## exio3\_to\_figaro

## February 17, 2025

```
[1]: import numpy as np
     import os
     import pymrio
     import pandas as pd
[]: figaro_2019_path = 'C:/Users/danie/Nextcloud/Coding/Masterthesis/data/raw/
     ⇔figaro_tables/2019_figaro_64.csv'
     figaro_2019 = pd.read_csv(figaro_2019_path)
     print(figaro_2019.head())
[2]: # Saveplace for EXIO3
     exio3_folder = 'C:/Users/danie/Nextcloud/Coding/Masterthesis/exiobase/exiobase3/
     # Download
     exio_downloadlog = pymrio.download_exiobase3(storage_folder=exio3_folder,__
      ⇔years=[2019], system='ixi')
     # Parsing and saving
     if not os.path.exists('C:/Users/danie/Nextcloud/Coding/Masterthesis/exiobase/
      ⇔exiobase3/exio3.pickle'):
         exio3 = pymrio.parse_exiobase3('C:/Users/danie/Nextcloud/Coding/
      →Masterthesis/exiobase/exiobase3/IOT_2019_ixi.zip')
         exio3.save('C:/Users/danie/Nextcloud/Coding/Masterthesis/exiobase/
      ⇔exiobase3')
     else:
         # Load saved data
         exio3 = pymrio.load('C:/Users/danie/Nextcloud/Coding/Masterthesis/exiobase/
      ⇔exiobase3/exio3.pickle')
     # Ensure exio3 is defined
     try:
         exio3
     except NameError:
         exio3 = pymrio.load('C:/Users/danie/Nextcloud/Coding/Masterthesis/exiobase/
      ⇔exiobase3/exio3.pickle')
```

```
# Check classifications
mrio_class = pymrio.get_classification(mrio_name="exio3_ixi")
print(mrio_class)
# Show full range of sectors
pd.set_option('display.max_rows', None)
mrio_class.sectors.to_csv('C:/Users/danie/Nextcloud/Coding/Masterthesis/
 ⇔exiobase/exiobase3/sectors.csv')
print("Classifications have been saved to sectors.csv")
# Rename sectors with shorter labels
conv_dict = mrio_class.get_sector_dict(mrio_class.sectors.ExioName, mrio_class.
  ⇒sectors.ExioLabel)
conv dict
print(conv_dict)
exio3.rename_sectors(conv_dict)
exio3.get_sectors()
ClassificationData(mrio_classification_folder=WindowsPath('c:/Users/danie/Nextcl
oud/Coding/Masterthesis/.env/Lib/site-
packages/pymrio/core/../mrio_models/exio3_ixi'),
sectors_file_name='sectors.tsv', sectors_sep='\t',
finaldemand_file_name='finaldemand.tsv', finaldemand_sep='\t', sectors=
ExioNumber
                                                     ExioName ExioCode \
Ω
                                         Cultivation of paddy rice
                                                                       i01.a
              1
              2
1
                                               Cultivation of wheat
                                                                       i01.b
2
              3
                                  Cultivation of cereal grains nec
                                                                       i01.c
3
              4
                            Cultivation of vegetables, fruit, nuts
                                                                       i01.d
4
              5
                                           Cultivation of oil seeds
                                                                       i01.e
158
            159
                 Activities of membership organisation n.e.c. (91)
                                                                         i91
                 Recreational, cultural and sporting activities...
159
            160
                                                                       i92
            161
                                     Other service activities (93)
160
                                                                         i93
            162
                                                                         i95
161
                     Private households with employed persons (95)
162
            163
                        Extra-territorial organizations and bodies
                                                                         i99
    ExioLabel
                 ISICCode
                                                                     ISICName \
                   ISIC_A Agriculture, hunting and related service activ...
0
       A_PARI
       A WHEA
                   ISIC A Agriculture, hunting and related service activ...
1
2
                   ISIC_A Agriculture, hunting and related service activ...
       A_OCER
3
       A_FVEG
                   ISIC_A Agriculture, hunting and related service activ...
                   ISIC_A Agriculture, hunting and related service activ...
4
       A OILS
. .
158
       A ORGA ISIC M N O Education; health and social work; other commu...
159
       A_RECR ISIC_M_N_O Education; health and social work; other commu...
160
       A_OSER
               ISIC_M_N_O Education; health and social work; other commu...
       A_PRHH
                                Private households with employed persons (P)
161
                   ISIC_P
```

```
ConsumptionCategories
0
                     Food
1
                     Food
2
                     Food
3
                     Food
4
                     Food
158
                 Services
159
                 Services
160
                 Services
161
                  Shelter
162
                 Services
                                        ExioNumber
[163 rows x 7 columns], finaldemand=
ExioName ExioCode \
0
          164
                     Final consumption expenditure by households
                                                                        y01
1
              Final consumption expenditure by non-profit or...
          165
                                                                   y02.a
2
          166
                     Final consumption expenditure by government
                                                                      y02.b
3
          167
                                    Gross fixed capital formation
                                                                        y04
4
          168
                                           Changes in inventories
                                                                      y05.a
5
          169
                                             Changes in valuables
                                                                      y05.b
6
                                             Exports: Total (fob)
          170
                                                                        y06
  ExioLabel
                    Type
     F_HOUS
             Expenditure
0
1
     F_NPSH
             Expenditure
2
     F_GOVE
             Expenditure
3
     I_GFCF
                 Capital
4
     I_CHIN
                 Capital
5
     I_CHVA
                 Capital
6
     X TOTA
                  Export
Classifications have been saved to sectors.csv
{'Cultivation of paddy rice': 'A PARI', 'Cultivation of wheat': 'A WHEA',
'Cultivation of cereal grains nec': 'A_OCER', 'Cultivation of vegetables, fruit,
nuts': 'A FVEG', 'Cultivation of oil seeds': 'A OILS', 'Cultivation of sugar
cane, sugar beet': 'A_SUGB', 'Cultivation of plant-based fibers': 'A_FIBR',
'Cultivation of crops nec': 'A_OTCR', 'Cattle farming': 'A_CATL', 'Pigs
farming': 'A_PIGS', 'Poultry farming': 'A_PLTR', 'Meat animals nec': 'A_OMEA',
'Animal products nec': 'A_OANP', 'Raw milk': 'A_MILK', 'Wool, silk-worm
cocoons': 'A WOOL', 'Manure treatment (conventional), storage and land
application': 'A_MANC', 'Manure treatment (biogas), storage and land
application': 'A MANB', 'Forestry, logging and related service activities (02)':
'A_FORE', 'Fishing, operating of fish hatcheries and fish farms; service
activities incidental to fishing (05): 'A_FISH', 'Mining of coal and lignite;
extraction of peat (10)': 'A_COAL', 'Extraction of crude petroleum and services
```

related to crude oil extraction, excluding surveying': 'A COIL', 'Extraction of

natural gas and services related to natural gas extraction, excluding surveying': 'A\_GASE', 'Extraction, liquefaction, and regasification of other petroleum and gaseous materials': 'A\_OGPL', 'Mining of uranium and thorium ores (12)': 'A\_ORAN', 'Mining of iron ores': 'A\_IRON', 'Mining of copper ores and concentrates': 'A COPO', 'Mining of nickel ores and concentrates': 'A NIKO', 'Mining of aluminium ores and concentrates': 'A\_ALUO', 'Mining of precious metal ores and concentrates': 'A PREO', 'Mining of lead, zinc and tin ores and concentrates': 'A\_LZTO', 'Mining of other non-ferrous metal ores and concentrates': 'A ONFO', 'Quarrying of stone': 'A STON', 'Quarrying of sand and clay': 'A\_SDCL', 'Mining of chemical and fertilizer minerals, production of salt, other mining and quarrying n.e.c.': 'A CHMF', 'Processing of meat cattle': 'A PCAT', 'Processing of meat pigs': 'A PPIG', 'Processing of meat poultry': 'A\_PPLT', 'Production of meat products nec': 'A\_POME', 'Processing vegetable oils and fats': 'A\_VOIL', 'Processing of dairy products': 'A\_DAIR', 'Processed rice': 'A\_RICE', 'Sugar refining': 'A\_SUGR', 'Processing of Food products nec': 'A OFOD', 'Manufacture of beverages': 'A BEVR', 'Manufacture of fish products': 'A\_FSHP', 'Manufacture of tobacco products (16)': 'A\_TOBC', 'Manufacture of textiles (17)': 'A\_TEXT', 'Manufacture of wearing apparel; dressing and dyeing of fur (18)': 'A\_GARM', 'Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19)': 'A LETH', 'Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials (20)': 'A\_WOOD', 'Re-processing of secondary wood material into new wood material': 'A\_WOOW', 'Pulp': 'A\_PULP', 'Re-processing of secondary paper into new pulp': 'A\_PAPR', 'Paper': 'A\_PAPE', 'Publishing, printing and reproduction of recorded media (22)': 'A\_MDIA', 'Manufacture of coke oven products': 'A\_COKE', 'Petroleum Refinery': 'A\_REFN', 'Processing of nuclear fuel': 'A\_NUCF', 'Plastics, basic': 'A\_PLAS', 'Reprocessing of secondary plastic into new plastic': 'A PLAW', 'N-fertiliser': 'A\_NFER', 'P- and other fertiliser': 'A\_PFER', 'Chemicals nec': 'A\_CHEM', 'Manufacture of rubber and plastic products (25)': 'A RUBP', 'Manufacture of glass and glass products': 'A\_GLAS', 'Re-processing of secondary glass into new glass': 'A\_GLAW', 'Manufacture of ceramic goods': 'A\_CRMC', 'Manufacture of bricks, tiles and construction products, in baked clay': 'A BRIK', 'Manufacture of cement, lime and plaster': 'A\_CMNT', 'Re-processing of ash into clinker': 'A ASHW', 'Manufacture of other non-metallic mineral products n.e.c.': 'A ONMM', 'Manufacture of basic iron and steel and of ferro-alloys and first products thereof': 'A STEL', 'Re-processing of secondary steel into new steel': 'A STEW', 'Precious metals production': 'A\_PREM', 'Re-processing of secondary preciuos metals into new preciuos metals': 'A\_PREW', 'Aluminium production': 'A\_ALUM', 'Re-processing of secondary aluminium into new aluminium': 'A\_ALUW', 'Lead, zinc and tin production': 'A\_LZTP', 'Re-processing of secondary lead into new lead, zinc and tin': 'A\_LZTW', 'Copper production': 'A\_COPP', 'Re-processing of secondary copper into new copper': 'A\_COPW', 'Other non-ferrous metal production': 'A ONFM', 'Re-processing of secondary other non-ferrous metals into new other non-ferrous metals': 'A\_ONFW', 'Casting of metals': 'A\_METC', 'Manufacture of fabricated metal products, except machinery and equipment (28)': 'A\_FABM', 'Manufacture of machinery and equipment n.e.c. (29)': 'A\_MACH', 'Manufacture of office machinery and computers (30)': 'A\_OFMA', 'Manufacture of

