

Requirement already satisfied: pandas in C:\Users\gabri\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-packages\Python311\site-packages (2.2.2)

Requirement already satisfied: matplotlib in C:\Users\gabri\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-packages\Python311\site-packages (3.9.2)

Requirement already satisfied: openpyxl in C:\Users\gabri\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-packages\Python311\site-packages (3.1.5)

Requirement already satisfied: numpy>=1.23.2 in C:\Users\gabri\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-packages\Python311\site-packages (from pandas) (2.0.1)

Requirement already satisfied: python-dateutil>=2.8.2 in C:\Users\gabri\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-packages\Python311\site-packages (from pandas) (2.9.0.post0)

Requirement already satisfied: pytz>=2020.1 in C:\Users\gabri\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-packages\Python311\site-packages (from pandas) (2024.1)

Requirement already satisfied: tzdata>=2022.7 in C:\Users\gabri\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-packages\Python311\site-packages (from pandas) (2024.1)

Requirement already satisfied: contourpy>=1.0.1 in C:\Users\gabri\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-packages\Python311\site-packages (from matplotlib) (1.3.0)

Requirement already satisfied: cycler>=0.10 in C:\Users\gabri\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-packages\Python311\site-packages (from matplotlib) (0.12.1)

Requirement already satisfied: fonttools>=4.22.0 in C:\Users\gabri\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-packages\Python311\site-packages (from matplotlib) (4.54.1)

Requirement already satisfied: kiwisolver>=1.3.1 in C:\Users\gabri\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-packages\Python311\site-packages (from matplotlib) (1.4.7)

Requirement already satisfied: packaging>=20.0 in C:\Users\gabri\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-packages\Python311\site-packages (from matplotlib) (24.1)

Requirement already satisfied: pillow>=8 in C:\Users\gabri\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-packages\Python311\site-packages (from matplotlib) (10.4.0)

Requirement already satisfied: pyparsing>=2.3.1 in C:\Users\gabri\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-packages\Python311\site-packages (from matplotlib) (3.1.4)

Requirement already satisfied: et-xmlfile in C:\Users\gabri\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-packages\Python311\site-packages (from openpyxl) (2.0.0)

Requirement already satisfied: six>=1.5 in C:\Users\gabri\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-packages\Python311\site-packages (from python-dateutil>=2.8.2->pandas) (1.16.0)

WARNING: Ignoring invalid distribution ~orch (C:\Users\gabri\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-packages\Python311\site-packages)

WARNING: Ignoring invalid distribution ~orch (C:\Users\gabri\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-packages\Python311\site-packages)

WARNING: Ignoring invalid distribution ~orch (C:\Users\gabri\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-packages\Python311\site-packages)

WARNING: Ignoring invalid distribution ~orch (C:\Users\gabri\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-packages\Python311\site-packages)

Collecting nbformat

Using cached nbformat-5.10.4-py3-none-any.whl.metadata (3.6 kB)

Collecting nbconvert

Using cached nbconvert-7.17.0-py3-none-any.whl.metadata (8.4 kB)

Collecting jupyter

Using cached jupyter-1.1.1-py2.py3-none-any.whl.metadata (2.0 kB)

```
WARNING: Ignoring invalid distribution ~orch (C:\Users\gabri\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-packages\Python311\site-packages)
WARNING: Ignoring invalid distribution ~orch (C:\Users\gabri\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-packages\Python311\site-packages)
ERROR: Could not find a version that satisfies the requirement nbconvert-tex-templates (from versions: none)
ERROR: No matching distribution found for nbconvert-tex-templates
```

```
C:\Users\gabri\AppData\Local\Microsoft\WindowsApps\PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\python.exe
```

```
Out[172... ['analisebase.ipynb',
            'br_seeg_emissoes_brasil.csv',
            'br_seeg_emissoes_brasil.xlsx']
```

Célula 2.1 — Guia de Leitura do Notebook (MD)

Guia de Leitura do Notebook

Este notebook está estruturado em blocos analíticos progressivos, permitindo leitura sequencial ou direcionada.

Estrutura geral:

- **Células 0–2:** Preparação do ambiente
- **Células 3–6:** Carga e compreensão dos dados
- **Células 7–8:** Engenharia temporal
- **Células 9.x:** Análises por gás individual (visão técnica)
- **Células 10.x:** Análises por grupos de gases (visão executiva)
- **Células 11+:** Visualizações e comunicação de resultados

Out[173...

	ano	nivel_1	nivel_2	nivel_3	nivel_4	nivel_5	nivel_6	tipo_emissao	gas	atividade_econom
0	1970	Agropecuária	Cultivo do Arroz	Diretas	Outros	Vegetal	Arroz	Emissão	CH4 (t)	N
1	1971	Agropecuária	Cultivo do Arroz	Diretas	Outros	Vegetal	Arroz	Emissão	CH4 (t)	N
2	1972	Agropecuária	Cultivo do Arroz	Diretas	Outros	Vegetal	Arroz	Emissão	CH4 (t)	N
3	1973	Agropecuária	Cultivo do Arroz	Diretas	Outros	Vegetal	Arroz	Emissão	CH4 (t)	N
4	1974	Agropecuária	Cultivo do Arroz	Diretas	Outros	Vegetal	Arroz	Emissão	CH4 (t)	N

Out[174...

	ano	gas	emissao
0	1970	CH4 (t)	23046217.0
1	1971	CH4 (t)	2260163.0
2	1972	CH4 (t)	2201012.0
3	1973	CH4 (t)	21419556.0
4	1974	CH4 (t)	18686284.0

Out[175...

	ano	gas	emissao
0	1970	C2F6 (t)	1.395662e+06
1	1970	CF4 (t)	2.134453e+07
2	1970	CH4 (t)	4.998021e+09
3	1970	CO (t)	4.356296e+09
4	1970	CO2 (t)	3.151364e+09

Out[176...

	gas	C2F6 (t)	CF4 (t)	CH4 (t)	CO (t)	CO2 (t)	CO2e (t) GTP-AR2	CO2e (t) GTP-AR4
ano								
1970		1395662.0	21344527.0	4.998021e+09	4.356296e+09	3.151364e+09	8.446847e+09	8.446847e+09
1971		20076635.0	30704159.0	5.664296e+09	4.495005e+09	3.538648e+09	8.614891e+09	8.614891e+09
1972		24281036.0	3713415.0	4.857771e+09	4.719047e+09	3.588300e+09	8.482554e+09	8.482554e+09
1973		2778885.0	42498817.0	5.615892e+09	4.302412e+09	3.725942e+09	8.946097e+09	8.946097e+09
1974		28261534.0	43221715.0	5.674398e+09	5.142865e+09	3.940045e+09	9.203126e+09	9.203126e+09

5 rows × 22 columns



Célula 6.1 — Unidade da Variável Emissão

A variável **emissao** representa o volume de emissões de gases de efeito estufa expresso em:

Milhões de toneladas (Mt)

Todas as agregações e gráficos mantêm essa unidade de forma consistente.

Out[177...

	ano	gas	emissao	periodo_5_anos	periodo_10_anos	periodo_30_anos
0	1970	C2F6 (t)	1.395662e+06	1970	1970	1950
1	1970	CF4 (t)	2.134453e+07	1970	1970	1950
2	1970	CH4 (t)	4.998021e+09	1970	1970	1950
3	1970	CO (t)	4.356296e+09	1970	1970	1950
4	1970	CO2 (t)	3.151364e+09	1970	1970	1950

Out[178...

	ano	periodo_5_anos
0	1970	1970–1974
1	1971	1970–1974
2	1972	1970–1974
3	1973	1970–1974
4	1974	1970–1974
5	1975	1975–1979
6	1976	1975–1979
7	1977	1975–1979
8	1978	1975–1979
9	1979	1975–1979

Out[179...

	ano	periodo_10_anos
0	1970	1970–1979
1	1971	1970–1979
2	1972	1970–1979
3	1973	1970–1979
4	1974	1970–1979
5	1975	1970–1979
6	1976	1970–1979
7	1977	1970–1979
8	1978	1970–1979
9	1979	1970–1979

Out[180...

	ano	periodo_30_anos
0	1970	1950–1979
1	1971	1950–1979
2	1972	1950–1979
3	1973	1950–1979
4	1974	1950–1979
5	1975	1950–1979
6	1976	1950–1979
7	1977	1950–1979
8	1978	1950–1979
9	1979	1950–1979

