



Supplement of

A comparative analysis of EDGAR and UNFCCC GHG emissions inventories: insights on trends, methodology and data discrepancies

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Supplementary figures

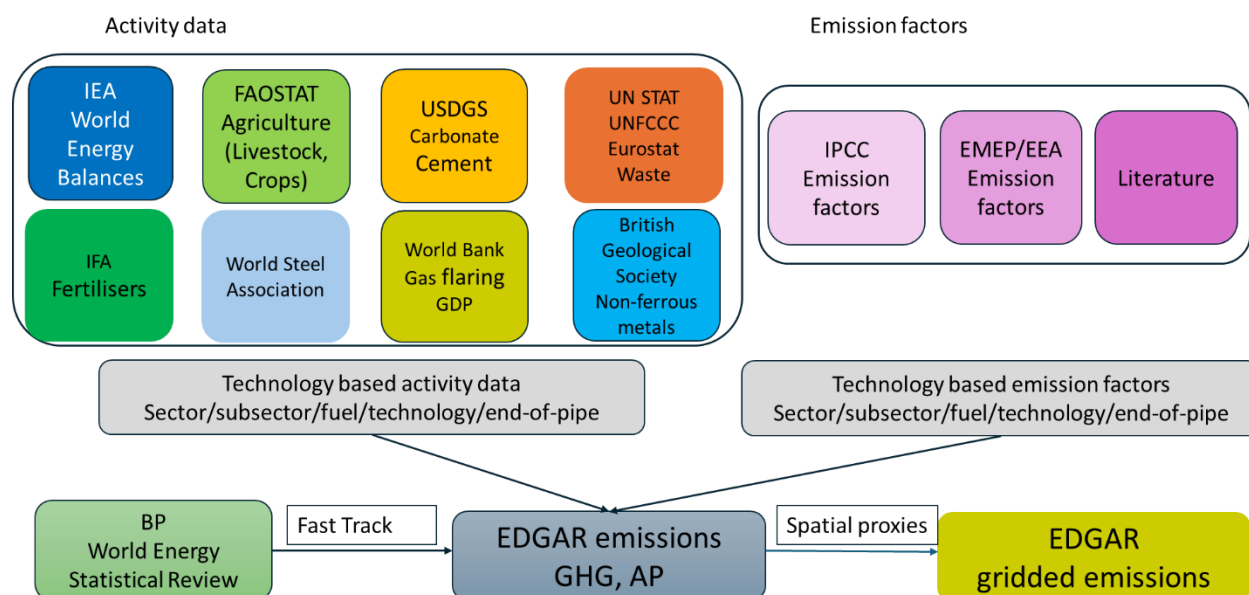


Figure S1. Data sources used to compile bottom-up EDGAR GHG and air pollutant emissions
Source: EDGAR 2024