electrical machinery and apparatus n.e.c. (31)': 'A ELMA', 'Manufacture of radio, television and communication equipment and apparatus (32)': 'A\_RATV', 'Manufacture of medical, precision and optical instruments, watches and clocks (33)': 'A\_MEIN', 'Manufacture of motor vehicles, trailers and semi-trailers (34)': 'A MOTO', 'Manufacture of other transport equipment (35)': 'A OTRE', 'Manufacture of furniture; manufacturing n.e.c. (36)': 'A\_FURN', 'Recycling of waste and scrap': 'A RYMS', 'Recycling of bottles by direct reuse': 'A BOTW', 'Production of electricity by coal': 'A\_POWC', 'Production of electricity by gas': 'A POWG', 'Production of electricity by nuclear': 'A POWN', 'Production of electricity by hydro': 'A\_POWH', 'Production of electricity by wind': 'A\_POWW', 'Production of electricity by petroleum and other oil derivatives': 'A\_POWP', 'Production of electricity by biomass and waste': 'A POWB', 'Production of electricity by solar photovoltaic': 'A\_POWS', 'Production of electricity by solar thermal': 'A POWE', 'Production of electricity by tide, wave, ocean': 'A\_POWO', 'Production of electricity by Geothermal': 'A\_POWM', 'Production of electricity nec': 'A\_POWZ', 'Transmission of electricity': 'A\_POWT', 'Distribution and trade of electricity': 'A\_POWD', 'Manufacture of gas; distribution of gaseous fuels through mains': 'A\_GASD', 'Steam and hot water supply': 'A\_HWAT', 'Collection, purification and distribution of water (41)': 'A WATR', 'Construction (45)': 'A CONS', 'Re-processing of secondary construction material into aggregates': 'A CONW', 'Sale, maintenance, repair of motor vehicles, motor vehicles parts, motorcycles, motor cycles parts and accessoiries': 'A\_TDMO', 'Retail sale of automotive fuel': 'A\_TDFU', 'Wholesale trade and commission trade, except of motor vehicles and motorcycles (51): 'A\_TDWH', 'Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods (52)': 'A\_TDRT', 'Hotels and restaurants (55)': 'A\_HORE', 'Transport via railways': 'A\_TRAI', 'Other land transport': 'A\_TLND', 'Transport via pipelines': 'A\_TPIP', 'Sea and coastal water transport': 'A\_TWAS', 'Inland water transport': 'A\_TWAI', 'Air transport (62)': 'A\_TAIR', 'Supporting and auxiliary transport activities; activities of travel agencies (63): 'A\_TAUX', 'Post and telecommunications (64)': 'A\_PTEL', 'Financial intermediation, except insurance and pension funding (65): 'A\_FINT', 'Insurance and pension funding, except compulsory social security (66)': 'A\_FINS', 'Activities auxiliary to financial intermediation (67)': 'A\_FAUX', 'Real estate activities (70)': 'A REAL', 'Renting of machinery and equipment without operator and of personal and household goods (71)': 'A\_MARE', 'Computer and related activities (72)': 'A\_COMP', 'Research and development (73)': 'A\_RESD', 'Other business activities (74)': 'A\_OBUS', 'Public administration and defence; compulsory social security (75)': 'A\_PADF', 'Education (80)': 'A\_EDUC', 'Health and social work (85)': 'A\_HEAL', 'Incineration of waste: Food': 'A\_INCF', 'Incineration of waste: Paper': 'A\_INCP', 'Incineration of waste: Plastic': 'A\_INCL', 'Incineration of waste: Metals and Inert materials': 'A\_INCM', 'Incineration of waste: Textiles': 'A\_INCT', 'Incineration of waste: Wood': 'A INCW', 'Incineration of waste: Oil/Hazardous waste': 'A INCO', 'Biogasification of food waste, incl. land application': 'A\_BIOF', 'Biogasification of paper, incl. land application': 'A\_BIOP', 'Biogasification of sewage slugde, incl. land application': 'A\_BIOS', 'Composting of food waste, incl. land application': 'A\_COMF', 'Composting of paper and wood, incl. land

```
application': 'A_COMW', 'Waste water treatment, food': 'A_WASF', 'Waste water
    treatment, other': 'A_WASO', 'Landfill of waste: Food': 'A_LANF', 'Landfill of
    waste: Paper': 'A LANP', 'Landfill of waste: Plastic': 'A LANL', 'Landfill of
    waste: Inert/metal/hazardous': 'A_LANI', 'Landfill of waste: Textiles':
    'A LANT', 'Landfill of waste: Wood': 'A LANW', 'Activities of membership
    organisation n.e.c. (91)': 'A_ORGA', 'Recreational, cultural and sporting
    activities (92)': 'A RECR', 'Other service activities (93)': 'A OSER', 'Private
    households with employed persons (95)': 'A_PRHH', 'Extra-territorial
    organizations and bodies': 'A EXTO'}
[2]: Index(['A_PARI', 'A_WHEA', 'A_OCER', 'A_FVEG', 'A_OILS', 'A_SUGB', 'A_FIBR',
           'A_OTCR', 'A_CATL', 'A_PIGS',
           'A_LANP', 'A_LANL', 'A_LANI', 'A_LANT', 'A_LANW', 'A_ORGA', 'A_RECR',
           'A_OSER', 'A_PRHH', 'A_EXTO'],
          dtype='object', name='sector', length=163)
[3]: print(exio3.Z.columns)
    MultiIndex([('AT', 'A_PARI'),
                ('AT', 'A_WHEA'),
                ('AT', 'A_OCER'),
                ('AT', 'A_FVEG'),
                ('AT', 'A OILS'),
                ('AT', 'A_SUGB'),
                ('AT', 'A FIBR'),
                ('AT', 'A_OTCR'),
                ('AT', 'A_CATL'),
                ('AT', 'A_PIGS'),
                ('WM', 'A_LANP'),
                ('WM', 'A_LANL'),
                ('WM', 'A_LANI'),
                ('WM', 'A_LANT'),
                ('WM', 'A_LANW'),
                ('WM', 'A_ORGA'),
                ('WM', 'A_RECR'),
                ('WM', 'A_OSER'),
                ('WM', 'A PRHH'),
                ('WM', 'A EXTO')],
               names=['region', 'sector'], length=7987)
[4]: # FIGARO countries
    figaro_countries = [
         'AR', 'AT', 'AU', 'BE', 'BG', 'BR', 'CA', 'CH', 'CN', 'CY', 'CZ', 'DE', '
```

'GR', 'HR', 'HU', 'ID', 'IE', 'IN', 'IT', 'JP', 'KR', 'LT', 'LU', 'LV',

```
'SA', 'SE', 'SI', 'SK', 'TR', 'US', 'ZA'
    ]
    # Extract country codes from EXIOBASE 3 dataset
    exio_countries = exio3.get_regions()
    # Convert EXIOBASE 3 country codes to 2-letter codes if necessary
    three_to_two_letter_mapping = {
        'AUT': 'AT', 'BEL': 'BE', 'BGR': 'BG', 'HRV': 'HR', 'CYP': 'CY', 'CZE': 
     ↔ 'CZ', 'DNK': 'DK', 'EST': 'EE', 'FIN': 'FI',
        'FRA': 'FR', 'DEU': 'DE', 'GRC': 'GR', 'HUN': 'HU', 'IRL': 'IE', 'ITA':
     'MLT': 'MT', 'NLD': 'NL', 'POL': 'PL', 'PRT': 'PT', 'ROU': 'RO', 'SVK':
     'GBR': 'GB', 'USA': 'US', 'CAN': 'CA', 'JPN': 'JP', 'CHN': 'CN', 'IND': [
     'KOR': 'KR', 'CHE': 'CH', 'TUR': 'TR', 'MEX': 'MX', 'NOR': 'NO', 'SAU':
     'ROW': 'FIGW1' # Assuming 'ROW' in EXIOBASE corresponds to 'FIGW1' in L
     \hookrightarrow FIGARO
    }
    exio_countries_2_letter = sorted([three_to_two_letter_mapping.get(code, code)_
     →for code in exio_countries])
    # Compare country codes
    common_countries = sorted(set(figaro_countries).
     →intersection(exio_countries_2_letter))
    figaro only countries = sorted(set(figaro countries) -
     ⇔set(exio_countries_2_letter))
    exio_only_countries = sorted(set(exio_countries_2_letter) -__
     ⇔set(figaro_countries))
    print("Common countries:", common_countries)
    print("Countries only in FIGARO:", figaro_only_countries)
    print("Countries only in EXIOBASE 3:", exio_only_countries)
   Common countries: ['AT', 'AU', 'BE', 'BG', 'BR', 'CA', 'CH', 'CN', 'CY', 'CZ',
    'DE', 'DK', 'EE', 'ES', 'FI', 'FR', 'GB', 'GR', 'HR', 'HU', 'ID', 'IE', 'IN',
    'IT', 'JP', 'KR', 'LT', 'LU', 'LV', 'MT', 'MX', 'NL', 'NO', 'PL', 'PT', 'RO',
    'RU', 'SE', 'SI', 'SK', 'TR', 'US', 'ZA']
   Countries only in FIGARO: ['AR', 'FIGW1', 'SA']
   Countries only in EXIOBASE 3: ['TW', 'WA', 'WE', 'WF', 'WL', 'WM']
[5]: rename_dict_exio3 = {
        "A_PARI": "A01",
        "A_WHEA": "AO1",
```

```
"A_OCER": "A01",
"A_FVEG": "A01",
"A OILS": "A01",
"A_SUGB": "A01",
"A_FIBR": "A01",
"A_OTCR": "A01",
"A CATL": "A01",
"A_PIGS": "A01",
"A_PLTR": "A01",
"A OMEA": "A01",
"A OANP": "AO1",
"A_MILK": "A01",
"A_WOOL": "A01",
"A_MANC": "A01",
"A_MANB": "A01",
"A_FORE": "A02",
"A_FISH": "A03",
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"A_OGPL": "B_gas",
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"A_COIL": "B_nongas",
"A_ORAN": "B_nongas",
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"A TDRT": "G47",
"A_TRAI": "H49",
"A_TLND": "H49",
"A_TPIP": "H49",
"A_TWAS": "H50",
"A_TWAI": "H50",
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    "A_HORE": "I",
    "A_COMP": "J62_63",
    "A_FINT": "K64",
    "A_FINS": "K65",
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    "A_RESD": "M_N",
    "A_OBUS": "M_N",
    "A_HEAL": "M_N",
    "A_MARE": "M_N",
    "A_PADF": "084",
    "A_EDUC": "P85",
    "A_RECR": "R_S",
    "A_ORGA": "R_S",
    "A_OSER": "R_S",
    "A_PRHH": "T",
    "A_EXTO": "U"
}
```

