graphics, instruction set [SSE2|AVX|AVX2]

Thread count: 8 physical cores, 16 logical processors, using up to 4 threads

Optimize a model with 180347 rows, 88053 columns and 346340 nonzeros

Model fingerprint: 0xe7f9d349

Coefficient statistics:

Matrix range [1e-03, 5e+02]

Objective range [1e-01, 5e+04]

Bounds range [3e+02, 1e+10]

RHS range [2e-03, 2e+11]

Warning: Model contains large rhs

Warning: Model contains large bounds

Consider reformulating model or setting NumericFocus parameter

to avoid numerical issues.

Presolve removed 112331 rows and 28298 columns

Presolve time: 0.26s

Presolved: 68016 rows, 59755 columns, 202593 nonzeros

Ordering time: 0.02s

Barrier statistics:

Dense cols : 58

Free vars : 4992

AA' NZ : 1.922e+05

Factor NZ : 1.150e+06 (roughly 60 MB of memory)

Factor Ops : 3.918e+07 (less than 1 second per iteration)

Threads : 4

Objective Residual

Iter Primal Dual Primal Dual Compl Time

0 8.26716376e+13 -2.51745153e+14 9.79e+06 6.31e+02 2.89e+10 0s

1 4.44993411e+13 -8.74595108e+13 5.47e+05 2.54e+02 2.23e+09 0s

2 1.97962202e+13 -1.12858261e+12 2.63e+03 5.42e+00 1.89e+08 1s

3 4.84922279e+11 -4.43149860e+10 1.70e+01 4.59e-01 4.41e+06 1s

4 1.58517943e+10 9.16566743e+08 3.94e-01 7.96e-02 1.24e+05 1s

5 5.87931297e+09 3.32484272e+09 6.39e-02 5.23e-03 2.13e+04 1s

6 4.27092932e+09 3.81839533e+09 1.14e-02 4.82e-04 3.77e+03 1s

7 4.21970969e+09 3.82867010e+09 9.25e-03 4.12e-04 3.26e+03 1s

8 4.13339995e+09 3.87072048e+09 6.70e-03 7.56e-04 2.19e+03 1s

9 4.09093256e+09 3.87990354e+09 5.47e-03 6.73e-04 1.76e+03 1s

10 4.02298856e+09 3.89109567e+09 3.51e-03 1.14e-03 1.10e+03 1s

11 3.93623530e+09 3.89748526e+09 9.86e-04 1.98e-03 3.23e+02 1s

12 3.91063392e+09 3.90054822e+09 2.41e-04 6.34e-04 8.40e+01 1s

13 3.90346011e+09 3.90156561e+09 3.85e-05 1.93e-04 1.58e+01 1s

14 3.90205237e+09 3.90193202e+09 1.91e-07 6.57e-05 1.00e+00 1s

15 3.90202273e+09 3.90201536e+09 1.01e-10 7.30e-06 6.13e-02 1s

16 3.90202080e+09 3.90202072e+09 1.17e-12 2.99e-08 6.61e-04 1s

17 3.90202075e+09 3.90202075e+09 1.05e-12 4.69e-09 1.58e-08 1s

Barrier solved model in 17 iterations and 1.31 seconds (0.72 work units)

Optimal objective 3.90202075e+09

INFO:pypsa.linopf:Optimization successful. Objective value: 3.90e+09

INFO:pypsa.io:Exported network elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc has storage\_units, carriers, global\_constraints, buses, stores, generators, lines, links, loads

INFO:\_\_main\_\_:Maximum memory usage: (428.4609375, 1678184772.3858325)

Benchmark: unable to collect cpu and memory benchmark statistics

CRITICAL:snakemake.logging:Benchmark: unable to collect cpu and memory benchmark statistics

[Tue Mar 7 11:26:13 2023]

INFO:snakemake.logging:[Tue Mar 7 11:26:13 2023]

Finished job 1.

INFO:snakemake.logging:Finished job 1.

1 of 2 steps (50%) done

INFO:snakemake.logging:1 of 2 steps (50%) done

Select jobs to execute...

WARNING:snakemake.logging:Select jobs to execute...

INFO:snakemake.logging:

[Tue Mar 7 11:26:13 2023]

INFO:snakemake.logging:[Tue Mar 7 11:26:13 2023]

localrule solve\_all\_networks:

input: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

jobid: 0

reason: Input files updated by another job: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp

INFO:snakemake.logging:localrule solve\_all\_networks:

input: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

jobid: 0

reason: Input files updated by another job: results/networks/elec\_s\_10\_ec\_lcopt\_Co2L-6H.nc

resources: tmpdir=C:\Users\Lenovo\AppData\Local\Temp

INFO:snakemake.logging:

[Tue Mar 7 11:26:13 2023]

INFO:snakemake.logging:[Tue Mar 7 11:26:13 2023]

Finished job 0.

INFO:snakemake.logging:Finished job 0.