Out[182...

	gas	C2F6 (t)	CF4 (t)	CH4 (t)	CO (t)	CO2 (t)	CO2e (t) GTP-AR2	
periodo_5_anos								
	1970–1974	76793752.0	141482633.0	2.681038e+10	2.301562e+10	1.794430e+10	4.369351e+10	4
	1975–1979	179425910.0	274404627.0	3.040979e+10	2.766947e+10	2.453556e+10	5.117312e+10	5
	1980–1984	426197118.0	361821242.0	3.873608e+10	3.316761e+10	3.270048e+10	6.177736e+10	6
	1985–1989	408206070.0	172450164.0	4.247015e+10	3.841416e+10	3.353496e+10	6.205227e+10	6
	1990–1994	470820560.0	165736484.0	3.976869e+10	3.806136e+10	4.176056e+10	7.106317e+10	7

5 rows × 22 columns



Out[183...

	gas	C2F6 (t)	CF4 (t)	CH4 (t)	CO (t)	CO2 (t)	CO2e (t) GTP-AR2
periodo_10_anos							
	1970–1979	256219662.0	4.158873e+08	5.722017e+10	5.068510e+10	4.247986e+10	9.486664e+10
	1980–1989	834403188.0	5.342714e+08	8.120622e+10	7.158177e+10	6.623544e+10	1.238296e+11
	1990–1999	833462734.0	5.433699e+08	7.847599e+10	7.438898e+10	8.614018e+10	1.462134e+11
	2000–2009	916422796.0	1.115858e+09	8.597986e+10	7.640134e+10	8.880178e+10	1.508789e+11
	2010–2019	731445755.0	8.138590e+08	9.777839e+10	8.310586e+10	8.042540e+10	1.531326e+11

5 rows × 22 columns



	gas	C2F6 (t)	CF4 (t)	CH4 (t)	CO (t)	CO2 (t)	CO2e (t) GTP-AR2
período_30_anos							
1950–1979		2.562197e+08	4.158873e+08	5.722017e+10	5.068510e+10	4.247986e+10	9.486664e+10
1980–2009		2.584289e+09	2.193500e+09	2.456621e+11	2.223721e+11	2.411774e+11	4.209219e+11
2010–2039		7.314458e+08	8.138590e+08	9.777839e+10	8.310586e+10	8.042540e+10	1.531326e+11

3 rows × 22 columns

Célula 10.0 — Transição da Análise Técnica para Executiva

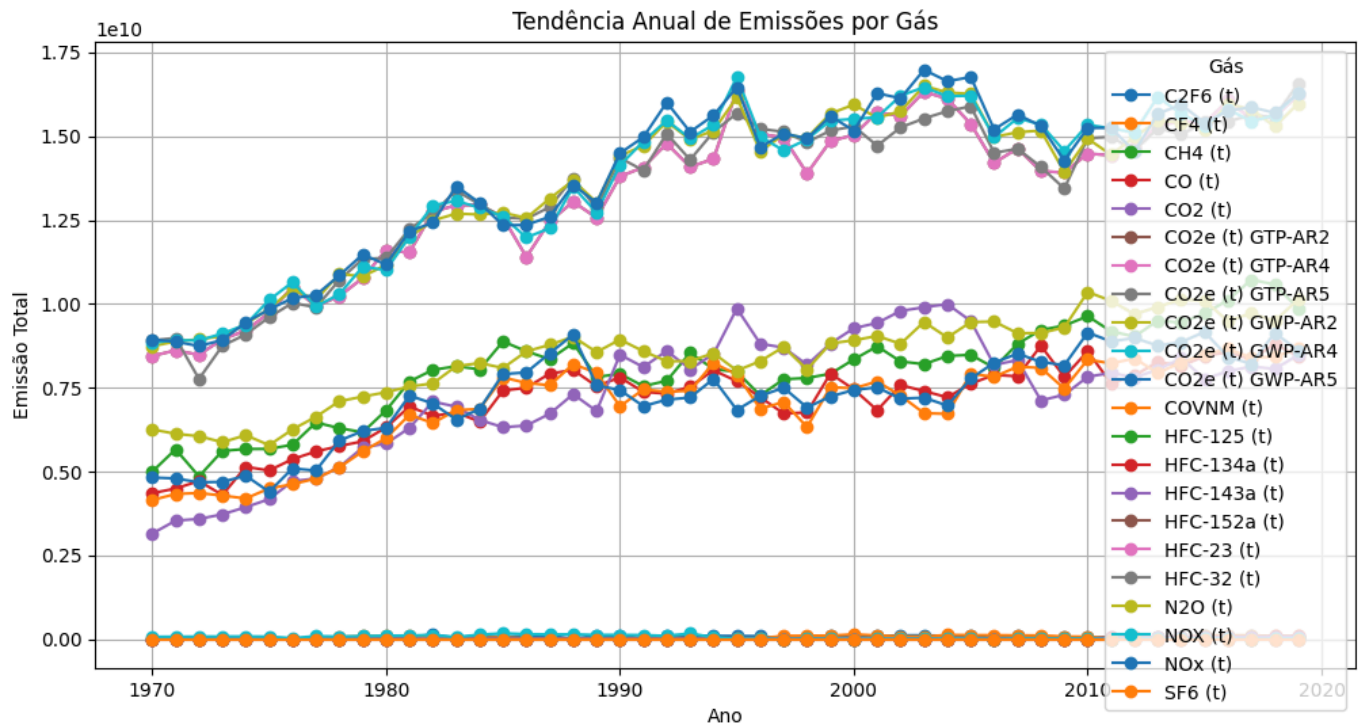
Até este ponto, as análises foram conduzidas considerando os **gases de efeito estufa individualmente**, preservando a granularidade técnica do dataset.

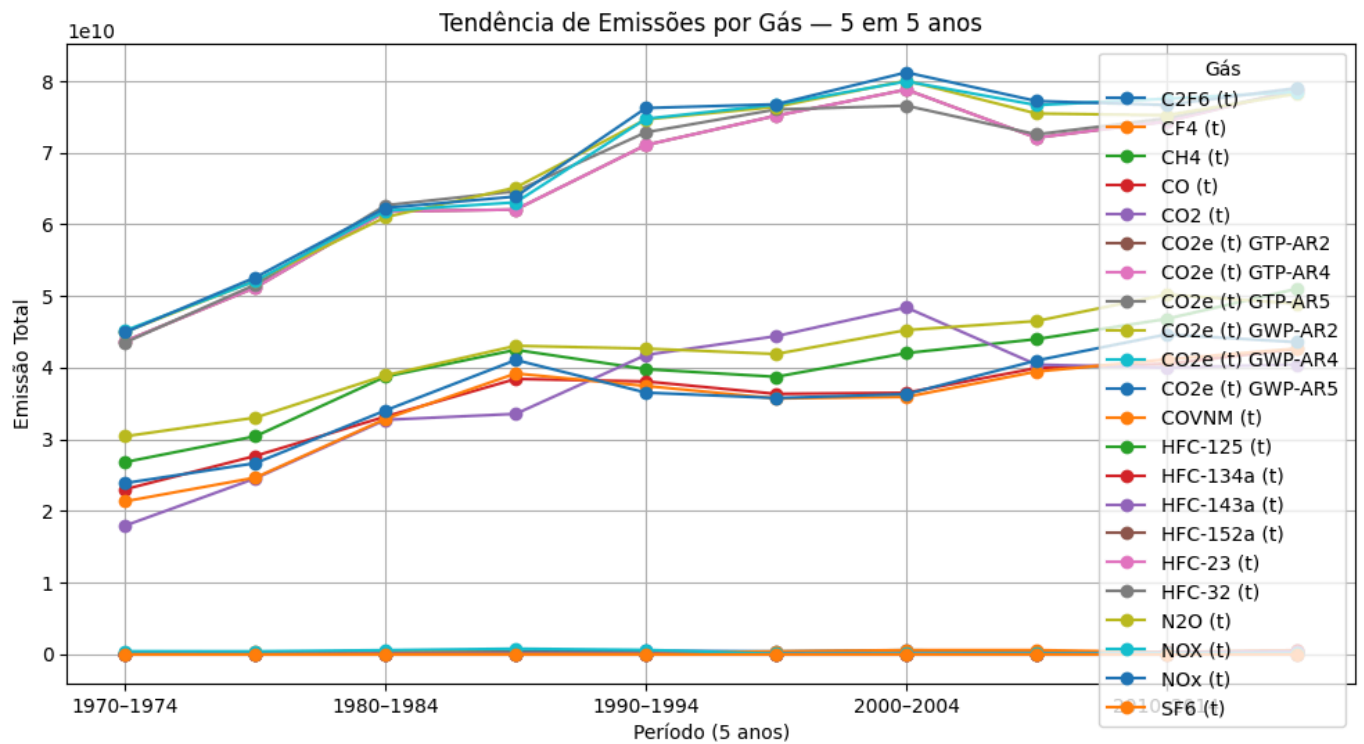
A partir da próxima célula, os gases serão **agrupados em categorias estratégicas** amplamente utilizadas em:

- Relatórios executivos
- Inventários ambientais (SEEG, IPCC)
- Comunicação com públicos não técnicos

Objetivo da transição:

- Reduzir complexidade visual
- Facilitar comunicação de resultados
- Manter consistência com padrões institucionais



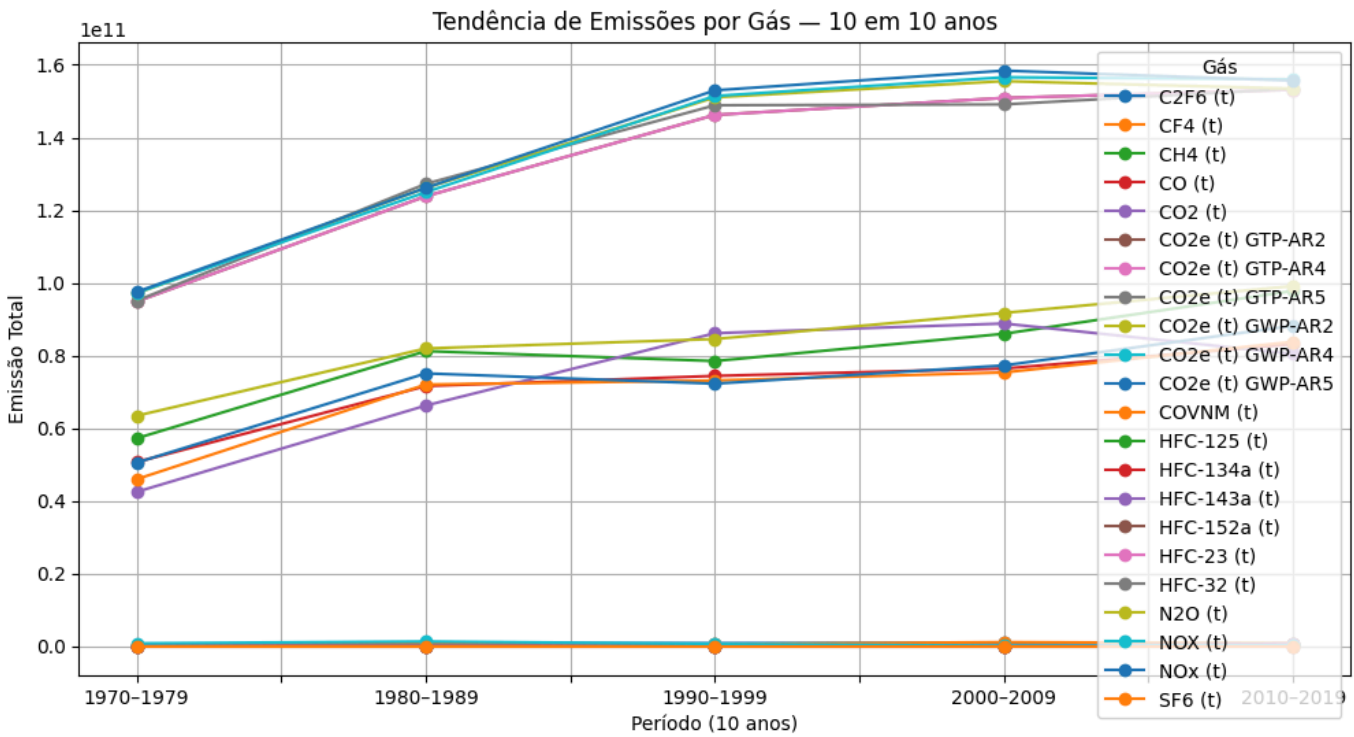
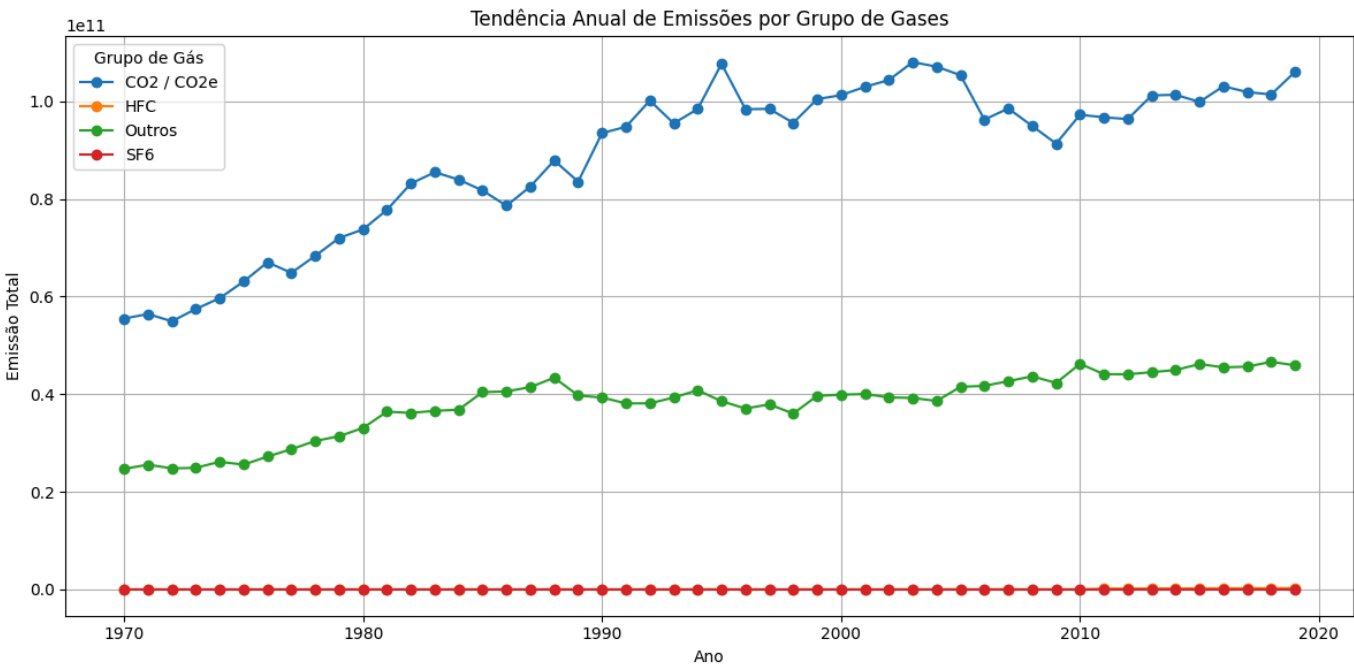


Out[187...