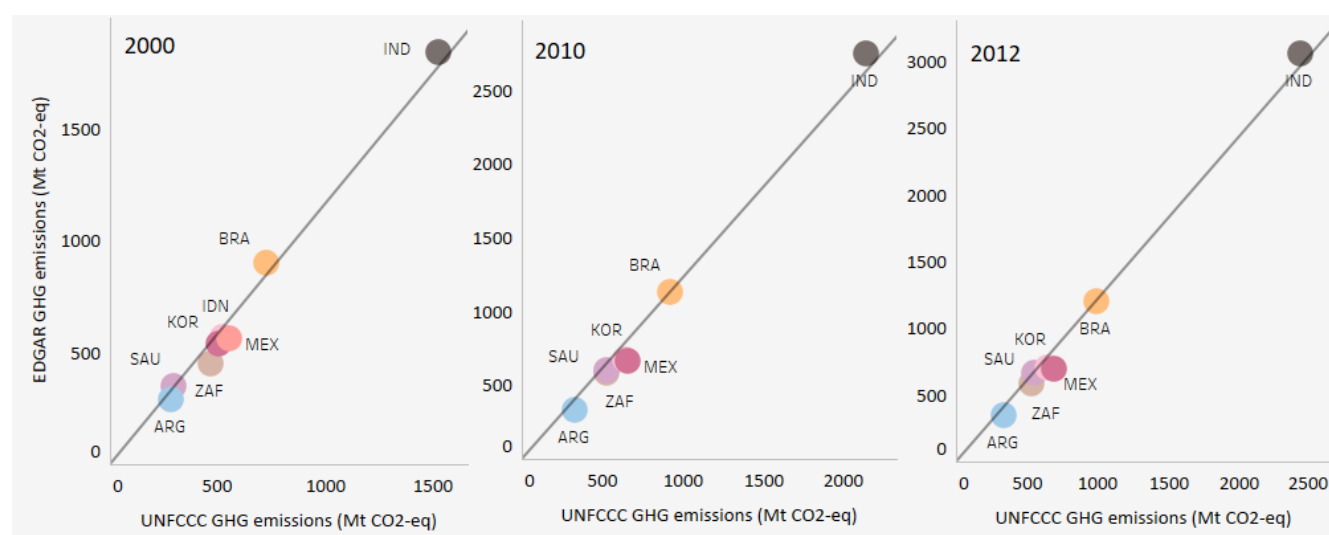


Figure S2. Correlation between EDGARv8.0 2023 and UNFCCC 2023 GHG emissions for G20 countries in years 2000, 2010 and 2012
Source: UNFCCC 2023, EDGARv8.0 2023

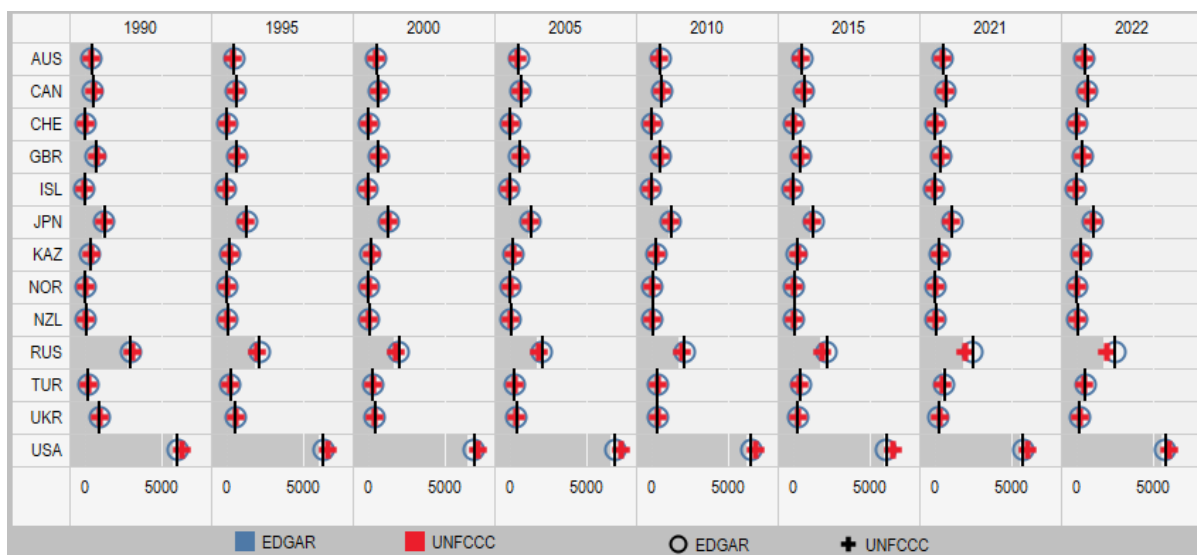


Figure S3. GHG (CO₂, CH₄ and N₂O) emissions every 5-years, 1990-2022, Annex I countries (EU27 not included), Mt CO₂-eq

Source: UNFCCC CRT 2024; EDGAR 2024

NB. GWP (100 years) of IPCC Fourth Assessment Report is applied for CH₄ and N₂O emissions.

EDGAR (blue circles) and UNFCCC submissions (red crosses) shown by both colour and shape for accessibility.

Highlighted area represents up to 90% of UNFCCC EU27 emissions.