## [6]: # Rename sectors to create overlapping labels exio3.rename\_sectors(rename\_dict\_exio3) print(exio3.Z)

region		AT					\
sector		A01	AO1	AO1	AO1	AO1	
region	sector						
AT	A01	0	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	
	A01	0	1.253390e+01	0.000000e+00	0.000000e+00	0.000000e+00	
	A01	0	0.000000e+00	1.282586e+01	0.000000e+00	0.000000e+00	
	A01	0	0.000000e+00	0.000000e+00	1.135534e+02	0.000000e+00	
	A01	0	0.000000e+00	0.000000e+00	0.000000e+00	5.329143e-01	
	A01	0	2.430459e-02	2.879480e-02	4.033217e-02	1.145744e-02	
	A01	0	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	
	A01	0	1.116363e-03	2.474190e-03	4.445031e-03	5.855602e-03	
	A01	0	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	
	A01	0	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	
	A01	0	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	
	A01	0	1.668966e-03	3.459982e-03	8.960867e-03	3.618095e-04	
	A01	0	1.347838e-03	2.794243e-03	7.236697e-03	2.921933e-04	
	A01	0	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	
	A01	0	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	
	A01	0	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	
	A01	0	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	
	A02	0	9.056585e-03	2.018687e-02	4.036061e-02	1.535727e-03	
	A03	0	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	

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B_nongas
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                             5.039672e-05
                                            9.012402e-05
                                                           7.436896e-06
B_nongas
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              7.498133e-03
                             1.418559e-02
                                            6.287006e-02
                                                           1.974483e-03
B_gas
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              1.883304e-02
                             3.655148e-02
                                            1.392238e-01
                                                           4.753558e-03
B_gas
           0
              5.968262e-04
                             1.154532e-03
                                            3.626235e-04
                                                           1.086261e-04
B nongas
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              0.000000e+00
                             0.000000e+00
                                            0.000000e+00
                                                           0.000000e+00
B_nongas
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                             2.864072e-03
                                            1.138293e-02
                                                           4.805106e-04
B nongas
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                                            0.000000e+00
                                                           0.000000e+00
B_nongas
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                             0.000000e+00
                                            0.000000e+00
                                                           0.000000e+00
B nongas
              0.000000e+00
                             0.000000e+00
                                            0.000000e+00
                                                           0.000000e+00
B_nongas
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                                                           0.000000e+00
B_nongas
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                                                           0.00000e+00
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                                            0.000000e+00
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                                            4.594674e-02
                                                           1.508940e-03
B_nongas
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                                                           8.631014e-03
                             9.911406e-02
                                            1.797309e-01
B_nongas
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                             1.878432e-01
                                            4.114586e-01
                                                           1.876550e-02
B_nongas
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                                                           1.292568e-03
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                                            2.395857e-02
                                                           2.559157e-03
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                             1.900212e-03
                                            3.903778e-03
                                                           4.347516e-04
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                             2.350687e-03
                                            4.794731e-03
                                                           5.509032e-04
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                             4.340060e-02
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                                                           3.461388e-02
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                                                           1.129126e-02
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                                             4.498542e-02
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                              5.717894e-02
                                             1.328592e-01
                                                            8.343664e-03
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C25
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                                             4.412374e+00
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                                             5.324786e-03
                                                            1.067406e-03
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                              1.937642e-02
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                                             0.000000e+00
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                                                            3.955815e-03
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               1.774149e-02
D35
                              3.358391e-02
                                             3.348348e-01
                                                            2.404362e-03
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                              1.532875e-01
                                             1.604692e+00
                                                            1.065059e-02
D35
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D35
               4.494621e-04
                              8.421934e-04
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D35
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                              0.000000e+00
                                             0.000000e+00
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               0.000000e+00
                              0.000000e+00
                                             0.000000e+00
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D35
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D35
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D35
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                                                            3.400947e-02
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                              2.656089e-01
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D35
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                                             5.590018e-01
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                                                            2.110864e+00
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                                             2.913700e-02
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                              4.786932e+00
                                             7.584305e+00
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G46
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                                             2.205281e+01
                                                            2.690176e+00
G47
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                                             4.768935e+00
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	B_nongas	0	1.917714e-06	4.363634e-06	8.243389e-06	3.192695e-07
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JΡ

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CN

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E37-39	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00
D35	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00
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H49	2.292139e-04		1.540244e+00	8.473776e-01	1.555198e+00
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L68	6.810177e-04	•••	9.047437e-02	5.840889e-02	1.588654e+00
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E37-39	0.000000e+00	•••	1.268339e-03	9.213207e-04	1.460841e-03
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E37-39	2.885669e-05	•••	1.290046e+00	1.108819e-02	1.437661e+00
R_S	4.011717e-05	•••	1.239758e-01	3.600060e-02	1.683062e-01
R_S	1.506841e-03	•••	6.431914e-01	3.059271e-01	7.707496e-01
R_S	4.760987e-04		6.363578e-02	3.038868e-02	8.222613e-02
T	3.723199e-04		1.622360e-01	9.590272e-02	1.723618e-01
U	0.000000e+00		0.000000e+00	0.000000e+00	0.000000e+00

region \

sector		E37-39	E37-39	R_S	R_S
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	A01	5.450237e-05	7.631378e-05	2.034299e-04	1.514647e-03
	A01	1.851072e-04	2.642625e-04	4.667644e-03	1.639933e-03
	A01	2.364037e-04	5.827175e-04	2.195505e-03	2.598694e-02
	A01	0.000000e+00	1.282885e-06	2.477639e-05	3.267696e-04
	AO1	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00
	AO1	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00
	AO1	1.654671e-05	2.718714e-05	5.288351e-04	4.515814e-03
	AO1	0.000000e+00	0.000000e+00	8.531112e-04	7.766854e-02
	A01	0.000000e+00	0.000000e+00	2.988795e-04	1.969241e-02
	AO1	0.000000e+00	0.000000e+00	9.717033e-05	6.402147e-03
	AO1	1.369901e-05	2.000575e-05	5.938785e-04	3.538328e-03
	AO1	9.254665e-06	1.306413e-05	4.274714e-04	2.032549e-03
	AO1	0.000000e+00	0.000000e+00	9.830054e-04	6.694654e-02
	AO1	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00
	AO1	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00
	AO1	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00
	A02	2.017499e-09	3.314802e-09	1.179221e-04	1.494749e-03
	A03	0.000000e+00	0.000000e+00	2.187438e-10	6.617008e-10
	B_nongas	4.154288e-07	4.695029e-07	2.026111e-06	8.146637e-06
	B_nongas	8.052225e-06	8.471736e-06	7.927487e-05	5.598647e-04
	B_gas	1.787336e-05	2.046701e-05	1.551763e-04	1.289295e-03
	B_gas	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00
	B_nongas	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00
	B_nongas	1.450784e-06	1.501035e-06	1.433008e-05	1.053570e-04
	B_nongas	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00
	B_nongas	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00
	B_nongas	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00
	B_nongas	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00
	B_nongas	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00
	B_nongas	5.326215e-06	5.096461e-06	3.795339e-05	6.587490e-04
	B_nongas	2.413103e-05	2.197674e-05	3.269515e-04	1.664599e-03
	B_nongas	6.876392e-05	6.951813e-05	6.906669e-04	6.468904e-03
	B_nongas	4.802218e-03	7.474516e-03	2.528350e-02	3.364681e-02
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	C10-12	3.954458e-04	6.640467e-04	9.923106e-03	1.956992e-02
	C10-12	1.259790e-04	1.238622e-04	3.706424e-04	9.748252e-04
	C10-12	2.954584e-03	5.035305e-03	6.756654e-02	1.335555e-01
	C10-12	3.399335e-04	5.608977e-04	7.474118e-03	1.553379e-02
	C10-12	1.400671e-04	2.047737e-04	1.045803e-02	5.813820e-02
	C10-12	1.900029e-06	2.998887e-06	3.713822e-05	7.816998e-05
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	C10-12	1.735051e-05	1.704604e-05	8.075234e-02	4.692322e-01
	C10-12	2.879130e-03	4.917266e-03	1.701402e-01	7.572124e-01
	C10-12	9.772289e-05	9.600945e-05	2.981900e-04	9.433461e-04
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                          1.277355e+02
                                         0
G47
           1.085963e+01
                                         0
                          2.297202e+00
G46
           9.529613e+02
                          2.795233e+02
                                         0
G47
           6.199593e+02
                          1.854616e+02
                                         0
Ι
           1.216527e+03
                          1.411446e+01
                                         0
```

```
8.260037e+01
H49
                         9.619644e+00
                                        0
H49
          6.064580e+02
                         1.148046e+02
                                        0
                         2.285007e+00
H49
          1.113492e+01
                                        0
H50
          5.754310e+01
                         3.826186e+01
                                        0
H50
          1.559175e+01
                         2.090519e-01
                                        0
H51
          5.817029e+01
                         9.229756e+00
                                        0
H52
          2.483100e+02
                         3.424343e+01
                                        0
H53
          5.811371e+02
                         7.069151e+01
                                        0
K64
          3.491475e+02
                         3.040306e+01
                                        0
K65
          8.868171e+01
                         1.604257e-01
                                        0
          6.175676e+01
K66
                         2.655458e+01
                                        0
L68
          6.332759e+02
                         1.412025e+01
                                        0
M N
           1.951000e+02
                         6.452157e+00
                                        0
J62_63
          1.125266e+02
                         6.338929e+00
                                        0
M_N
          6.352883e+00
                         8.735331e-02
                                        0
M_N
          1.459675e+03
                         4.887948e+01
                                        0
084
           1.106097e+02
                         3.915777e+00
                                        0
P85
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                         3.850378e-02
                                        0
          1.301607e+01
                         8.560176e-02
                                        0
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E37-39
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                         1.008818e-04
                                        0
E37-39
          4.488643e-01
                         6.046566e-05
                                        0
          1.230879e+00
E37-39
                         5.866721e-05
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E37-39
          1.176002e+00
                         1.769585e-05
                                        0
E37-39
                         2.706732e-05
          1.245550e+00
                                        0
                         3.880726e-05
E37-39
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E37-39
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                         9.452670e-06
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E37-39
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E37-39
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                         4.141726e-02
                                        0
E37-39
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                         3.807613e-02
                                        0
          3.031597e+01
                         3.806270e+00
R_S
                                        0
R_S
          2.000774e+02
                         7.936415e-01
                                        0
R_S
          4.074875e+02
                         1.207542e-01
                                        0
Т
           1.336379e+01
                         2.962805e+01
                                        0
U
          0.000000e+00
                         0.000000e+00
```

[7987 rows x 7987 columns]