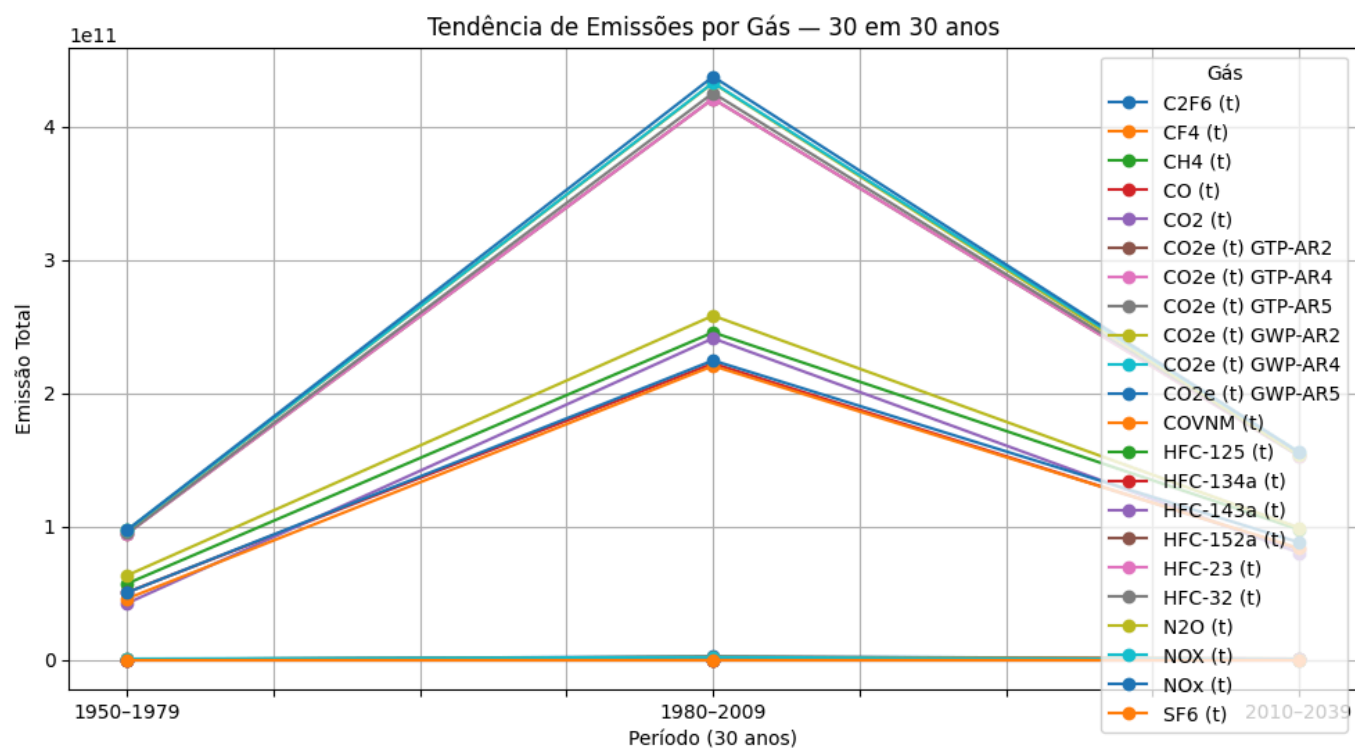
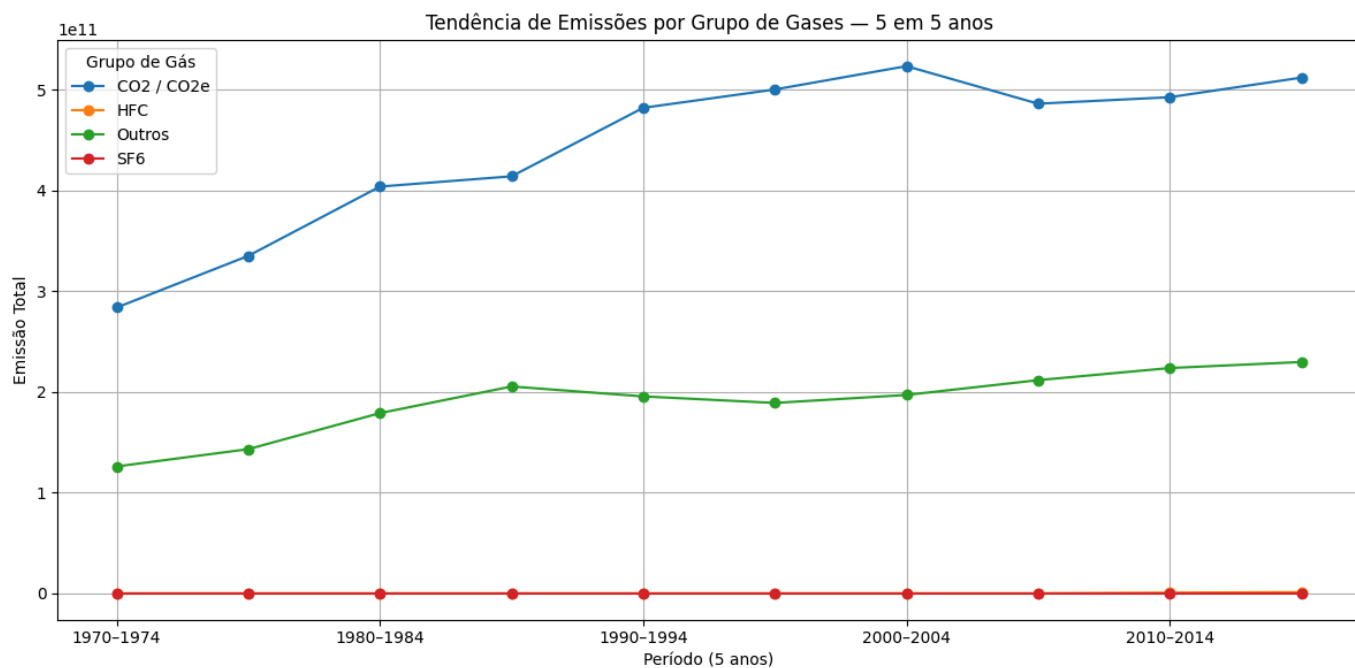
	gas	grupo_gas
14150	CO2 (t)	CO2 / CO2e
50	CO2e (t) GTP-AR2	CO2 / CO2e
100	CO2e (t) GTP-AR4	CO2 / CO2e
150	CO2e (t) GTP-AR5	CO2 / CO2e
200	CO2e (t) GWP-AR2	CO2 / CO2e
250	CO2e (t) GWP-AR4	CO2 / CO2e
300	CO2e (t) GWP-AR5	CO2 / CO2e
430800	HFC-32 (t)	HFC
430750	HFC-23 (t)	HFC
430700	HFC-152a (t)	HFC
430650	HFC-143a (t)	HFC
430600	HFC-134a (t)	HFC
430550	HFC-125 (t)	HFC
439200	C2F6 (t)	Outros
0	CH4 (t)	Outros
34850	COVNM (t)	Outros
439250	CF4 (t)	Outros
7650	NOX (t)	Outros
7250	CO (t)	Outros
4200	N2O (t)	Outros
34950	NOx (t)	Outros
445700	SF6 (t)	SF6

grupo_gas CO2 / CO2e HFC Outros SF6

ano				
1970	5.548073e+10	0.0	2.468583e+10	0.0
1971	5.641745e+10	0.0	2.554148e+10	0.0
1972	5.491845e+10	0.0	2.478522e+10	0.0
1973	5.744273e+10	0.0	2.490051e+10	0.0
1974	5.966347e+10	0.0	2.613586e+10	0.0