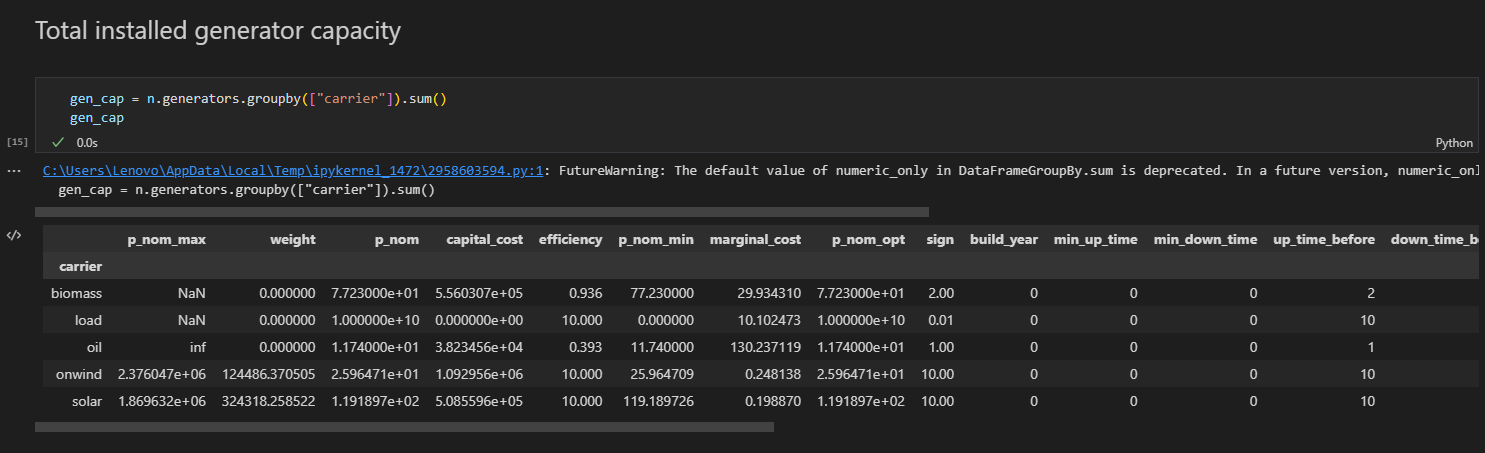
2 of 2 steps (100%) done

INFO:snakemake.logging:2 of 2 steps (100%) done

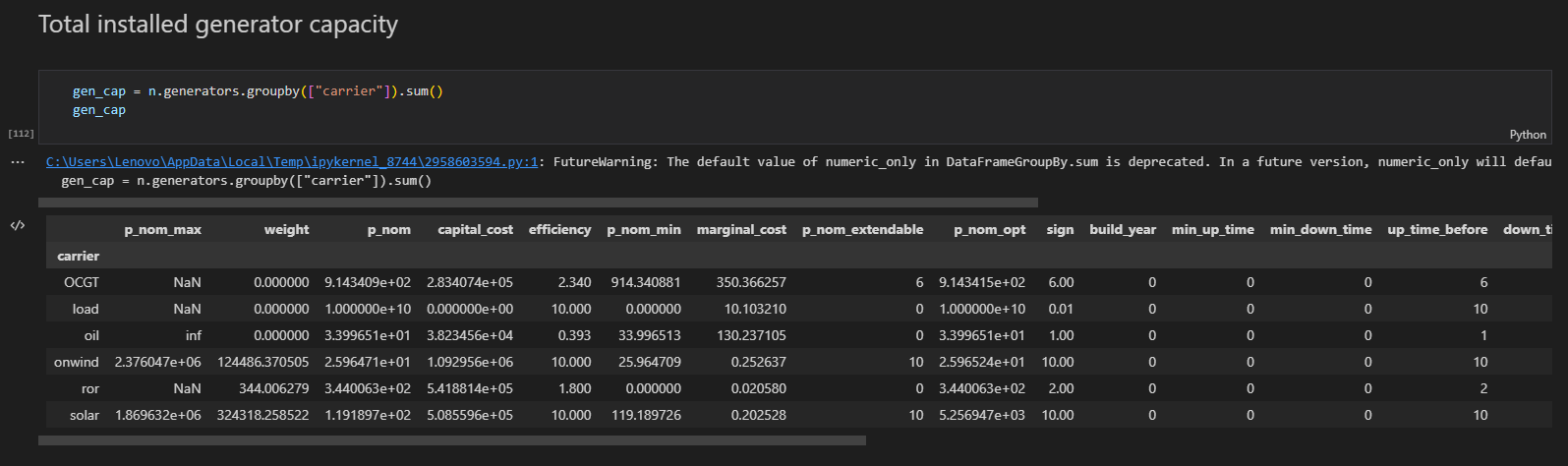
Complete log: .snakemake\log\2023-03-07T112538.169072.snakemake.log

WARNING:snakemake.logging:Complete log: .snakemake\log\2023-03-07T112538.169072.snakemake.log

* While the problem is solved for the solar capacities, thermal units and hydro plants are not being considered in the model, which is weird given the differences between them and the results found when the model is run without the custom\_powerplants file enabled