Vertical line represents the median value of EDGAR emissions

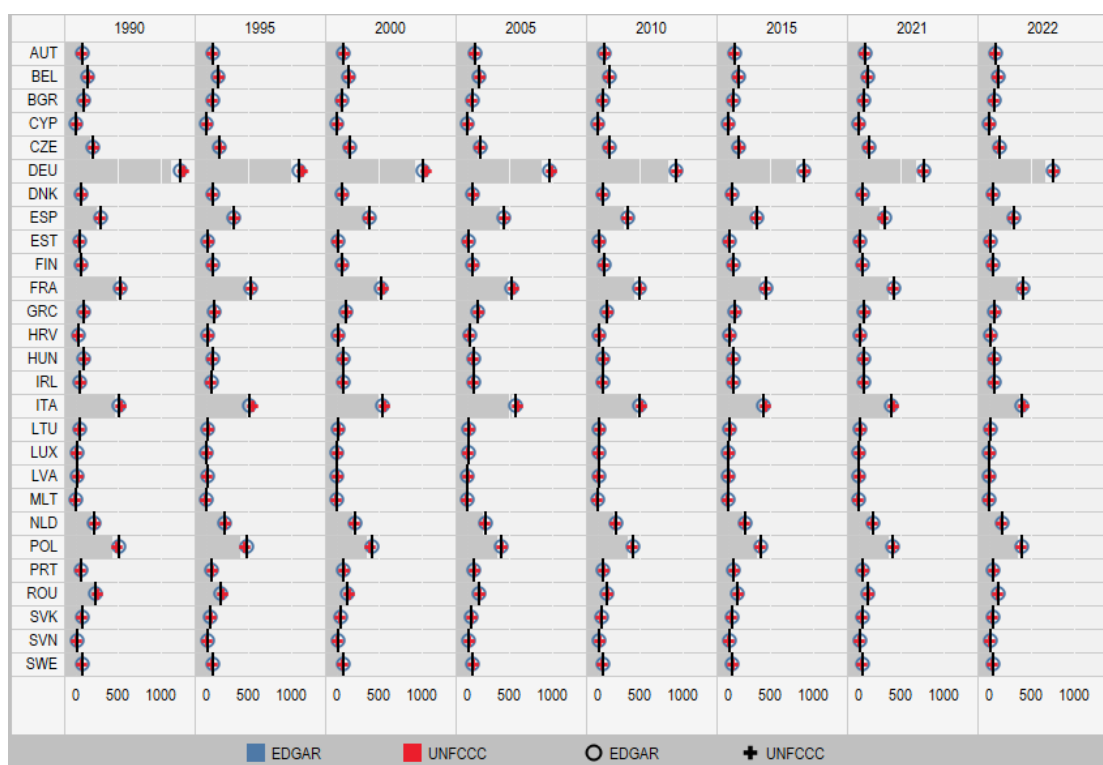


Figure S4. GHG (CO₂, CH₄, N₂O) emissions in EU27 MS: EDGAR vs UNFCCC submission every 5-years, 1990-2022, Mt CO₂-eq

Source: UNFCCC CRT 2024, EDGAR 2024

NB. EDGAR (blue circles) and UNFCCC submissions (red crosses) shown by both colour and shape for accessibility.

Highlighted area represents up to 90% of UNFCCC EU27 emissions.

Vertical line represents the median value of EDGAR emissions

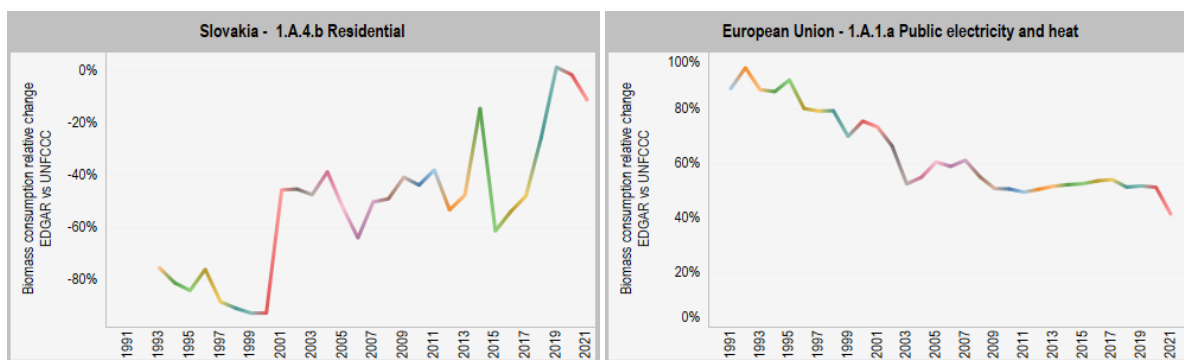


Figure S5. Relative change of biomass consumption in Slovakia's residential sector and EU27 public electricity and heat sector: EDGAR vs UNFCCC, 1990-2021, (%) – coloured by year