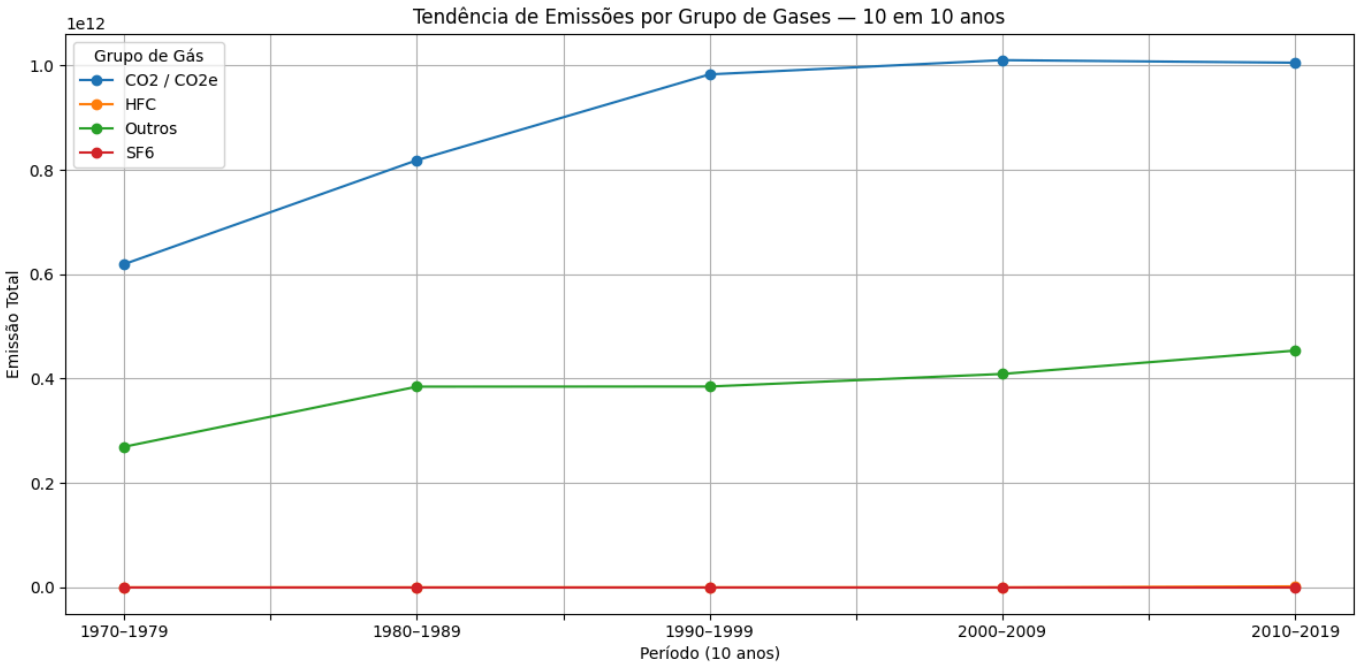


1970–1974	2.839228e+11	0.0	1.260489e+11	0.0
1975–1979	3.352636e+11	0.0	1.432301e+11	0.0
1980–1984	4.040778e+11	0.0	1.790153e+11	0.0
1985–1989	4.142889e+11	0.0	2.054856e+11	0.0
1990–1994	4.823137e+11	47846.0	1.956275e+11	418.0



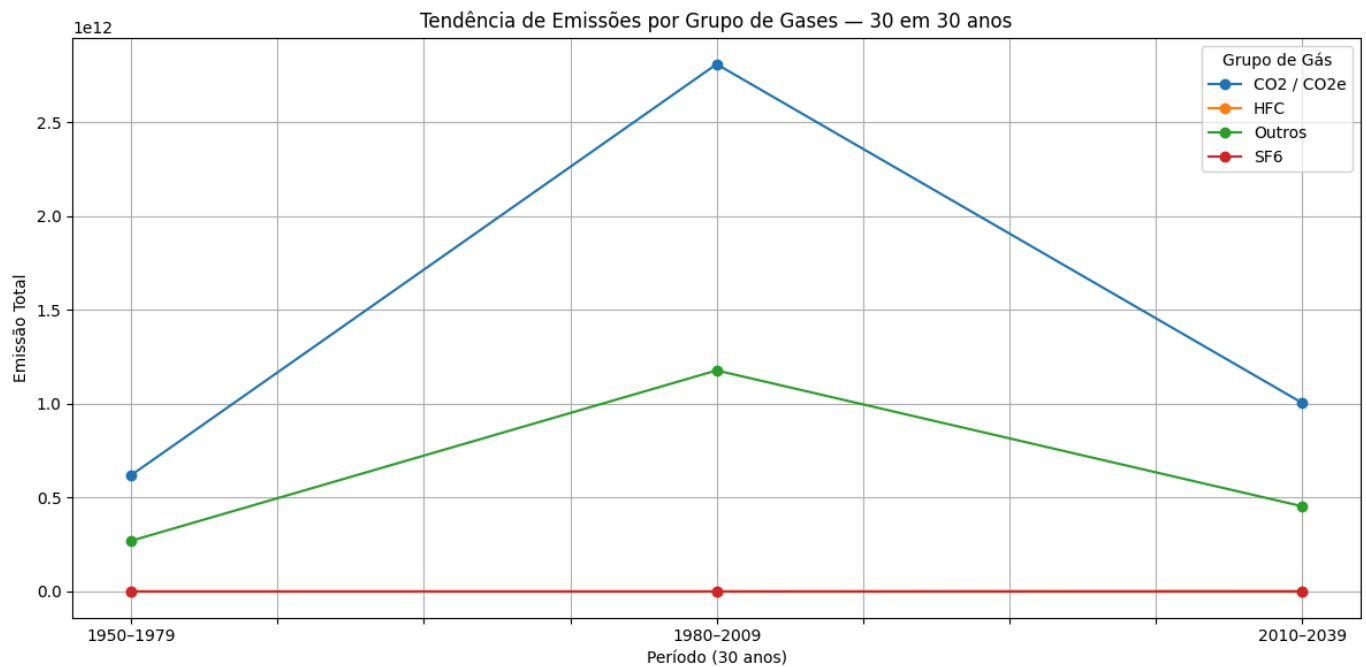
Out[194...

grupo_gas	CO2 / CO2e	HFC	Outros	SF6
período_10_anos				
1970–1979	6.191865e+11	0.000000e+00	2.692790e+11	0.0
1980–1989	8.183668e+11	0.000000e+00	3.845009e+11	0.0
1990–1999	9.828534e+11	1.542440e+05	3.847686e+11	1162.0
2000–2009	1.010124e+12	3.517470e+05	4.088443e+11	3172.0
2010–2019	1.005183e+12	1.846420e+09	4.536035e+11	7202.0



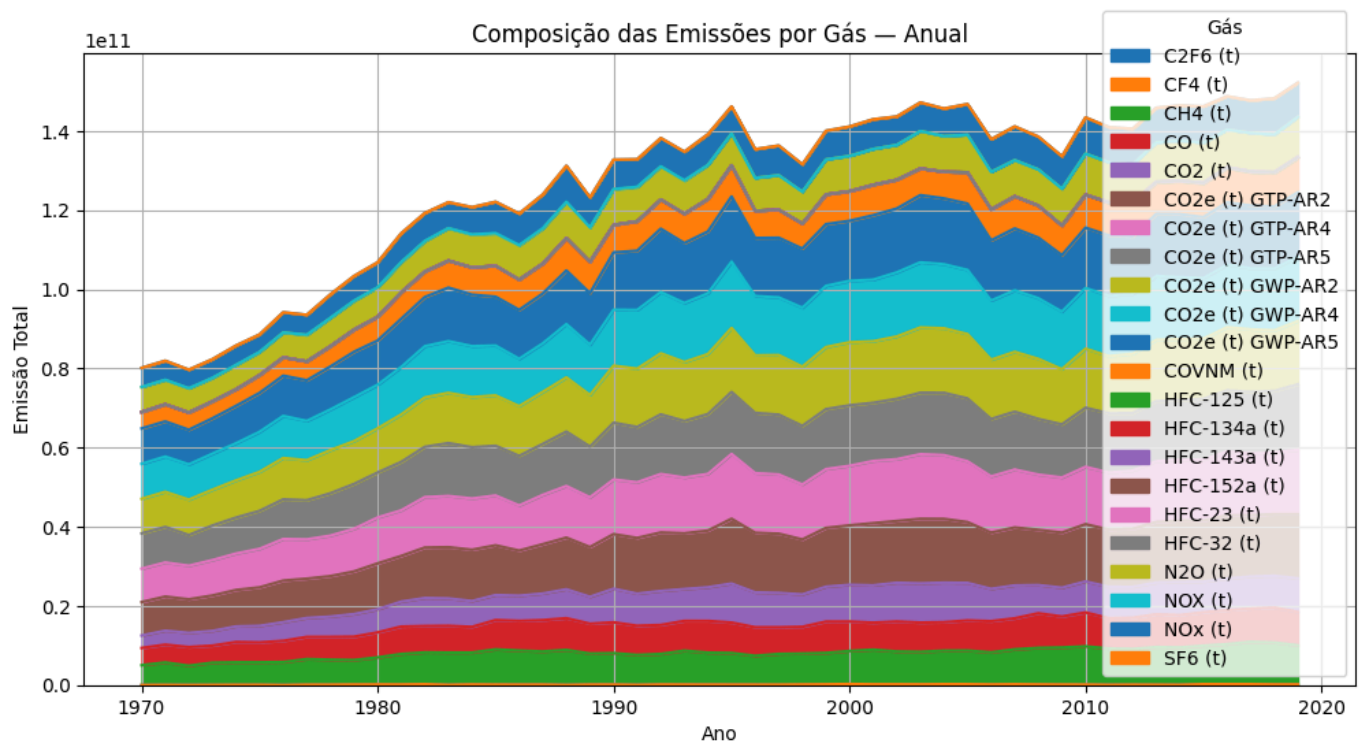
Out[196...