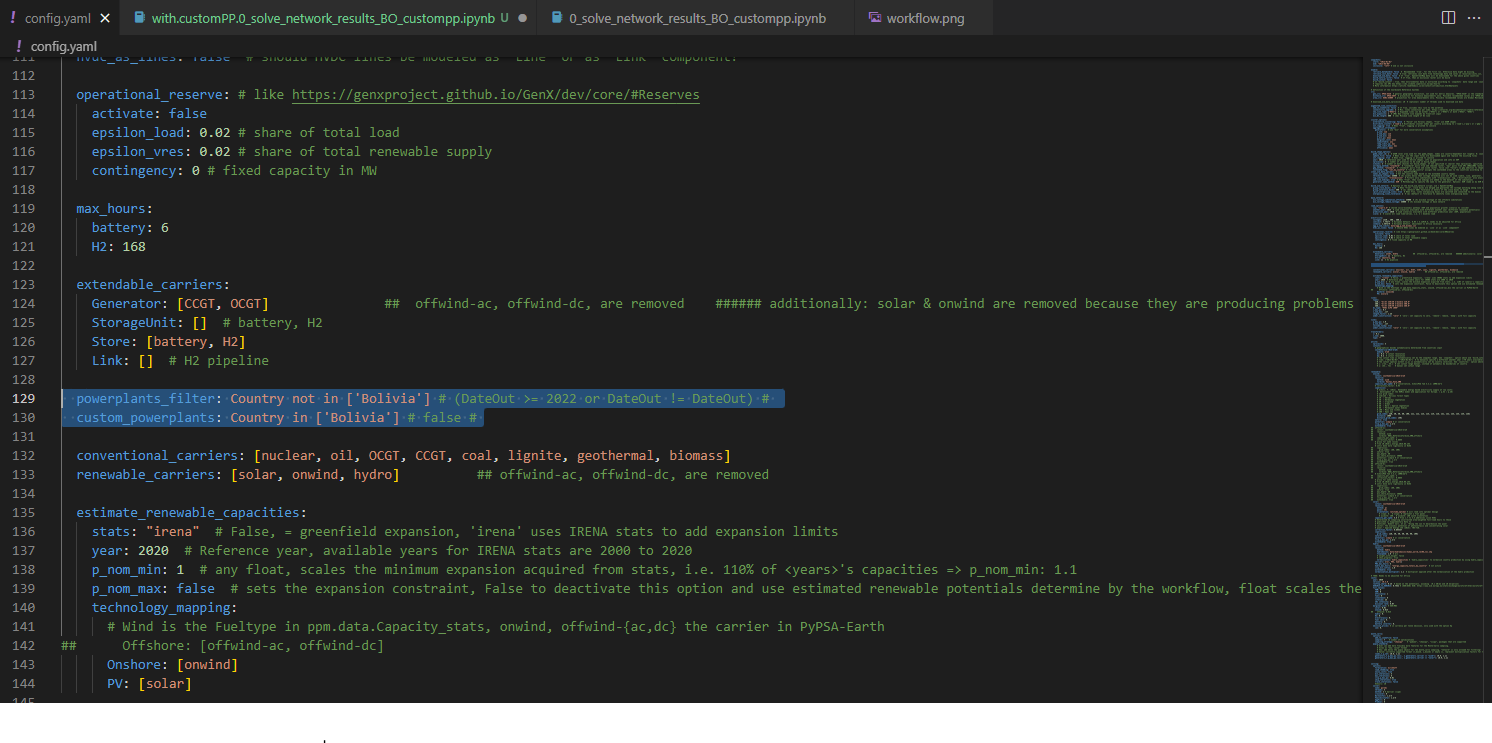


(only custom\_powerplants.csv file considered)