```
[7]: # Aggregate duplicates of the pymrio object, which where created through
      ⇔renaming_dict
     exio3.aggregate_duplicates()
     print(exio3.Z)
    c:\Users\danie\Nextcloud\Coding\Masterthesis\.env\Lib\site-
    packages\pymrio\core\mriosystem.py:2177: FutureWarning: The 'axis' keyword in
    DataFrame.groupby is deprecated and will be removed in a future version.
      df.groupby(df.index, axis=0, sort=False)
    c:\Users\danie\Nextcloud\Coding\Masterthesis\.env\Lib\site-
    packages\pymrio\core\mriosystem.py:2179: FutureWarning: DataFrame.groupby with
    axis=1 is deprecated. Do `frame.T.groupby(...)` without axis instead.
      .groupby(df.columns, axis=1, sort=False)
    c:\Users\danie\Nextcloud\Coding\Masterthesis\.env\Lib\site-
    packages\pymrio\core\mriosystem.py:2177: FutureWarning: The 'axis' keyword in
    DataFrame.groupby is deprecated and will be removed in a future version.
      df.groupby(df.index, axis=0, sort=False)
    c:\Users\danie\Nextcloud\Coding\Masterthesis\.env\Lib\site-
    packages\pymrio\core\mriosystem.py:2179: FutureWarning: DataFrame.groupby with
    axis=1 is deprecated. Do `frame.T.groupby(...)` without axis instead.
      .groupby(df.columns, axis=1, sort=False)
    c:\Users\danie\Nextcloud\Coding\Masterthesis\.env\Lib\site-
    packages\pymrio\core\mriosystem.py:2177: FutureWarning: The 'axis' keyword in
    DataFrame.groupby is deprecated and will be removed in a future version.
      df.groupby(df.index, axis=0, sort=False)
    c:\Users\danie\Nextcloud\Coding\Masterthesis\.env\Lib\site-
    packages\pymrio\core\mriosystem.py:2179: FutureWarning: DataFrame.groupby with
    axis=1 is deprecated. Do `frame.T.groupby(...)` without axis instead.
      .groupby(df.columns, axis=1, sort=False)
    c:\Users\danie\Nextcloud\Coding\Masterthesis\.env\Lib\site-
    packages\pymrio\core\mriosystem.py:2174: FutureWarning: The 'axis' keyword in
    DataFrame.groupby is deprecated and will be removed in a future version.
      df = df.groupby(df.index, axis=0, sort=False).first()
    region
                               AT
                                                                              \
                              A01
                                            A02
                                                           A03
    sector
                                                                    B_nongas
    region sector
    AT
           A01
                     3.800401e+02 3.742758e-02 4.271022e-02 3.806809e-01
                     1.731643e-01 1.354626e+03 8.816282e-04 9.598073e-02
           A02
           A03
                     0.000000e+00 0.000000e+00 2.410300e+00 0.000000e+00
                     7.353993e+00 8.375855e-01 6.150618e-02 3.349498e+02
           B_{nongas}
                     6.685539e-01 1.119307e-01 7.055725e-03 7.741119e-01
           B_gas
           C10-12
                     3.312763e+02 6.212344e-01 1.968099e+00 1.826830e+00
```

3.785196e+00 1.176756e-01 9.274436e-03 3.438371e-01

2.307278e+01 9.275860e-01 1.352480e-01 1.196326e+01

7.614849e+00 1.874569e+00 6.141926e-02 3.642252e+00

1.067602e+00 2.173134e-01 9.380774e-03 1.783625e+00

2.848661e+01 8.085439e+00 4.375651e-02 1.256986e+01

C13-15

C16

C17

C18

C19

```
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                                1.822264e+00
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                                                              1.061390e+01
       C22
                  1.487727e+01
                                6.479931e-01
                                               4.883552e-02
                                                              8.773512e+00
       C23
                                9.374064e-01
                                               1.813206e-01
                                                              3.282692e+01
                  4.098480e+00
       C25_33
                  1.171357e+01
                                3.195226e+00
                                               5.935045e-02
                                                              4.820434e+00
       C25
                  1.602312e+01
                                5.575906e+00
                                               7.924819e-02
                                                              8.531049e+00
       C26
                  7.213149e-02
                                3.212519e-02
                                               9.344979e-04
                                                              2.205390e-02
       C27
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                                5.275222e+01
                                               6.046905e-01
                                                              3.511282e+01
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                                3.186567e+00
                                               3.308553e-02
                                                              2.744932e+00
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                                2.131072e+00
                                               5.577377e-02
                                                              3.071020e+00
       C30
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                                1.697950e-01
                                               4.160677e-03
                                                              3.180238e-01
                                                              1.594154e+01
       C31
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                                1.306927e+01
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                                               1.668381e-02
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                                                              1.318648e+02
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                                3.593845e-01
                                               6.716295e-02
                                                              1.212330e+00
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                                6.448204e+01
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                                               9.534111e-01
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                                1.150677e+01
                                               1.259097e+00
                                                              2.101373e+01
       G46
                  1.950897e+02
                                7.925704e+01
                                               2.277038e+00
                                                              6.444468e+01
       Ι
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                                1.135111e+00
                                               1.040972e-01
                                                              6.988437e+00
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                                                              8.854445e+01
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                                                              2.766435e-01
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                                               6.137618e-01
                                                              7.448720e+01
       H53
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                                1.440015e+00
                                               1.823370e-01
                                                              1.438454e+01
                                                              3.972179e+01
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                                1.816449e+00
                                               1.900787e-01
                                                              1.128466e+01
       K65
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       K66
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                                1.878810e-01
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                                5.837953e+00
                                               5.708289e-01
                                                              6.386023e+01
                  2.281704e+02
                                                              1.827921e+02
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                                1.268449e+00
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                                                              7.834975e+00
                  3.249740e+00
                                                              3.309178e+00
       084
                                8.756301e-01
                                               4.764563e-02
       P85
                  8.270219e-01
                                5.257349e-01
                                               7.804142e-02
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                                4.349051e-01
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                                                              4.794199e+00
       Τ
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                                                              0.000000e+00
                  0.000000e+00
                                               0.000000e+00
       U
                  0.000000e+00
                                0.000000e+00
                                               0.000000e+00
                                                              0.000000e+00
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                                1.890019e-02
                                               2.167900e-07
                                                              1.683067e-04
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                                               1.562981e-03
                                                              1.264403e-05
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                                2.347673e-03
                                               5.173329e-04
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                                0.000000e+00
                                               0.00000e+00
                                                              0.00000e+00
       C10-12
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                                               9.965337e-03
                                                              3.161346e-03
                  1.730528e+00
       C13-15
                  6.383644e-02
                                1.967282e-03
                                               1.083157e-04
                                                              4.649208e-03
       C16
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                                1.234827e-03
                                               2.404870e-04
                                                              1.036626e-02
       C17
                                8.174347e-03
                                               6.455636e-05
                                                              5.703511e-03
                  8.645104e-03
       C18
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                                               3.794278e-05
                                                              2.341572e-03
                  7.658762e-01
                                2.244253e-01
                                               9.612510e-04
                                                              5.039543e-01
       C19
       C24
                  7.265230e-03
                                1.522466e-03
                                               1.716928e-05
                                                              2.564267e-01
```

1.362814e+00

2.820054e-02

9.222574e+00

C24

4.440853e+00

```
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                                        1.048510e-03
                                                      6.213170e-02
C22
          1.798234e-01
                         3.279545e-03
                                        4.389690e-04
                                                       1.016669e-01
C23
          6.872922e-02
                         7.358500e-04
                                        5.548771e-03
                                                       2.093404e-02
C25_33
          1.239908e-01
                         3.198534e-02
                                        3.782172e-04
                                                       3.755487e-02
C25
          5.720780e-02
                         2.601763e-02
                                        2.814200e-04
                                                      2.385350e-02
C26
          4.384158e-03
                         2.002728e-03
                                        1.819773e-05
                                                       7.169421e-04
C27
          3.813491e-01
                         2.111334e-01
                                        2.303900e-03
                                                       1.468008e-01
C28_32
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                         9.607482e-03
                                        1.053797e-04
                                                      7.296599e-03
C29
          3.150094e-02
                         1.092827e-02
                                        1.677959e-04
                                                       1.353967e-02
C30
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                         2.601026e-04
                                        7.960608e-06
                                                       4.228244e-04
C31
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D35
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                         7.176517e-03
                                        3.998156e-03
                                                       6.865235e-02
E36
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                         3.009212e-04
                                        8.914472e-06
                                                       2.085554e-03
                                                       7.901897e-02
F
          1.545227e-01
                         7.601471e-02
                                        1.463239e-03
G45
          9.043624e-03
                         2.188993e-03
                                        1.438162e-04
                                                       7.194979e-03
G47
          2.185840e-03
                         4.778394e-04
                                        1.262254e-04
                                                      9.336510e-04
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                         7.152770e-02
                                        1.186551e-02
                                                       3.596471e-01
Ι
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H50
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                                        5.432012e-04
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H52
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                                        2.445396e-03
                                                       3.932196e-01
H53
          2.377719e-02
                         2.958429e-03
                                        3.417693e-04
                                                      2.251466e-02
K64
          2.385409e-01
                         2.214503e-02
                                        7.120175e-04
                                                      5.095501e-02
K65
          1.661251e-02
                         2.477388e-03
                                        2.606667e-04
                                                       1.518669e-02
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                                        3.001256e-06
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K66
L68
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                                        4.508859e-05
                                                       4.291598e-03
M N
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                         6.891939e-02
                                        3.268949e-03
                                                       4.892781e-01
J62_63
          4.543928e-03
                                                       8.702697e-03
                         2.612027e-03
                                        6.181940e-05
084
          5.761306e-03
                         7.637136e-04
                                        1.591697e-05
                                                       5.348456e-03
P85
          9.007148e-04
                         2.917639e-04
                                        2.470202e-05
                                                       5.836518e-03
R_S
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                                                       4.742613e-03
Τ
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                                        0.000000e+00
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U
                                                       0.000000e+00
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                                        0.000000e+00
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                                        5.089198e-05
                                                       2.991297e-04
A02
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                         2.807219e-02
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                                                       1.318428e-04
A03
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B_nongas
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                         1.356936e-04
                                        9.450790e-06
                                                       1.533829e-02
                                        5.980683e-05
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                                                       1.281664e-01
B_gas
          6.892555e-03
C10-12
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                         9.045147e-04
                                        9.776233e-04
                                                       4.173049e-03
C13-15
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                         1.586621e-03
                                        3.710016e-05
                                                       9.867102e-04
C16
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                         1.587666e-03
                                        2.912970e-05
                                                       2.248669e-03
C17
          4.944074e-03
                         3.943344e-03
                                        2.941481e-05
                                                       2.487472e-03
C18
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                         2.461797e-04
                                        4.470864e-06
                                                      9.316627e-04
C19
          1.250873e-01
                         3.655325e-02
                                        1.984954e-04
                                                       1.246667e-01
C24
          8.949126e-03
                         1.985122e-04
                                        4.308584e-06
                                                       1.279429e-02
C20-21
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                         4.083164e-03
                                        7.490611e-05
                                                       1.567593e-01
```

BG