grupo_gas	CO2 / CO2e	HFC	Outros	SF6
período_30_anos				
1950–1979	6.191865e+11	0.000000e+00	2.692790e+11	0.0
1980–2009	2.811344e+12	5.059910e+05	1.178114e+12	4334.0
2010–2039	1.005183e+12	1.846420e+09	4.536035e+11	7202.0

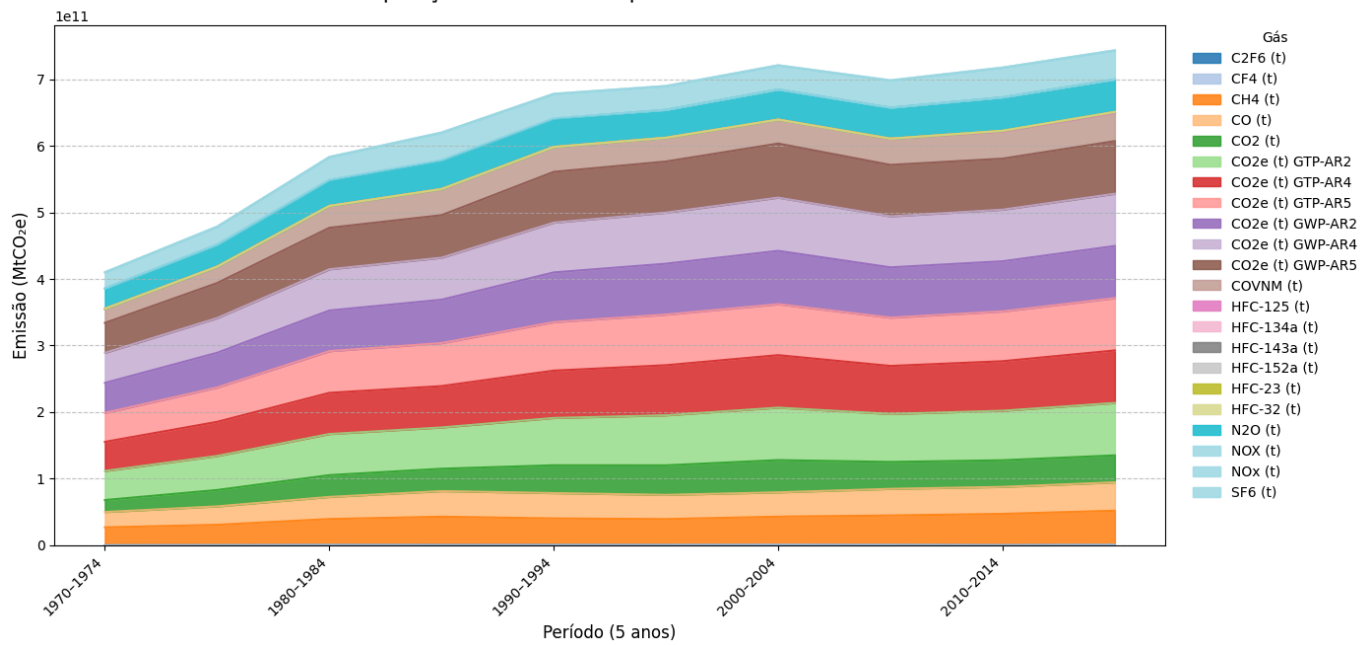


TODO:

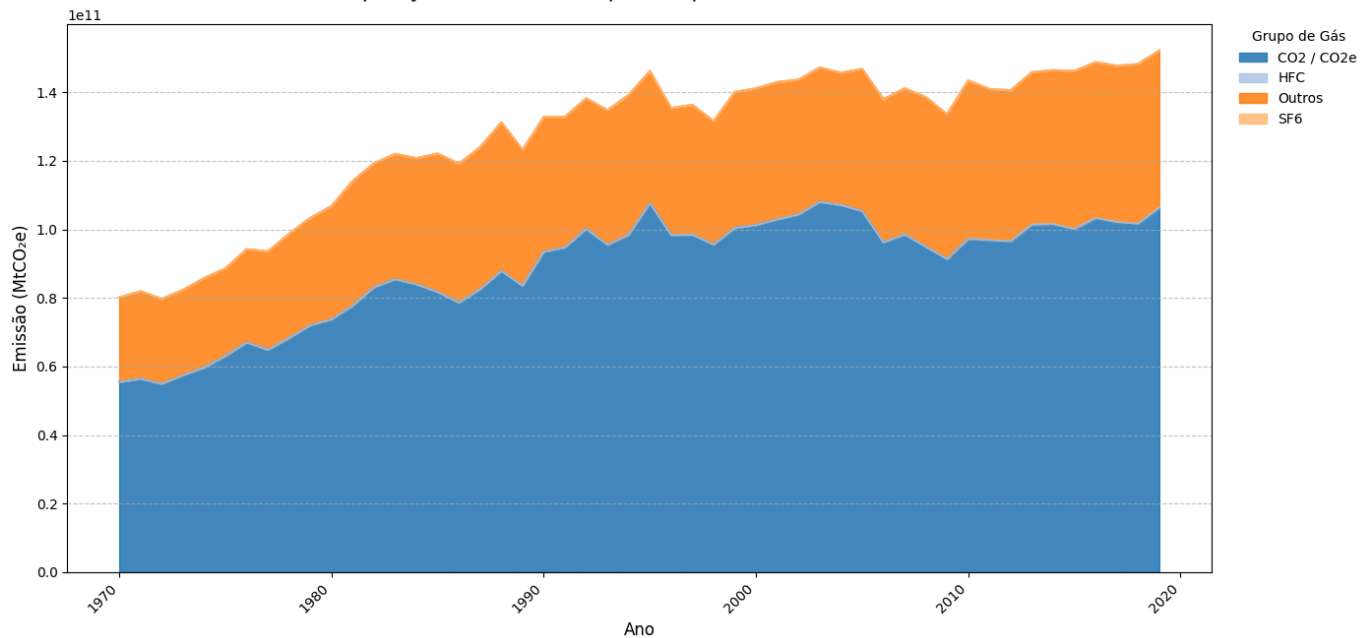
ajeitar toda a organização do processo do 11 (11.1. et cetera)



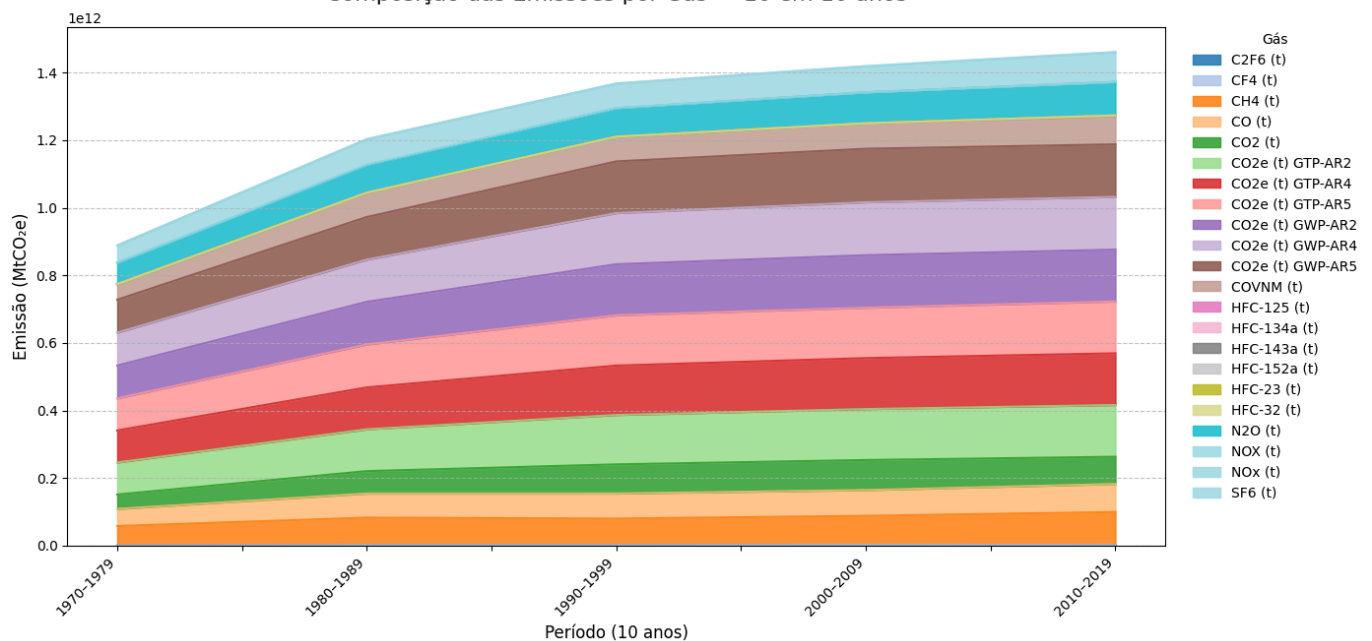
Composição das Emissões por Gás — 5 em 5 anos