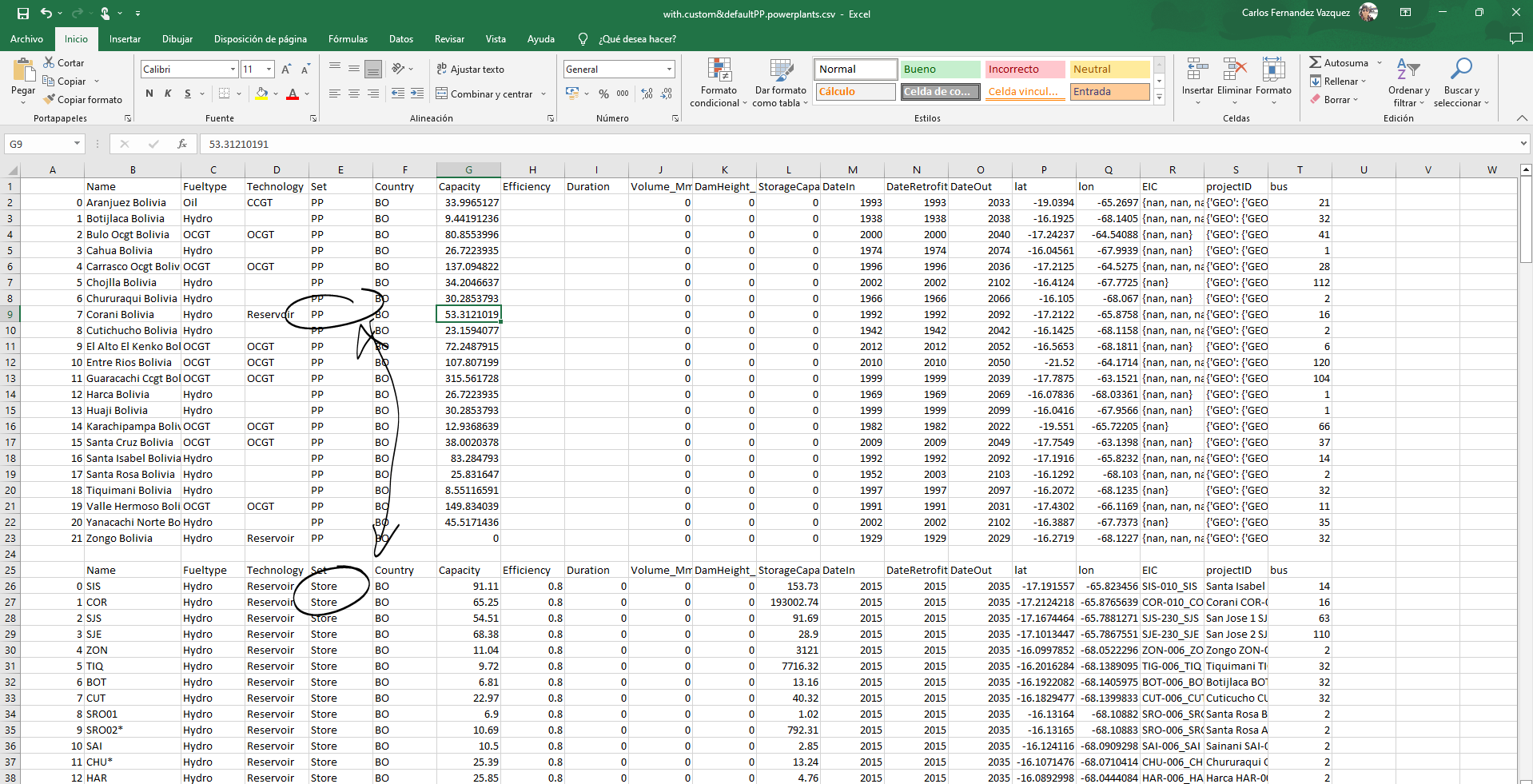


(only predefined data sources (PPM))

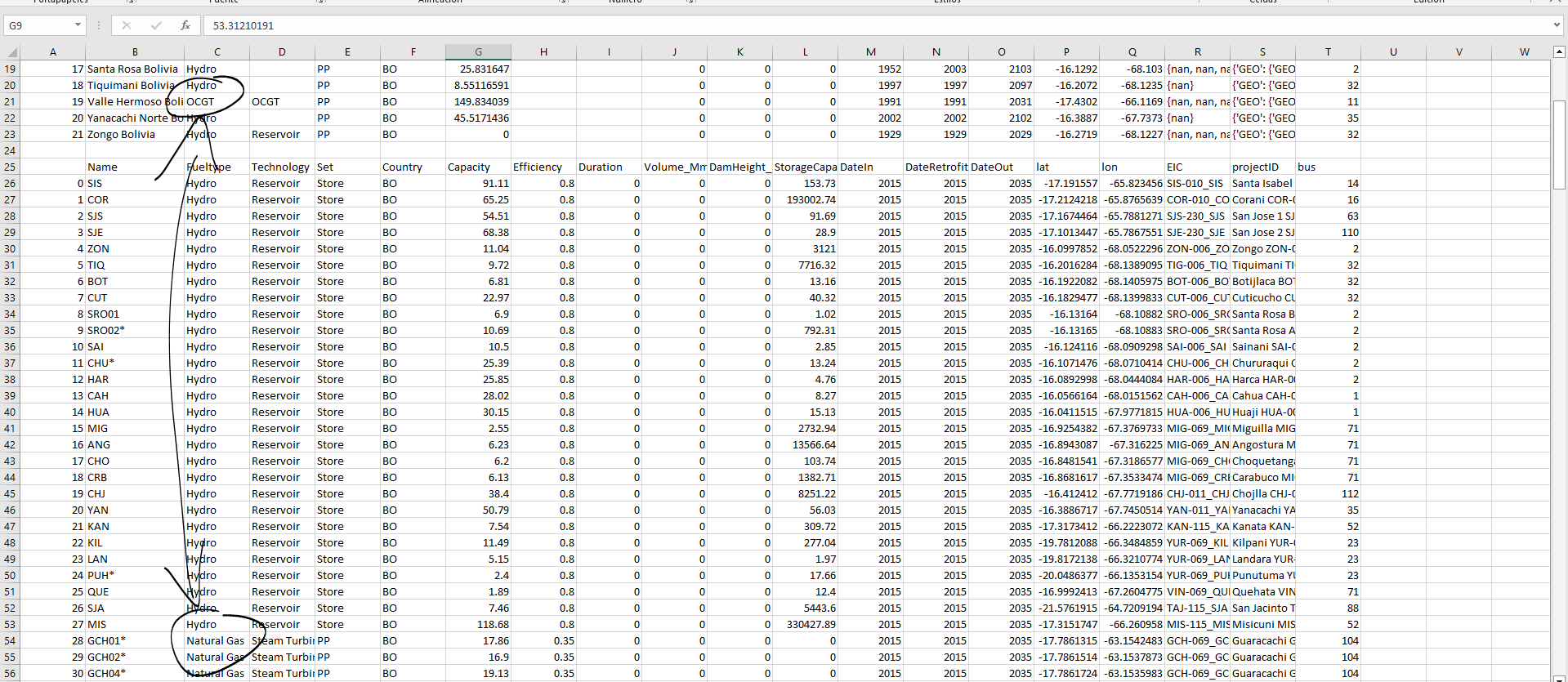
* To check how powerplants are designated in the powerplants.csv for both cases, and have the proper nomenclature to adapt the one used in the custom\_powerplants.csv file that was created, both data sources are included in the model