```
C22
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                                3.914776e-04
                                               6.854138e-05
                                                              1.606776e-02
       C23
                  3.840557e-02
                                8.223230e-04
                                               4.198821e-04
                                                              1.177889e-02
       C25_33
                  2.113046e-02
                                1.558948e-03
                                               2.116947e-05
                                                              2.080798e-03
       C25
                  1.588752e-02
                                4.444330e-03
                                               3.708096e-05
                                                              7.071853e-03
       C26
                  1.247934e-03
                                4.997307e-04
                                               4.925760e-06
                                                              3.261715e-04
       C27
                  3.598399e-02
                                1.815976e-02
                                               1.997879e-04
                                                              1.312000e-02
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                                3.942569e-03
                                               4.109150e-05
                                                              3.096085e-03
       C29
                  2.496684e-03
                                9.959242e-04
                                               1.028600e-05
                                                              7.787202e-04
       C30
                  1.289282e-03
                                4.357380e-04
                                               6.036982e-06
                                                              3.976911e-04
       C31
                  2.353484e-01
                                4.923170e-02
                                               3.189564e-04
                                                              4.716660e-02
       E37-39
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                                2.900090e-04
                                               1.215112e-05
                                                              1.091139e-03
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	A02	4.995754e-01	2.009774e+00	8.471801e-02	8.677830e-01
	A03	2.942903e-01	3.579225e+00	7.910840e-02	1.869803e+00
	B_nongas	1.239303e+01	3.568814e+01	1.110820e+00	6.581745e+00
	B_gas	1.286856e+00	7.678557e+00	7.169084e-01	9.963950e+00
	C10-12	1.007967e+01	1.319192e+02	4.247500e+00	5.102374e+01
	C13-15	2.685643e+00	3.135481e+01	1.556090e+00	1.740195e+01
	C16	1.090583e+01	3.147130e+00	2.866579e-01	7.215418e+00
	C17	1.814319e+00	2.632840e+01	2.875386e+00	2.331563e+01
	C18	2.682969e+00	3.904723e+01	4.510148e+00	1.894750e+01
	C19	6.302492e+00	6.954457e+01	3.017703e+00	6.563543e+01
	C24	1.469083e+01	4.409056e+01	3.575047e+00	1.159900e+01
	C20-21	4.883385e-02	4.079957e+02	2.456477e-02	1.475147e+02
	C22	2.450066e+01	1.207967e+02	1.318133e+01	7.699504e+01
	C23	4.785629e+00	1.296452e+01	2.969879e-01	4.967028e+00
	C25_33	1.129481e+01	2.754286e+01	2.208371e+00	3.155158e+01
	C25	8.558510e+00	4.799191e+01	5.064204e+00	6.946199e+01
	C26	3.074364e+00	2.726497e+01	1.551986e+01	2.253299e+01
	C27	9.382145e+00	1.190628e+02	5.576001e+01	1.276384e+02
	C28_32	2.207091e-01	1.914380e+01	5.550929e-01	7.048974e+00
	C29	3.100439e+00	9.029898e+01	8.407506e+00	1.238244e+02
	C30	1.370705e+00	1.590348e+01	1.319306e+00	2.039735e+02
	C31	8.201851e-01	1.429748e+00	1.511920e-01	1.525791e+00
	E37-39	8.173850e-01	2.169161e+00	2.104837e-01	2.866139e+00
	D35	6.386690e-01	2.979863e+00	4.342612e-01	2.073812e+00
	E36	6.411753e-02	2.502451e-01	4.140957e-02	2.195115e-01
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	G45	2.362683e+00	5.306931e+00	1.817724e+00	4.059217e+00
	G47	1.971846e+00	1.288380e+01	1.256607e+00	7.063167e+00
	G46	5.646949e+00	3.379932e+01	4.237823e+00	2.161449e+01
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	H51	1.525166e+00	3.600745e+00	5.760454e-02	3.503839e+00
	H52	2.158047e+00	9.124248e+00	1.091852e+00	3.825579e+00
	H53	2.063860e+00	1.536131e+01	3.251920e+00	1.182696e+01
	K64	8.990467e-02	1.235603e+01	8.264593e+00	5.445724e-01
	K65	5.226078e-02	1.576884e-01	2.745661e-02	6.049943e-02
	K66	2.246737e-02	5.911629e+00	2.512434e+00	5.461071e+00
	L68	5.493958e+00	7.245502e+00	6.079279e-01	1.753347e+00
	M_N	1.551845e+01	9.291297e+01	1.975189e+01	3.004675e+01
	J62_63	6.902606e+00	8.066381e+00	2.554519e-01	4.927686e-01
	084	3.348825e-01	1.610641e+00	2.038413e-01	8.462492e-01
	P85	1.409468e-01	8.632171e-01	1.655249e-01	4.186366e-01
	R_S	1.182567e+00	8.862623e+00	5.809046e-01	3.026358e+00
	T	7.950951e+00	5.647979e+00	9.794358e-01	1.036335e+00

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	A02	4.747758e-02	1.554541e-01	4.072179e-03	5.489769e-02
	A03	4.088504e-02	2.186221e-01	5.470825e-03	6.693161e-02
	B_nongas	5.945385e+00	2.080128e+01	3.523875e+00	6.579011e+00
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	C10-12	1.272549e+01	9.230581e+01	1.597291e+00	3.439106e+01
	C13-15	2.712520e-01	1.704123e+00	6.214486e-02	1.092385e+00
	C16	4.790250e+00	1.461839e+00	1.181674e-01	3.117676e+00
	C17	3.248708e-01	2.328308e+00	2.445266e-01	1.562496e+00
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	C19	8.351705e-01	5.941732e+00	3.420094e-01	1.074587e+01
	C24	1.495779e+01	3.307291e+01	1.438847e+00	2.279116e+00
	C20-21	1.037943e-01	1.264465e+01	1.516390e-02	4.521385e+00
	C22	3.965557e-01	1.742176e+00	1.719366e-01	1.004250e+00
	C23	4.154827e-01	9.938224e-01	2.788460e-02	2.015622e-01
	C25_33	4.727982e-01	1.136026e+00	6.581010e-02	4.045161e-01
	C25	3.511371e-01	1.802398e+00	1.707973e-01	2.105227e+00
	C26	7.881504e-02	2.467391e-01	2.559218e-02	6.989428e-02
	C27	5.085639e-01	2.987550e+00	9.017076e-01	1.585953e+00
	C28_32	1.629954e-01	1.123270e+01	2.438547e-01	3.824047e+00
	C29	1.206931e-01	6.156987e-01	4.919324e-02	5.214072e-01
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	E36	3.919803e-03	9.726443e-03	4.464562e-04	1.430287e-03
	F	2.514038e-01	4.353319e-01	3.416218e-02	1.392854e-01
	G45	1.864790e-01	5.381779e-01	7.852377e-02	1.653220e-01
	G47	3.016304e-01	1.333571e+00	5.689353e-02	4.358550e-01
	G46	3.745871e-01	1.701072e+00	1.035806e-01	5.610144e-01
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	H52	2.400563e-02	1.153826e-01	5.202276e-03	3.691634e-02
	H53	5.669664e-02	3.236754e-01	6.539351e-02	2.266820e-01
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	K65	4.320730e-04	1.480498e-03	2.343509e-04	4.659899e-04
	K66	6.849237e-03	6.474928e-02	1.463916e-02	4.209883e-02
	L68	3.969962e-02	1.066989e-01	4.390992e-03	3.203883e-02
	M_N	8.726679e-01	4.420271e+00	7.378007e-01	1.418532e+00
	J62_63	1.826395e-01	2.163246e-01	4.071726e-03	7.167985e-03
	084	8.786608e-02	2.321207e-01	1.067061e-02	2.964961e-02
	P85	1.649444e-02	7.572084e-02	2.220971e-03	2.524627e-02
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WM

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B_nongas	5.665887e+02	2.253006e+03		1.214279e+03
B_gas	1.214541e+02	6.172070e+02	7.660844e+01	8.024595e+02
C10-12	1.926827e+02	3.026808e+03	1.015012e+02	1.659053e+03
C13-15	5.584731e+01	4.915767e+02	4.163609e+01	2.338448e+02
C16	2.903659e+02	1.678245e+02	2.490533e+01	2.249858e+02
C17	9.700087e+01	1.372382e+03	1.682338e+02	1.227902e+03
C18	3.800836e+02	5.396869e+03	6.218082e+02	2.641287e+03
C19	2.561202e+02	1.545944e+03	1.034511e+02	2.327543e+03
C24	1.464403e+02	4.741881e+02	5.659228e+01	2.000122e+02
C20-21	1.909673e+02	9.929886e+02	1.381640e+02	6.785364e+02
C22	2.235854e+02	5.159896e+02	7.503778e+00	3.935345e+01
C23	3.388920e+02	5.808308e+02	2.118213e+01	3.642566e+02
C25_33	4.184374e+02	1.136736e+03	1.188180e+02	1.166896e+03
C25	3.308481e+02	1.826823e+03	2.311311e+02	2.559940e+03
C26	2.363695e+01	2.770918e+02	1.848728e+02	2.895495e+02
C27	1.884395e+02	1.460243e+03	7.071224e+02	1.528649e+03
C28_32	3.347529e+01	7.918339e+01	4.846728e+01	5.279927e+02
C29	7.844917e+01	7.188185e+02	8.966315e+01	8.779929e+02
C30	3.489548e+01	2.761179e+02	3.471777e+01	2.634880e+03
C31	1.006267e+02	1.805382e+02	1.546912e+01	3.859292e+01
E37-39	6.731552e+02	6.953803e+02	4.232846e+01	1.874101e+03
D35	3.589764e+03	6.483247e+03	8.320694e+02	6.624474e+03
E36	3.968322e+02	5.825697e+02	2.877556e+01	7.776082e+02
F	8.204506e+03	2.415129e+03	2.320710e+02	4.722604e+03
G45	4.451379e+02	3.632210e+03	5.185524e+02	1.382359e+03
G47	1.134478e+03	7.209620e+03	8.566670e+02	3.526138e+03
G46	1.712501e+03	1.058191e+04	1.621693e+03	3.744943e+03
I	6.361449e+02	5.442038e+03	9.418602e+02	2.985750e+03
H49	8.534829e+02	6.769987e+03	1.143625e+03	6.185583e+03
H50	9.481760e+01	4.907816e+02	7.056110e+01	4.519264e+02
H51	1.311579e+02	1.776409e+03	3.814292e+02	1.647774e+03
H52	4.920630e+02	3.984076e+03	5.845122e+02	2.620858e+03
H53	1.523902e+03	1.237241e+04	3.401700e+03	8.898045e+03
K64	1.262998e+04	5.963528e+03	6.801592e+02	2.805444e+03
K65	2.283254e+03	2.877234e+03	2.170797e+02	4.790135e+02
K66	1.936256e+03	2.165973e+03	4.353519e+02	1.096049e+03
L68	7.126569e+03	1.024686e+04	1.421036e+03	2.717924e+03
M_N	8.423908e+03	5.754236e+04	9.328136e+03	1.954011e+04
J62_63	3.631562e+02	3.471548e+03	2.692694e+03	3.075147e+03
084	8.482011e+02	2.020051e+03	1.777002e+02	1.959260e+03
P85	3.600156e+01	3.925358e+02	6.904771e+01	4.017587e+02
R_S	8.063930e+02	4.435584e+03	4.435198e+02	1.510584e+03
T T	6.478584e+01	7.355814e+01	1.114597e+01	2.051884e+01
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region sector P85 R\_S T U