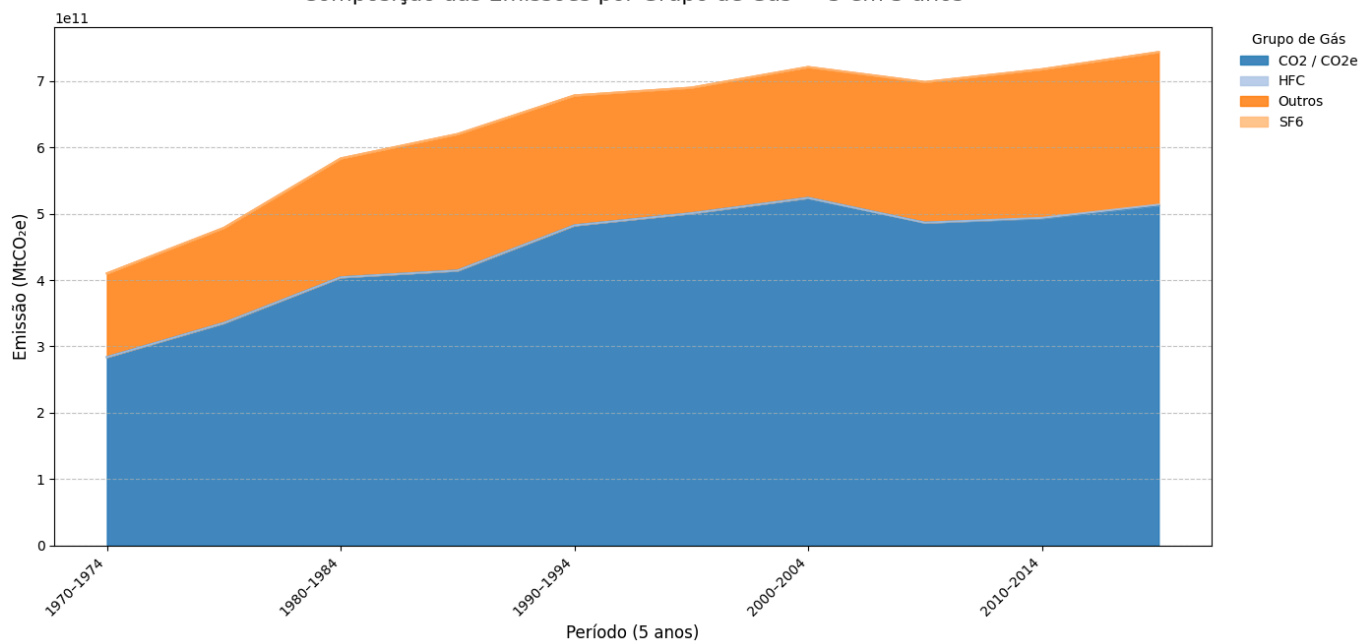
Composição das Emissões por Grupo de Gás — Visão Anual



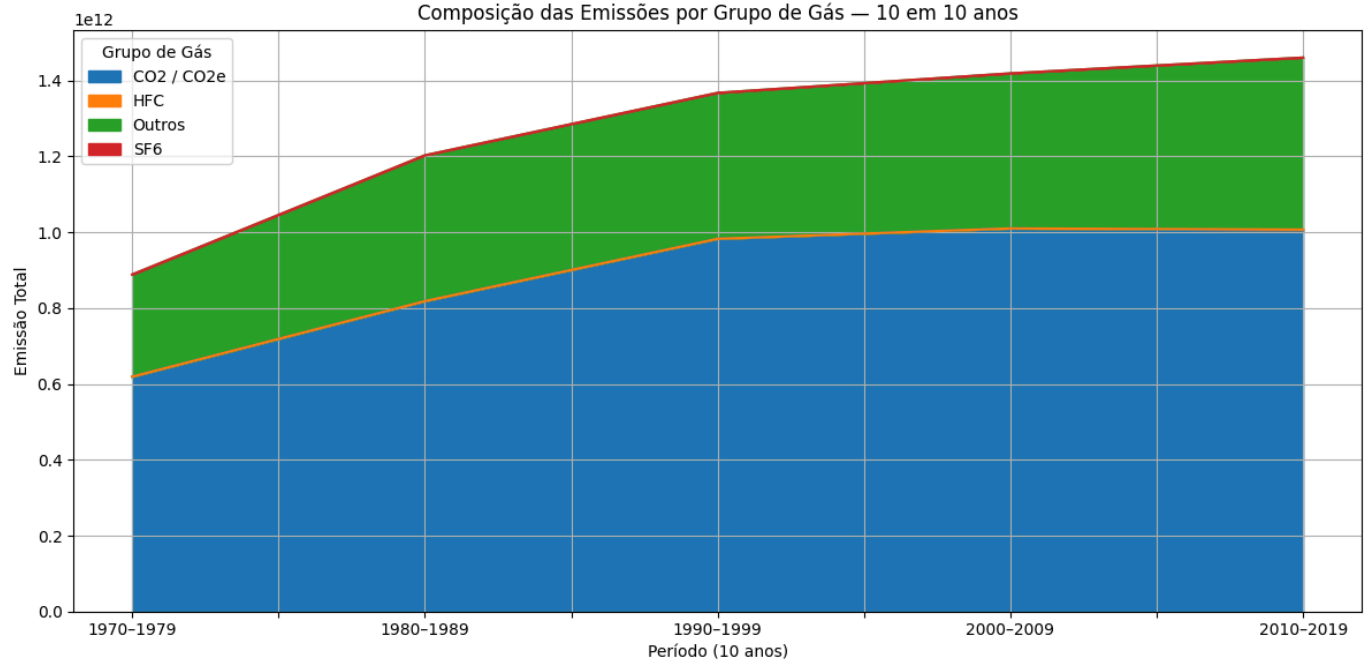
Composição das Emissões por Gás — 10 em 10 anos



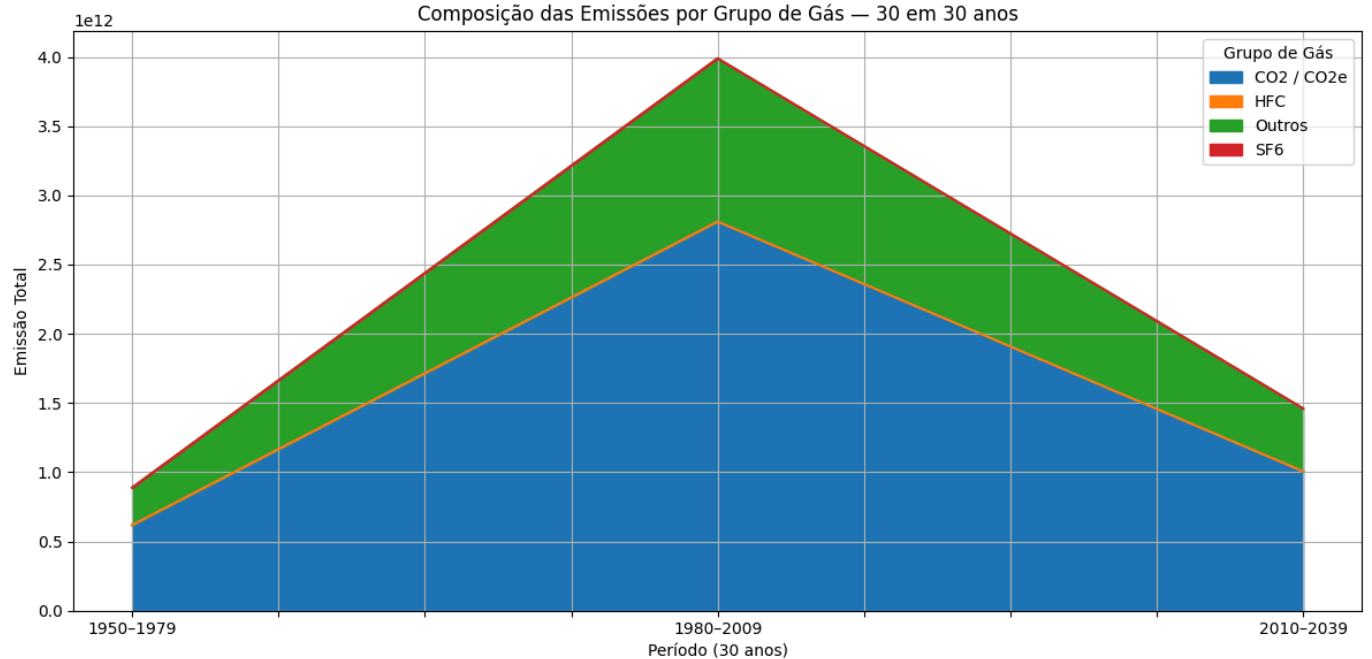
Composição das Emissões por Grupo de Gás — 5 em 5 anos