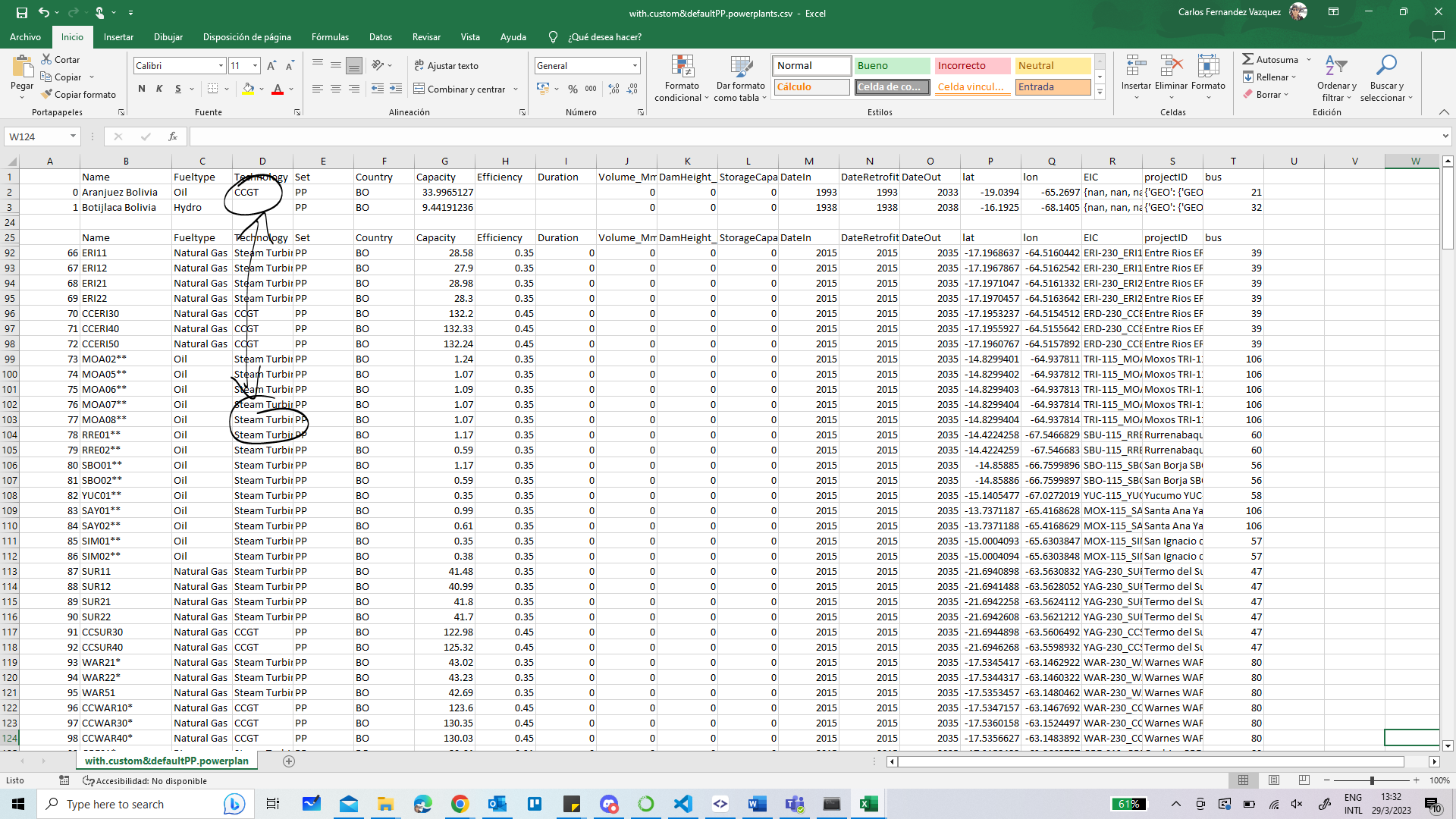
* Results show that when both sources are used, however, it can be inferred that there is a problem with the nomenclature of the powerplants given that only biomass powerplants are included in the model as new PP from the custom\_powerplants file. By comparing files used in cases run with only the customized file, with only default data and with both sources, discrepancies on how powerplants are tagged can be found:



(hydro reservoir are noted as “PP” not “store” in the set column)