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	C10-12	7.670625e-02	3.267173e-01	2.265347e-02	0.0
	C16	2.555219e-01	5.186212e-01	1.924782e-04	0.0
	C17	3.548677e+00	4.054910e+00	3.826379e-02	0.0
	C18	7.303723e+00	7.131416e+00	2.920351e-04	0.0
	C19	1.465125e-02	1.577548e-02	1.140680e-03	0.0
	C24	1.805791e-01	3.007559e-01	2.032873e-02	0.0
	C20-21	7.189473e-02	1.299949e-01	1.275579e-02	0.0
	C22	3.337269e-01	9.633330e-01	1.027789e-02	0.0
	C23	2.938694e-01	9.847716e-02	1.365674e-03	0.0
	C25_33	5.147899e-01	6.141568e-01	3.219996e-02	0.0
	C25_55	6.319142e-01	9.401127e-01	1.047476e-02	0.0
	C26	5.432187e-02	3.632384e-02	8.581982e-05	0.0
	C27	7.223615e-01	1.551970e+00	6.842418e-02	0.0
	C28_32	1.750255e-01	2.432264e-01	1.168032e-03	0.0
	C29	7.030066e-01	1.629517e+00	5.192969e-01	0.0
	C30	4.477493e-02	1.067237e-01	1.340083e-01	0.0
	C31	1.998127e-01	2.120168e-01	4.185107e-03	0.0
	E37-39	5.971235e-02	6.560102e-02	8.924918e-04	0.0
	D35	2.327230e-02	3.691169e-02	1.238144e-03	0.0
	E36	8.368435e-04	6.543613e-04	1.103905e-05	0.0
	F	1.591947e-01	1.775846e-01	2.573808e-03	0.0
	G45	1.283924e+00	1.076430e+00	9.407602e-04	0.0
	G47	5.323968e-01	8.500156e-01	9.244703e-02	0.0
	G46	1.015256e+00	1.660532e+00	1.331582e-01	0.0
	I	6.367652e-01	1.845422e+00	2.648204e-04	0.0
	H49	3.765265e-01	4.832094e-01	6.491858e-03	0.0
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	H51	2.817826e-01	3.123906e-01	4.332645e-02	0.0
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	K64	7.790875e-01	3.798225e+00	1.498034e-02	0.0
	K65	3.425611e-03	2.879233e-03	4.723777e-08	0.0
	K66	4.706062e-02	1.204806e-01	7.265367e-05	0.0
	L68	1.120269e-01	2.899280e-02	1.318378e-04	0.0
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	P85	5.059769e-02	3.842733e-02	1.091424e-05	0.0
	R_S	5.326334e-02	3.758530e-01	8.902120e-05	0.0
	T	3.518752e-01	1.465867e-01	6.124901e-02	0.0
	U	0.000000e+00	0.000000e+00	0.000000e+00	0.0

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DE	A01 A02	1.939874e-03	1.027497e-03	7.258436e-05	0.0
	A03	1.947734e-03	2.422039e-04	5.153693e-06	0.0
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	C13-15	2.674893e-01	1.190531e+00	8.342736e-02	0.0
	C16	6.520578e-02	1.290949e-01	7.051732e-06	0.0
	C17	2.604558e+00	2.916271e+00	3.017641e-03	0.0
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	C19	1.550389e+00	1.347681e+00	9.483695e-02	0.0
	C24	4.476515e+00	6.603435e+00	5.919965e-02	0.0
	C20-21	6.295592e-01	1.012225e+00	9.820834e-02	0.0
	C22	6.065559e-01	1.824508e+00	9.982920e-03	0.0
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	C26	1.280930e-01	9.193720e-02	6.283061e-05	0.0
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	C30	1.975554e-01	4.653670e-01	5.462300e-01	0.0
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	G47	1.731748e-02	1.516475e-02	1.152555e-03	0.0
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	H52	5.120569e+00	2.157519e+00	7.181114e-02	0.0
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	K65	1.414363e-02	1.144428e-02	2.222481e-07	0.0
	K66	6.192725e-01	1.714069e+00	4.089209e-04	0.0
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ES

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                                                               0.0
       K64
                  1.800092e-03
                                 4.288099e-03
                                                1.210040e-05
                                                               0.0
                                                1.004504e-08
                                                               0.0
       K65
                  3.477528e-04
                                 3.296624e-04
       K66
                  1.753848e-02
                                 1.400463e-02
                                                6.291201e-06
                                                               0.0
       L68
                  3.667350e-02
                                 9.138000e-03
                                                3.865757e-05
                                                               0.0
       M_N
                  6.095846e-01
                                 6.066214e-01
                                                9.510233e-04
                                                               0.0
       J62_63
                  2.840500e-01
                                 2.644634e-01
                                                1.719146e-04
                                                               0.0
       084
                  1.072596e-01
                                 1.254306e-01
                                                5.948584e-04
                                                               0.0
       P85
                                 7.996469e-03
                  3.286966e-02
                                                5.628460e-05
                                                               0.0
```

```
R_S
                  8.988575e-02
                                 5.572612e-02
                                                3.518611e-04
                                                               0.0
       Τ
                  8.513668e-03
                                 8.667781e-03
                                                6.149154e-05
                                                               0.0
       U
                  0.000000e+00
                                 0.000000e+00
                                                0.000000e+00
                                                               0.0
WE
       A01
                                                               0.0
                  4.806548e+01
                                 6.211108e+01
                                                1.603327e+00
       A02
                  1.697756e-02
                                 8.223775e-03
                                                1.706517e-06
                                                               0.0
       A03
                  4.337331e-03
                                 1.583933e-03
                                                8.257357e-06
                                                               0.0
                                 1.003512e+00
                                                               0.0
       B_nongas
                  1.638524e+01
                                                4.951326e-03
       B_gas
                  3.473739e-02
                                 1.372348e-02
                                                7.336491e-04
                                                               0.0
       C10-12
                  7.323332e+00
                                 5.083979e+00
                                                7.706011e-02
                                                               0.0
       C13-15
                  1.120526e-01
                                 4.268019e-01
                                                2.158245e-02
                                                               0.0
       C16
                  2.145116e-01
                                 3.960232e-01
                                                2.259573e-04
                                                               0.0
       C17
                  1.185237e+00
                                 1.284706e+00
                                                4.033518e-04
                                                               0.0
       C18
                  4.195915e-01
                                 4.049520e-01
                                                1.403868e-03
                                                               0.0
       C19
                  1.013775e+00
                                 6.163927e-01
                                                4.295479e-02
                                                               0.0
       C24
                  1.816265e+00
                                 3.330344e+00
                                                2.739285e-01
                                                               0.0
       C20-21
                  5.938858e-01
                                 1.698689e-01
                                                1.046961e-02
                                                               0.0
       C22
                  3.876905e-01
                                 1.128402e+00
                                                4.104295e-03
                                                               0.0
       C23
                  3.842360e-01
                                 6.424969e-02
                                                7.470052e-04
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                  2.413639e-01
                                 3.185688e-01
                                                1.989358e-02
                                                               0.0
       C25_33
       C25
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                                 4.393973e-01
                                                4.608858e-03
                                                               0.0
       C26
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                                 1.575361e-02
                                                1.854700e-04
                                                               0.0
       C27
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                                 5.170771e-01
                                                1.742889e-02
                                                               0.0
       C28_32
                  2.070416e-01
                                 2.579660e-01
                                                6.601579e-04
                                                               0.0
       C29
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                                 3.611820e-01
                                                1.069675e-01
                                                               0.0
       C30
                  1.109959e-01
                                 2.070193e-01
                                                2.469210e-01
                                                               0.0
       C31
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                                 2.384867e-02
                                                2.385120e-03
                                                               0.0
                  1.487618e-01
                                 5.758165e-02
       E37-39
                                                1.382561e-03
                                                               0.0
       D35
                  3.361948e-01
                                 1.055398e-01
                                                1.611340e-03
                                                               0.0
       E36
                  2.644979e-02
                                 7.194116e-03
                                                2.254576e-04
                                                               0.0
       F
                  2.630924e-01
                                 1.774644e-01
                                                6.501455e-04
                                                               0.0
       G45
                  3.364396e-01
                                 2.552673e-01
                                                4.854813e-04
                                                               0.0
       G47
                  8.374513e-01
                                 2.306405e-01
                                                1.961985e-02
                                                               0.0
       G46
                  2.081787e-01
                                 2.398518e-01
                                                2.187586e-02
                                                               0.0
       Ι
                  2.939307e-01
                                 7.856800e-01
                                                1.480197e-03
                                                               0.0
       H49
                  6.037250e-01
                                 5.700931e-01
                                                8.817659e-03
                                                               0.0
       H50
                  6.713091e-02
                                 6.363041e-02
                                                8.928519e-03
                                                               0.0
                  1.417346e+00
                                 1.571682e+00
                                                2.219140e-01
                                                               0.0
       H51
       H52
                  4.245373e-01
                                 1.546821e-01
                                                4.094318e-03
                                                               0.0
       H53
                  2.954496e-01
                                 4.466512e-01
                                                6.249235e-05
                                                               0.0
                  3.758397e-01
       K64
                                 1.858170e+00
                                                7.344154e-03
                                                               0.0
       K65
                  2.237801e-03
                                 2.413545e-03
                                                1.908159e-06
                                                               0.0
       K66
                  4.364231e-02
                                 1.348727e-01
                                                1.661584e-04
                                                               0.0
       L68
                  5.624513e-02
                                 1.075277e-02
                                                1.262612e-05
                                                               0.0
       M_N
                  1.115495e+00
                                 7.731140e-01
                                                1.956636e-03
                                                               0.0
                                 1.012495e+00
       J62_63
                  1.112258e+00
                                                5.095723e-05
                                                               0.0
       084
                  2.274137e-02
                                 1.827241e-02
                                                1.511113e-03
                                                               0.0
       P85
                  2.626300e-02
                                 1.267114e-02
                                                4.548724e-04
                                                               0.0
       R_S
                  3.997782e-02
                                 3.135579e-01
                                                8.092327e-04
                                                               0.0
```

		4 450400 04	1 700010 01	7 000705 00	
	T	4.158466e-01	1.708646e-01	7.032705e-02	0.0
	U	0.000000e+00	0.000000e+00	0.000000e+00	0.0
WF	A01	3.718367e+02	4.057581e+02	2.090936e+00	0.0
	A02	6.446229e-02	9.353580e-02	7.469011e-04	0.0
	A03	5.642971e-01	2.457178e-01	6.726509e-03	0.0
	B_nongas	2.390937e+01	2.652919e+01	4.333187e+00	0.0
	B_gas	9.967500e+01	4.200442e+01	1.438514e-01	0.0
	C10-12	1.511153e+01	7.018198e+00	1.204052e-01	0.0
	C13-15	5.060799e-01	1.835673e+00	9.929130e-02	0.0
	C16	2.416918e-01	4.594822e-01	5.986294e-04	0.0
	C17	1.606014e+00	1.822604e+00	1.006228e-02	0.0
	C18	2.769507e-01	2.868895e-01	1.859912e-04	0.0
	C19	4.356137e+00	1.595472e+00	7.937013e-02	0.0
	C24	1.365837e+01	1.972185e+01	7.011582e-02	0.0
	C20-21	1.582696e-01	2.203541e-01	2.018141e-02	0.0
	C22	2.850644e-01	4.907870e-01	8.273047e-03	0.0
	C23	5.852483e-01	3.571340e-01	2.709653e-03	0.0
	C25_33	1.617442e+00	1.884208e+00	7.100706e-02	0.0
	C25	2.142819e-01	3.096199e-01	8.575926e-03	0.0
	C26	6.904655e-02	7.778289e-02	5.220078e-04	0.0
	C27	9.158755e-01	1.978691e+00	5.330355e-02	0.0
	C28_32	1.442080e-01	1.987819e-01	1.598089e-03	0.0
	C29	7.007296e-01	1.637442e+00	5.202897e-01	0.0
	C30	2.532127e-01	5.651825e-01	6.235858e-01	0.0
	C31	5.164198e-02	7.479122e-02	2.848695e-03	0.0
	E37-39	2.273518e-01	2.158390e-01	2.773820e-03	0.0
	D35	1.532052e-01	1.179012e-01	2.453718e-03	0.0
	E36	7.892841e-03	1.112985e-02	3.691552e-05	0.0
	F	7.946863e-01	8.537669e-01	3.863388e-03	0.0
	G45	5.495593e-01	4.702059e-01	2.861666e-03	0.0
	G47	9.009284e-01	5.787338e-01	2.249494e-02	0.0
	G46	1.031837e+00	1.244226e+00	3.605381e-02	0.0
	I	1.625165e-02	1.562579e-02	1.747174e-04	0.0
	H49	2.024521e-01	2.201746e-01	6.231124e-03	0.0
	H50	2.117474e-02	4.228308e-03	6.734542e-04	0.0
	H51	1.170682e-01	1.626158e-01	1.085760e-02	0.0
	H52	3.058279e-02	2.371452e-02	3.312301e-03	0.0
	H53	4.340343e-01	8.101590e-01	2.147117e-04	0.0
	K64	3.605416e-03	8.905797e-03	1.709209e-05	0.0
	K65	7.749965e-04	7.404113e-04	2.273857e-08	0.0
	K66	2.488704e-02	6.805166e-02	1.661661e-05	0.0
	L68	3.032735e-02	5.768540e-03	9.308462e-07	0.0
	M_N	1.474180e+00	1.415390e+00	3.692450e-04	0.0
	_ J62_63	8.843763e-02	8.462961e-02	2.489996e-05	0.0
	084	6.355615e-02	8.013639e-02	7.650011e-04	0.0
	P85	2.481681e-03	2.424224e-03	2.410183e-06	0.0
	R_S	2.941192e-02	3.982500e-02	2.031288e-05	0.0
	T	3.952544e-02	1.725959e-02	1.134059e-04	0.0

	U	0.000000e+00	0.000000e+00	0.000000e+00	0.0
WM	A01	4.535335e+02	8.792695e+02	1.072348e+02	0.0
****	A02	1.317955e+01	6.936204e+00	3.405460e-02	0.0
	A03	1.862874e+01	4.183037e+01	2.693178e+00	0.0
	B_nongas	4.142236e+02	8.028176e+02	8.982652e+01	0.0
	B_gas	1.228640e+02	1.616661e+02	5.110951e+00	0.0
	C10-12	8.157690e+02	8.433788e+02	1.642894e+01	0.0
	C13-15	8.020614e+01	2.678876e+02	1.683532e+01	0.0
	C16	4.676886e+01	1.157429e+02	2.575159e+00	0.0
	C17	2.294508e+02	3.755900e+02	2.005905e+01	0.0
	C18	1.158511e+03	1.164438e+03	2.458690e+00	0.0
	C10	3.523670e+02	3.770769e+02	2.755658e+00	0.0
	C24	1.190892e+02	1.719173e+02	6.162269e+00	0.0
	C24 C20-21	1.267773e+02	1.708721e+02	5.804086e+00	0.0
	C20 21	7.713649e+01	1.299711e+02	1.716760e+01	0.0
	C23	1.370598e+02	1.227361e+02	6.177130e+00	0.0
	C25_33	1.657153e+02	2.774299e+02	1.805049e+01	0.0
	C25_55	2.086982e+02	2.811237e+02	3.297013e+00	0.0
	C26	9.584805e+01	4.899082e+01	2.046315e-01	0.0
	C27	1.797887e+02	4.072105e+02	1.773068e+01	0.0
	C28_32	5.928936e+01	7.822313e+01	4.061064e-01	0.0
	C29	1.030474e+02	2.125100e+02	6.959450e+01	0.0
	C30	4.521235e+01	9.476792e+01	8.740299e+01	0.0
	C31	1.704806e+02	8.807313e+01	5.031982e-01	0.0
	E37-39	2.338191e+02	1.915640e+02	8.179022e+00	0.0
	D35	2.854502e+03	1.897046e+03	4.205191e+01	0.0
	E36	3.633045e+02	2.803988e+02	1.391008e+00	0.0
	F	7.566822e+02	5.714707e+02	2.415298e+01	0.0
	G45	5.555717e+02	1.137386e+03	1.277355e+02	0.0
	G47	1.229883e+03	2.227590e+03	1.877588e+02	0.0
	G46	1.445160e+03	2.843464e+03	2.795233e+02	0.0
	I	8.940621e+02	2.403406e+03	1.411446e+01	0.0
	H49	2.339643e+03	2.299869e+03	1.267092e+02	0.0
	H50	1.117550e+02	2.006171e+02	3.847092e+01	0.0
	H51	2.144177e+02	7.618934e+02	9.229756e+00	0.0
	H52	6.209476e+02	1.237138e+03	3.424343e+01	0.0
	H53	1.221889e+03	2.692967e+03	7.069151e+01	0.0
	K64	6.147162e+02	2.995795e+03	3.040306e+01	0.0
	K65	2.657735e+02	3.704433e+02	1.604257e-01	0.0
	K66	1.482851e+02	5.511560e+02	2.655458e+01	0.0
	L68	1.837986e+03	2.074528e+03	1.412025e+01	0.0
	$M_N$	3.802613e+03	7.945299e+03	5.550459e+01	0.0
	J62_63	5.444578e+02	5.507856e+02	6.338929e+00	0.0
	084	4.800568e+02	8.461211e+02	3.915777e+00	0.0
	P85	8.469950e+02	9.333965e+01	3.850378e-02	0.0
	R_S	6.382755e+02	4.773686e+03	4.720666e+00	0.0
	T	1.947535e+01	3.689545e+01	2.962805e+01	0.0
	U	0.000000e+00	0.000000e+00	0.000000e+00	0.0

[]: exio3.Z.to\_csv('exio3\_aggr.csv')