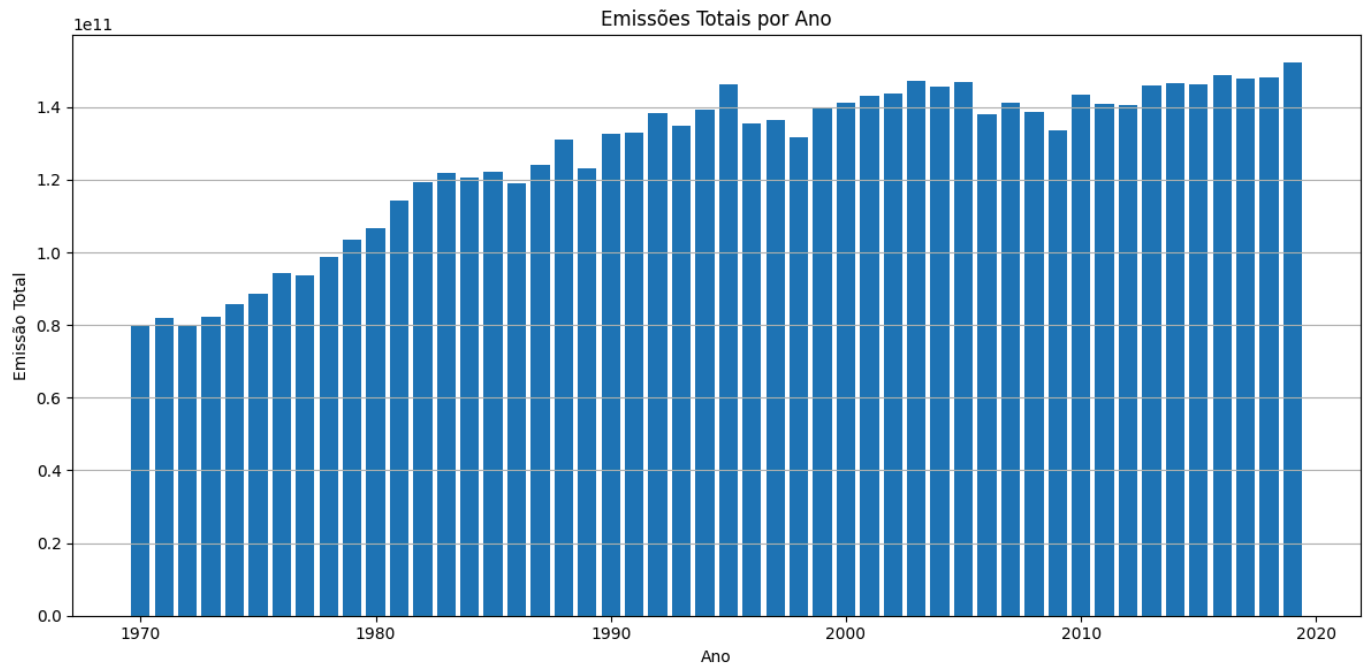


Composição das Emissões por Grupo de Gás — 10 em 10 anos

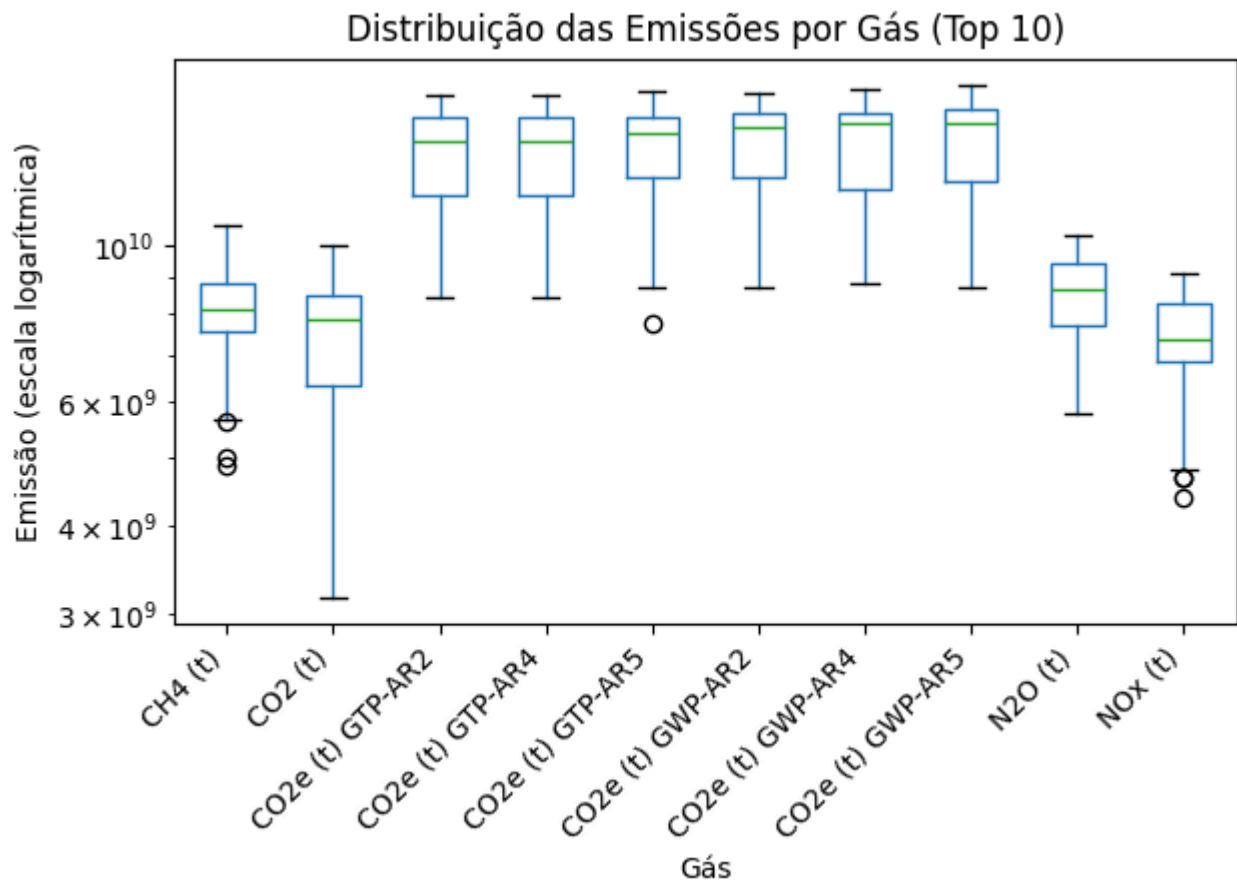


Composição das Emissões por Grupo de Gás — 30 em 30 anos





<Figure size 1400x600 with 0 Axes>



```
Out[226...] '\nTODO: Célula 14 – Exportação para PDF\nwith open("analisebase.ipynb", encoding="utf-8") as f:\n    nb = nbformat.read(f, as_version=4)\n    npdf_exporter = PDFExporter()\n    npdf_exporter.template_name = \'report\'\n    npdf_exporter.latex_engine = \'xelatex\' # essencial para acentos\n    \nbody, resources = pdf_exporter.from_notebook_node(nb)\n    \nwriter = FileWriter()\n    \nwriter.write(body, resources, notebook_name="analise da base de dados emissões do brasil")\n'
```