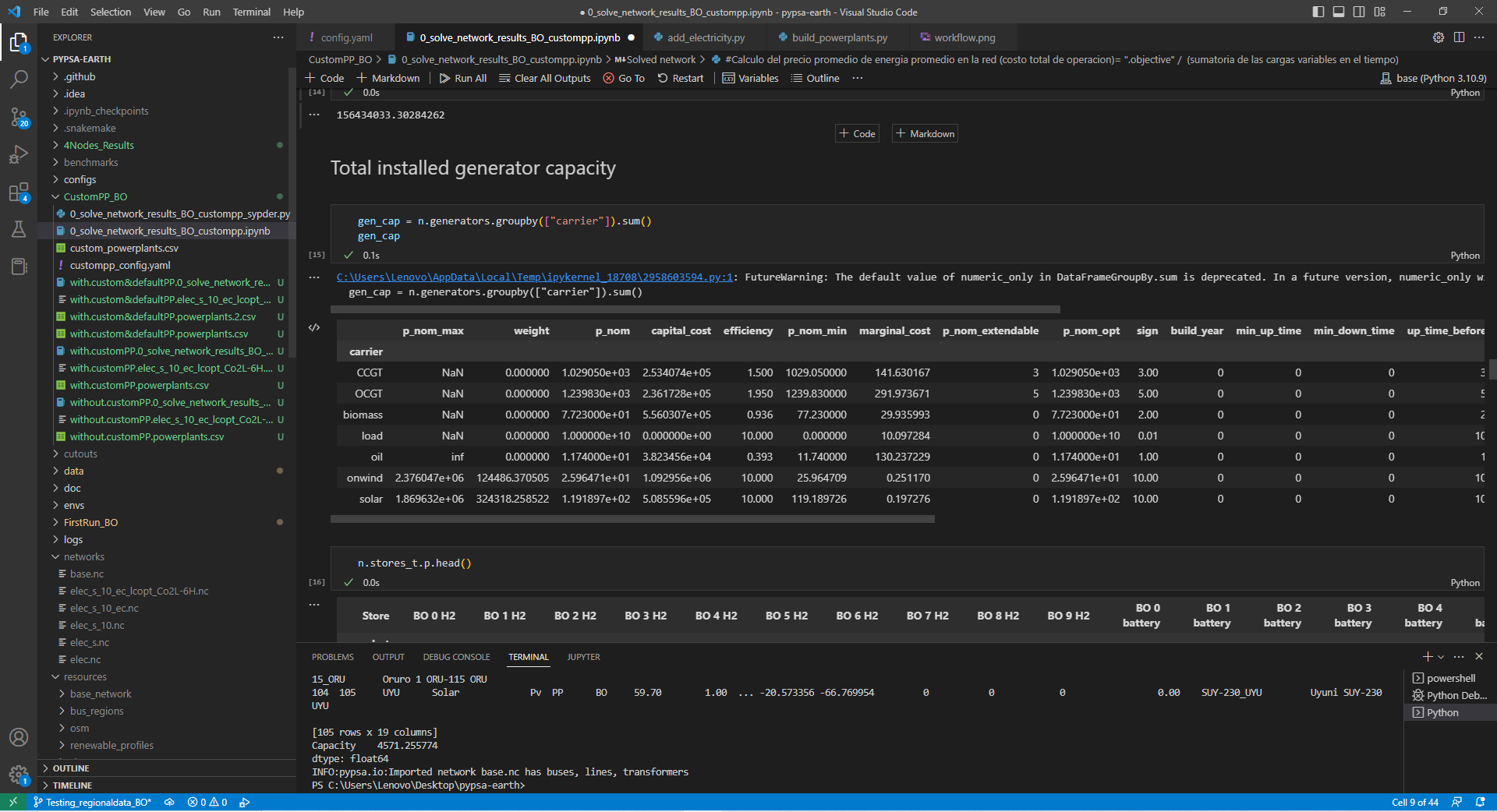


(“natural gas” is designated as “OCGT” or ”CCGT” in the fueltype column)



(“steam turbines” are designated as “OCGT” or “CCGT” in the technology column)