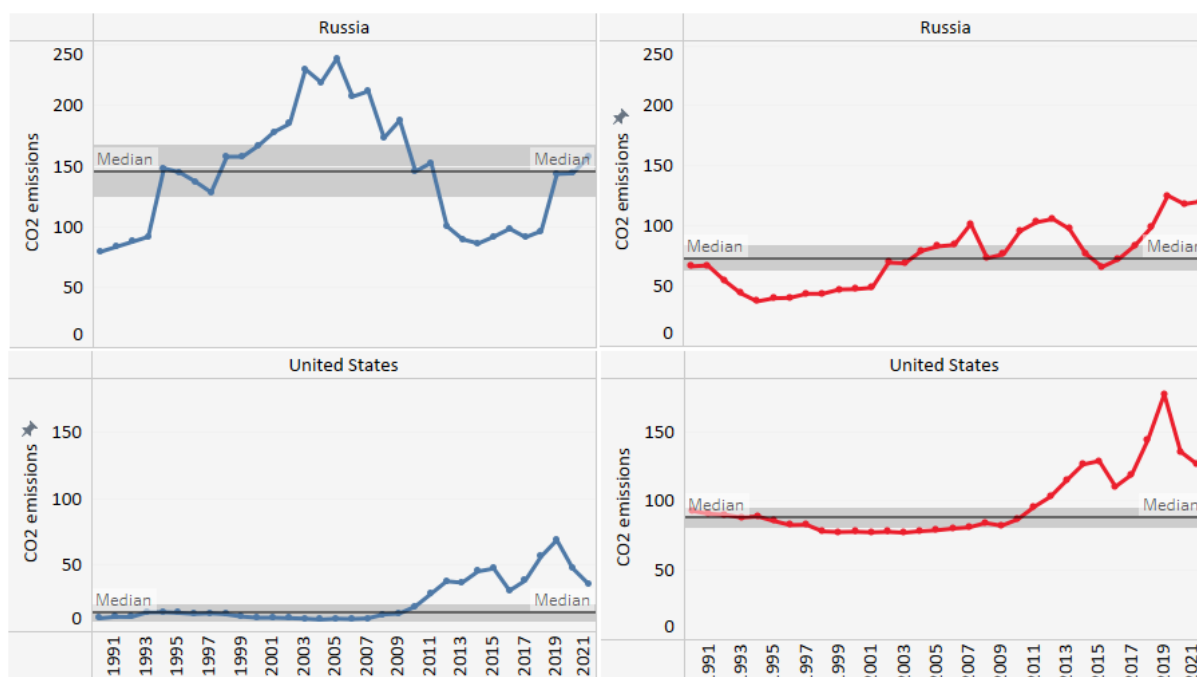
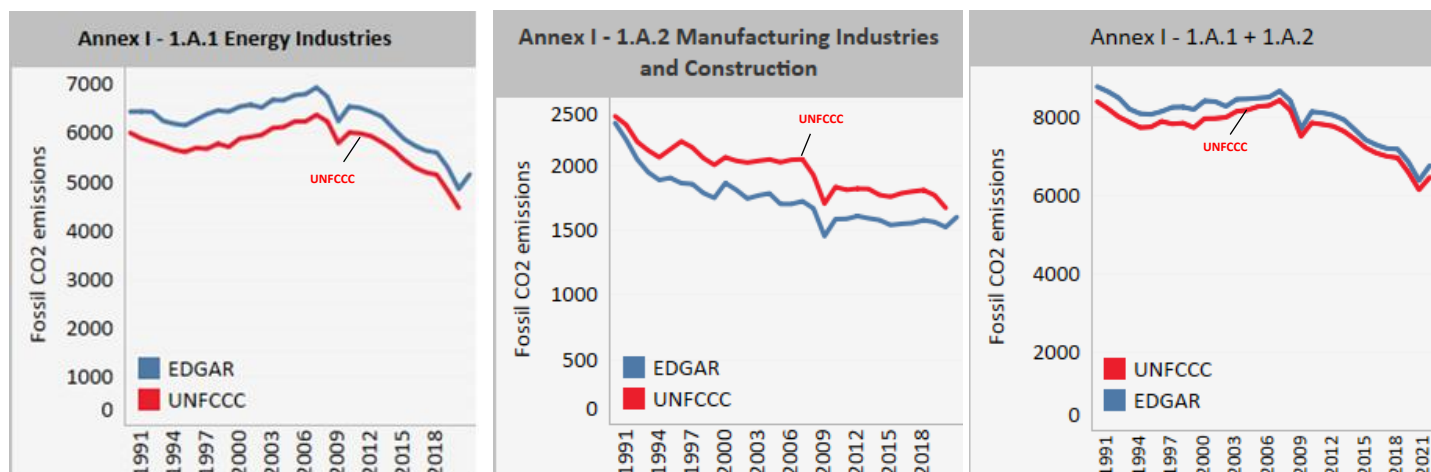