```
print("Exio3 Z matrix saved")
[]: # Define gas and non-gas sectors
     gas_sector = "B_gas"
     nongas_sector = "B_nongas"
     # Extract inputs from gas and non-gas sectors to all industries (row-wise)
     B_gas_inputs = exio3.Z.xs(gas_sector, level='sector', drop_level=False)
     B_nongas_inputs = exio3.Z.xs(nongas_sector, level='sector', drop_level=False)
     # Extract outputs from gas and non-gas sectors to all industries (column-wise)
     B gas_outputs = exio3.Z.xs(gas_sector, level='sector', axis=1, drop_level=False)
     B_nongas_outputs = exio3.Z.xs(nongas_sector, level='sector', axis=1,__

drop_level=False)

     # Compute total inputs and outputs
     total_inputs = B_gas_inputs.add(B_nongas_inputs, fill_value=0)
     total_outputs = B_gas_outputs.add(B_nongas_outputs, fill_value=0)
     # Compute shares
     def compute_shares(gas_values, non_gas_values, total_values):
         shares_gas = gas_values / total_values
         shares_nongas = non_gas_values / total_values
         # Handle cases where total is zero
        shares_gas[total_values == 0] = 0
        shares_nongas[total_values == 0] = 0
        return shares_gas, shares_nongas
     # Compute row and column weights
     B_weights_row_gas, B_weights_row_nongas = compute_shares(B_gas_inputs,__
      →B_nongas_inputs, total_inputs)
     B_weights_col_gas, B_weights_col_nongas = compute_shares(B_gas_outputs,_
      →B_nongas_outputs, total_outputs)
     # Combine weights into DataFrames
     B_weights_row = pd.concat([B_weights_row_gas, B_weights_row_nongas],_
      ⇔keys=[gas_sector, nongas_sector], names=["energy_type"])
     B weights col = pd.concat([B weights col gas, B weights col nongas], axis=1,
      ⇔keys=[gas_sector, nongas_sector])
     # Validate results
```

```
print("Gas & Non-Gas Weighting Vectors Computed Successfully!")
     print("B_weights_row shape:", B_weights_row.shape)
     print("B_weights_col shape:", B_weights_col.shape)
     # Confirm that shares sum to ~1 where gas & non-gas are present
     print("Row Shares Sum Check (should be ~1):")
     print(B_weights_row.groupby(level=1).sum().head())
     print("Column Shares Sum Check (should be ~1):")
     print(B_weights_col.sum(axis=1).head())
     # Create a matrix with ones for non-energy sectors and weights for energy \Box
      \hookrightarrowsectors
     B_weights_matrix = pd.DataFrame(1, index=exio3.Z.index, columns=exio3.Z.columns)
     # Apply weights to the energy sectors
     for sector in [gas_sector, nongas_sector]:
         B weights matrix.loc[sector] = B weights row.loc[sector]
         B_weights_matrix[sector] = B_weights_col[sector]
     print("B_weights_matrix shape:", B_weights_matrix.shape)
     print(B weights matrix.head())
[]: # Define gas and non-gas sectors
     gas_sector = "B_gas"
     nongas_sector = "B_nongas"
     # Step 1: Extract Gas & Non-Gas Sectors for Each Country
     try:
         # Extract inputs from gas and non-gas sectors to all industries (row-wise)
         B gas_inputs = exio3.Z.xs(gas_sector, level='sector', drop_level=False)
         B_nongas_inputs = exio3.Z.xs(nongas_sector, level='sector',__

drop level=False)

         # Extract outputs from gas and non-gas sectors to all industries_
      ⇔(column-wise)
         B_gas_outputs = exio3.Z.xs(gas_sector, level='sector', axis=1,__

drop_level=False)

         B_nongas_outputs = exio3.Z.xs(nongas_sector, level='sector', axis=1,__

drop_level=False)

     except KeyError as e:
         print(f" KeyError: The sector '{e.args[0]}' is missing in exio3.Z. Check⊔
      →renaming.")
         print("Available sectors:", exio3.Z.index.get_level_values('sector').