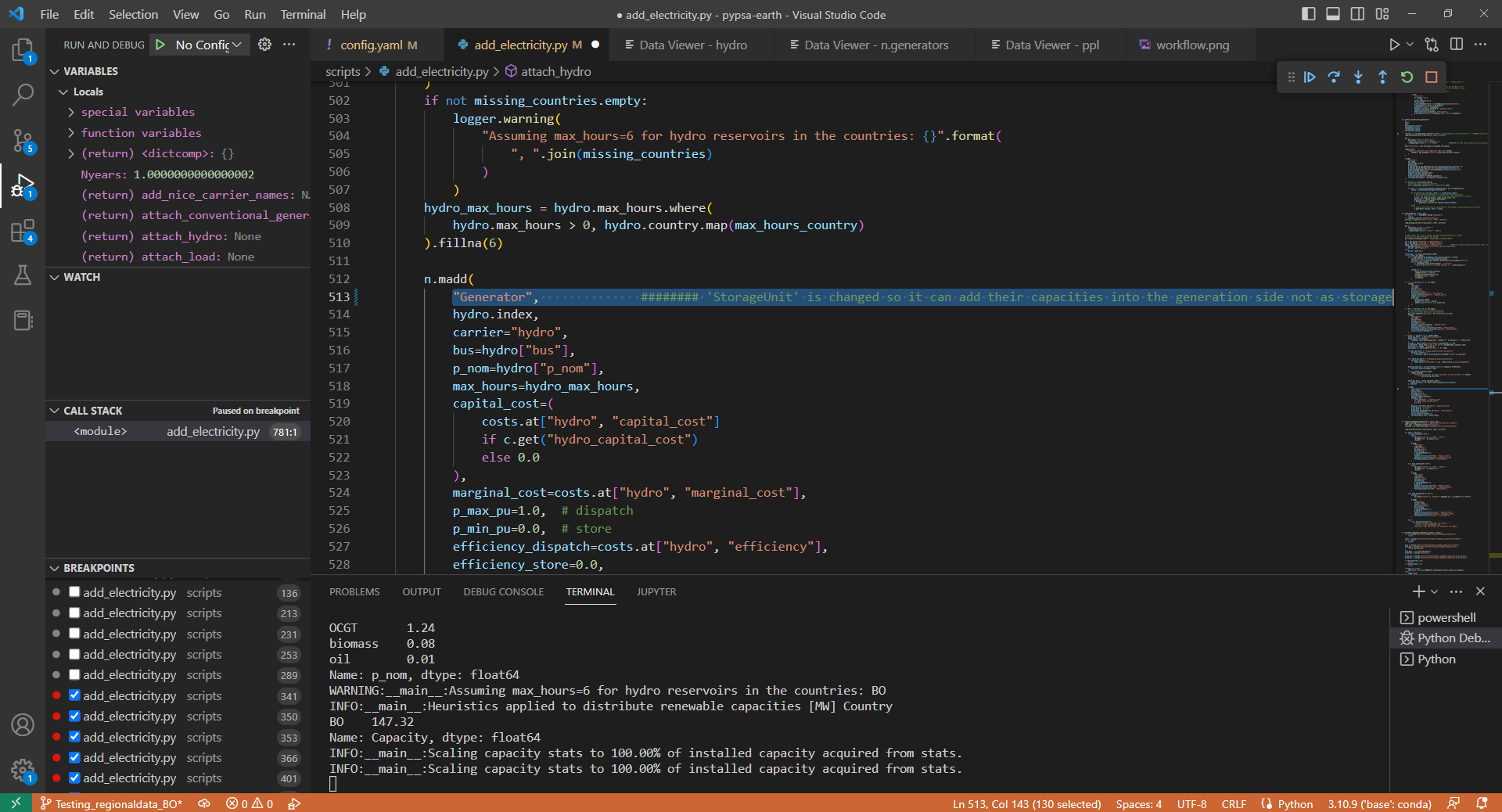
* To solve these issues, the custom\_powerplants.csv was again adapted to use this configuration changing fueltype for “natural gas” into OCGT and CCGT for natural gas based power plants, and sets for hydro from “store” to “PP”. Oil and bioenergy were not changed since they were considered before. After this, outputs files were deleted (files in folder networks and results), config.yaml file was adapted to run only with the newly defined custom\_powerplants data and the execution of the workflow was done. As a result of these changes, installed capacity is now extended to 2503 MW, however, hydropower is still not being recognized by the model.