unique())
         raise # Stop execution if sectors are missing
```

```
# Step 2: Compute Correct Total Deliveries (Gas + Non-Gas) Per Industry and
\hookrightarrow Country
total inputs = B gas inputs.add(B nongas inputs, fill value=0) # Total energy
 ⇔deliveries per sector
total_outputs = B_gas_outputs.add(B_nongas_outputs, fill_value=0) # Total_
 ⇔energy demand per sector
# Step 3: Compute Gas & Non-Gas Shares Correctly
def compute_shares(gas_values, non_gas_values, total_values):
    """Compute shares correctly, ensuring they sum to 1 where applicable."""
    shares_gas = gas_values / total_values
    shares_nongas = non_gas_values / total_values
    # Handle cases where total is zero
    shares_gas[total_values == 0] = 0
    shares_nongas[total_values == 0] = 0
    return shares_gas, shares_nongas
# Compute row and column weights using the corrected logic
B_weights_row_gas, B_weights_row_nongas = compute_shares(B_gas_inputs,_
 →B_nongas_inputs, total_inputs)
B_weights_col_gas, B_weights_col_nongas = compute_shares(B_gas_outputs,_u
 →B_nongas_outputs, total_outputs)
# Step 4: Ensure DataFrames Have Correct 2-Row / 2-Column Structure
B_weights_row = pd.concat([B_weights_row_gas, B_weights_row_nongas],_
 ⇔keys=[gas_sector, nongas_sector], names=["energy_type"])
B_weights_col = pd.concat([B_weights_col_gas, B_weights_col_nongas], axis=1,__
 →keys=[gas_sector, nongas_sector])
# Step 5: Validate Results
print(" Gas & Non-Gas Weighting Vectors Computed Successfully!")
print("B weights row shape:", B weights row.shape) # Should be (2*N countries, ...
 \hookrightarrow N sectors)
print("B_weights_col shape:", B_weights_col.shape) # Should be (N_sectors,_
\hookrightarrow 2*N_countries)
# Confirm that shares sum to ~1 where gas & non-gas are present
print("Row Shares Sum Check (should be ~1):")
print(B_weights_row.groupby(level=1).sum().head())
print("Column Shares Sum Check (should be ~1):")
print(B_weights_col.sum(axis=1).head()) # Sum across gas & non-gas columns
```

```
[]: display(B_weights_row)
     display(B_weights_col)
[8]: ### Conversion of FIGARO tables to new table with gas and other energy
     ⇔seperated ###
     import pandas as pd
     # 1 Load the FIGARO dataset first
     figaro_file_path = r"C:
      →\Users\danie\Nextcloud\Coding\Masterthesis\data\raw\figaro_tables\2021_figaro_64.
     figaro_2021 = pd.read_csv(figaro_file_path, index_col=0) # Set row labels as_
      \rightarrow index
     # 2 Extract the Country Code and Sector Name Separately
     def split_country_sector(label):
         """Splits country-sector into (country, sector) tuple."""
         parts = label.split("_", 1) # Splitting at the first underscore
         return parts[0], parts[1] if len(parts) > 1 else parts[0] # If no sector, u
      ⇔return as-is
     # Split row and column labels into country & sector
     row_info = figaro_2021.index.map(split_country_sector)
     col_info = figaro_2021.columns.map(split_country_sector)
     # Convert to DataFrame for easy mapping
     row_df = pd.DataFrame(row_info.tolist(), index=figaro_2021.index,__
      ⇔columns=["Country", "Sector"])
     col_df = pd.DataFrame(col_info.tolist(), index=figaro_2021.columns,_
     ⇔columns=["Country", "Sector"])
     # 3 Define the sector mapping AFTER loading and extracting the country-sector
     figaro_mapping = {
         "A01": "A01".
         "A02": "A02",
         "A03": "A03",
         "B": ["B_gas", "B_nongas"], # Split into Gas and Non-Gas
         "C10T12": "C10-12",
         "C13T15": "C13-15",
         "C16": "C16",
         "C17": "C17",
         "C18": "C18",
         "C19": "C19",
         "C20": "C20-21",
         "C21": "C20-21",
         "C22": "C22",
```

```
"C23": "C23",
"C24": "C24",
"C25": "C25_33", # Grouped
"C26": "C26",
"C27": "C27",
"C28": "C28_32", # Grouped with C32
"C29": "C29",
"C30": "C30",
"C31_32": "C31", # C32 is included in C28_32
"C33": "C25_33", # Grouped with C25
"D35": "D35",
"E36": "E36",
"E37T39": "E37-39",
"F": "F",
"G45": "G45".
"G46": "G46",
"G47": "G47",
"H49": "H49",
"H50": "H50",
"H51": "H51",
"H52": "H52",
"H53": "H53",
"I": "I",
"J58": "J62 63",
"J59_60": "J62_63",
"J61": "J62_63",
"J62_63": "J62_63",
"K64": "K64",
"K65": "K65",
"K66": "K66",
"L": "L68", # Real Estate
"M69_70": "M_N",
"M71": "M_N",
"M72": "M_N",
"M73": "M_N",
"M74_75": "M_N",
"N77": "M_N",
"N78": "M_N",
"N79": "M_N",
"N80T82": "M_N",
"084": "084",
"P85": "P85",
"Q86": "M_N",
"Q87_88": "M_N",
"R90T92": "R_S",
"R93": "R_S",
"S94": "R_S",
```

```
"S95": "R_S",
    "S96": "R_S",
    "T": "T".
    ոլլու ոլլու
}
     Apply Mapping to Modify Only the Sector Part
row_df["Sector"] = row_df["Sector"].replace(figaro_mapping)
col_df["Sector"] = col_df["Sector"].replace(figaro_mapping)
# Reconstruct new country-sector labels
row_df["New_Label"] = row_df["Country"] + "_" + row_df["Sector"]
col_df["New_Label"] = col_df["Country"] + "_" + col_df["Sector"]
# Apply new labels to the dataset
figaro_2021.index = row_df["New_Label"]
figaro_2021.columns = col_df["New_Label"]
     Aggregate Data by Summing Over Mapped Sectors
figaro aggregated = figaro 2021.groupby(figaro 2021.index).sum()
figaro_aggregated = figaro_aggregated.T.groupby(figaro_aggregated.T.columns,__
→axis=1).sum()
# **Ensure Symmetry**
assert figaro_aggregated.shape[0] == figaro_aggregated.shape[1], "Row-column_u
 ⇔mismatch after aggregation!"
# **Check Energy Sector Per Country**
print("Aggregated Energy Sectors Per Country:")
energy_countries = [label for label in figaro_aggregated.index if "B_" in label]
print(figaro_aggregated.loc[energy_countries, energy_countries])
# **Save the processed file**
figaro aggregated.to csv("figaro aggregated 2021.csv")
```

```
95 # Reconstruct new country-sector labels
File c:\Users\danie\Nextcloud\Coding\Masterthesis\.
 env\Lib\site-packages\pandas\core\generic.py:8051, in NDFrame.replace(self,__
 8048
           else:
                to_replace, value = keys, values
   8049
-> 8051
           return self.replace(
                to_replace, value, inplace=inplace, limit=limit, regex=regex
   8052
   8053
   8054 else:
   8055
           # need a non-zero len on all axes
   8056
           if not self.size:
File c:\Users\danie\Nextcloud\Coding\Masterthesis\.
 →env\Lib\site-packages\pandas\core\generic.py:8099, in NDFrame.replace(self,
 sto_replace, value, inplace, limit, regex, method)
   8094
            if len(to_replace) != len(value):
   8095
               raise ValueError(
   8096
                    f"Replacement lists must match in length. "
   8097
                    f"Expecting {len(to_replace)} got {len(value)} "
   8098
-> 8099
           new_data = self._mgr.replace_list(
   8100
                src_list=to_replace,
   8101
                dest_list=value,
   8102
                inplace=inplace,
   8103
               regex=regex,
   8104
   8106 elif to replace is None:
   8107
           if not (
   8108
                is_re_compilable(regex)
                or is list like(regex)
   8109
                or is_dict_like(regex)
   8110
           ):
   8111
File c:\Users\danie\Nextcloud\Coding\Masterthesis\.
 →env\Lib\site-packages\pandas\core\internals\base.py:278, in DataManager.
 replace_list(self, src_list, dest_list, inplace, regex)
    275 """do a list replace"""
    276 inplace = validate_bool_kwarg(inplace, "inplace")
--> 278 bm = self.apply_with_block(
    279
           "replace list",
    280
           src_list=src_list,
    281
           dest list=dest list,
    282
           inplace=inplace,
    283
           regex=regex,
    284
           using_cow=using_copy_on_write();
           already_warned=_AlreadyWarned()
    285
```

```
286
              287 bm._consolidate_inplace()
              288 return bm
File c:\Users\danie\Nextcloud\Coding\Masterthesis\.
     oenv\Lib\site-packages\pandas\core\internals\managers.py:363, in oenv\Lib\site\managers.py:363, in oenv\Lib\
     →BaseBlockManager.apply(self, f, align_keys, **kwargs)
              361
                                                       applied = b.apply(f, **kwargs)
              362
--> 363
                                                       applied = getattr(b, f)(**kwargs)
                                         result_blocks = extend_blocks(applied, result_blocks)
              364
              366 out = type(self).from_blocks(result_blocks, self.axes)
File c:\Users\danie\Nextcloud\Coding\Masterthesis\.
     →env\Lib\site-packages\pandas\core\internals\blocks.py:1119, in Block.
     replace_list(self, src_list, dest_list, inplace, regex, using_cow, using_cow
     →already_warned)
          1114
                                         m = mib[blk_num : blk_num + 1]
          1116 # error: Argument "mask" to "_replace_coerce" of "Block" has
          1117 # incompatible type "Union[ExtensionArray, ndarray[Any, Any], bool]";
          1118 # expected "ndarray[Any, dtype[bool_]]"
-> 1119 result = blk._replace_coerce(
          1120
                                         to_replace=src,
          1121
                                        value=dest,
          1122
                                         mask=m,
          1123
                                        inplace=inplace,
          1124
                                         regex=regex,
          1125
                                        using_cow=using_cow,
          1126
          1128 if using_cow and i != src_len:
                                         # This is ugly, but we have to get rid of intermediate refs
          1129
                                         # that did not go out of scope yet, otherwise we will trigger
          1130
                                         # many unnecessary copies
          1131
                                         for b in result:
          1132
File c:\Users\danie\Nextcloud\Coding\Masterthesis\.
     wenvLib\site-packages\pandas\core\internals\blocks.py:1223, in Block.
     -_replace_coerce(self, to_replace, value, mask, inplace, regex, using_cow)
          1221
                                                       return [self]
                                         return [self] if inplace else [self.copy()]
          1222
-> 1223 return self.replace(
          1224
                                        to_replace=to_replace,
          1225
                                         value=value,
          1226
                                         inplace=inplace,
          1227
                                         mask=mask,
          1228
                                         using_cow=using_cow,
          1229
```

```
File c:\Users\danie\Nextcloud\Coding\Masterthesis\.
 wenv\Lib\site-packages\pandas\core\internals\blocks.py:881, in Block.
 replace(self, to_replace, value, inplace, mask, using_cow, already_warned)
    877 elif self._can_hold_element(value):
            # TODO(CoW): Maybe split here as well into columns where mask hasu
    878
 →True
    879
            # and rest?
    880
            blk = self._maybe_copy(using_cow, inplace)
            putmask_inplace(blk.values, mask, value)
--> 881
            if (
    882
    883
                inplace
    884
                and warn_copy_on_write()
    885
                and already_warned is not None
    886
                and not already_warned.warned_already
    887
            ):
    888
                if self.refs.has_reference():
File c:\Users\danie\Nextcloud\Coding\Masterthesis\.
 ⊶env\Lib\site-packages\pandas\core\array_algos\putmask.py:56, in_
 →putmask_inplace(values, mask, value)
     54
                values[mask] = value[mask]
     55
            else:
---> 56
                values[mask] = value
     57 else:
     58
            # GH#37833 np.putmask is more performant than setitem
     59
            np.putmask(values, mask, value)
ValueError: NumPy boolean array indexing assignment cannot assign 2 input value
 →to the 46 output values where the mask is true
```