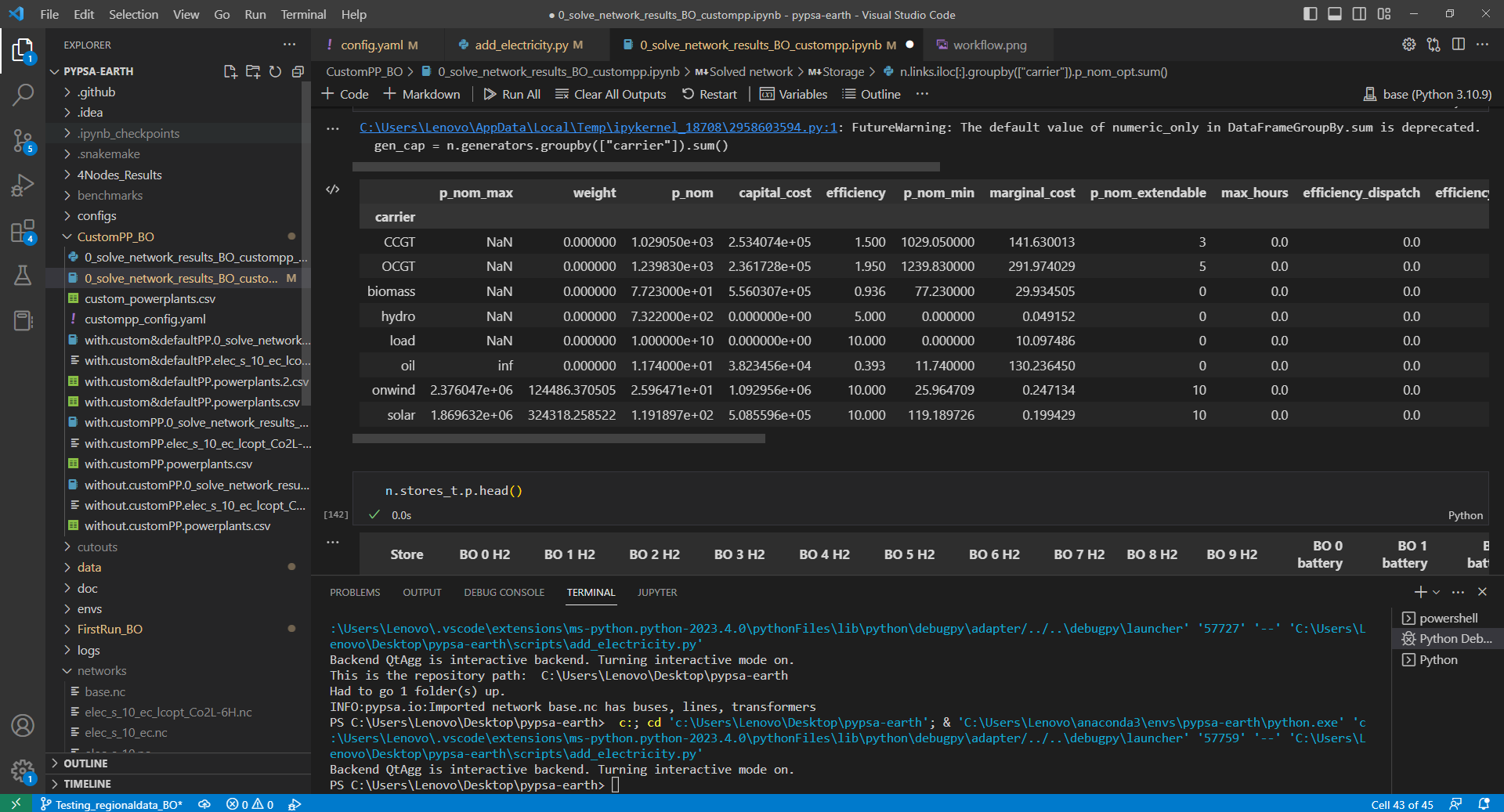
* Debugging the add\_electricity rule some additional problems were found regarding the configuration of the script:
  + To avoid removing renewables like solar and wind (from the extendable technologies section in the config.yaml file (line 123), this list was excluded/commented in the script

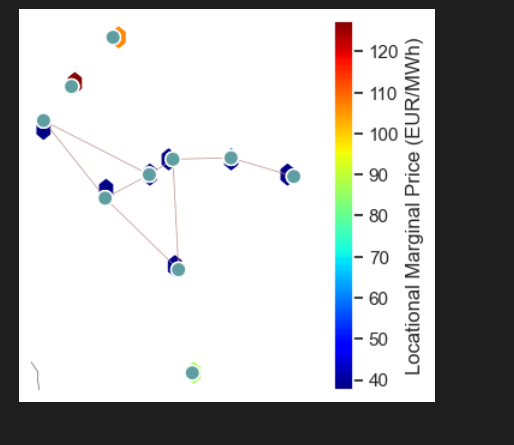
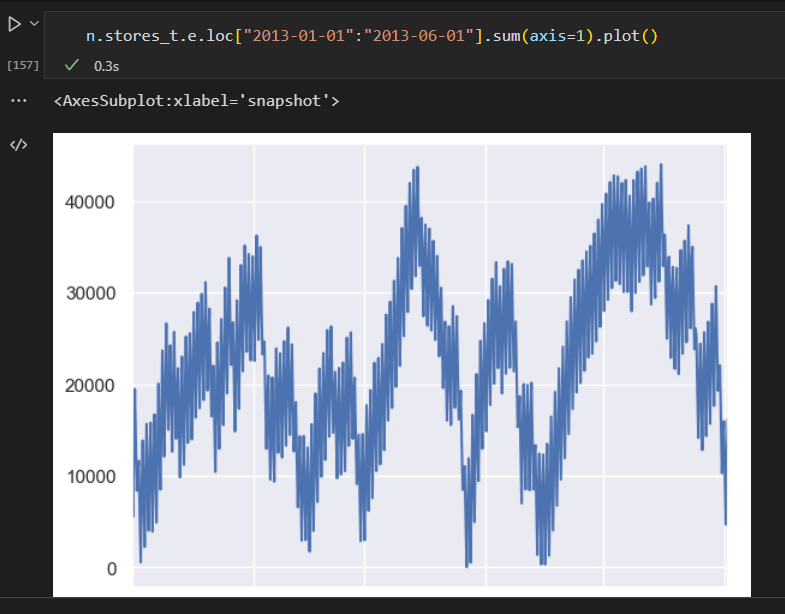


* + Hydro wasn’t being added as installed capacity in the model, but as ‘StorageUnit’ in the adding processes of the list of technologies (line 513). Here the change was made to include them as “Generator”. With this the script seems to work properly.



* After these modifications, the model has been run a final time and results are realistic. Currently the model can include historical capacities of existing powerplants (hydro specially) with the new version of custom\_powerplants, representing the total install capacity of the system (3235 MW) and using storage technologies, together with solar to provide energy on isolated systems



* d