Figure S6. Fossil CO₂ fugitive emissions for Russia and USA: EDGAR (left) vs UNFCCC (right) – 1990-2021, kt

Source: UNFCCC GHG Locator 2023, EDGARv8.0

NB. Median with 95% confidence limit is shown in darker grey bands



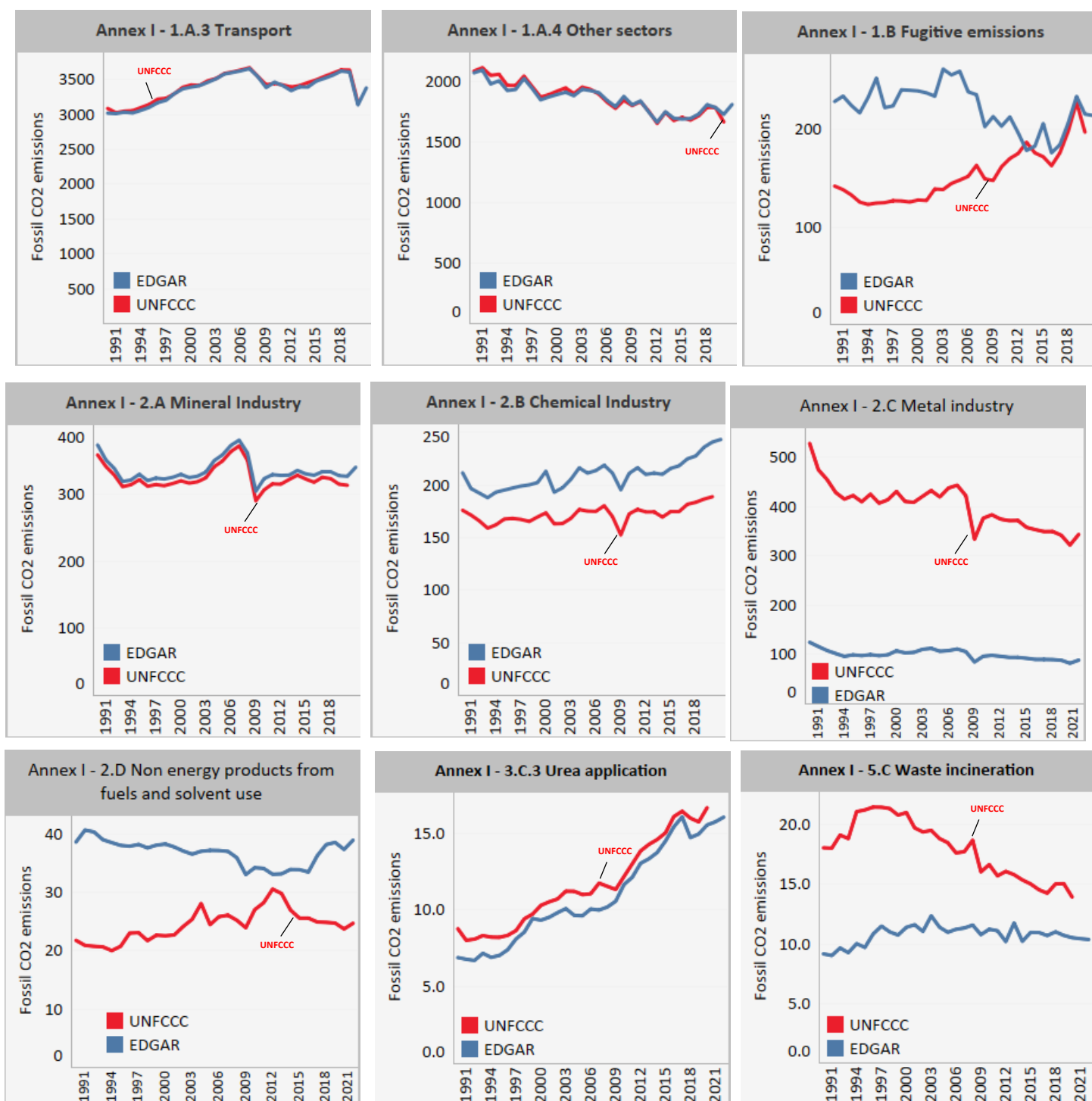


Figure S7. Temporal trends by sector of fossil CO₂ emissions in Annex I: EDGAR vs UNFCCC inventories, 1990-2021, Mt
EDGAR -blue line, UNFCCC -red line & red dots (when time series is not complete), UNFCCC annotated for accessibility

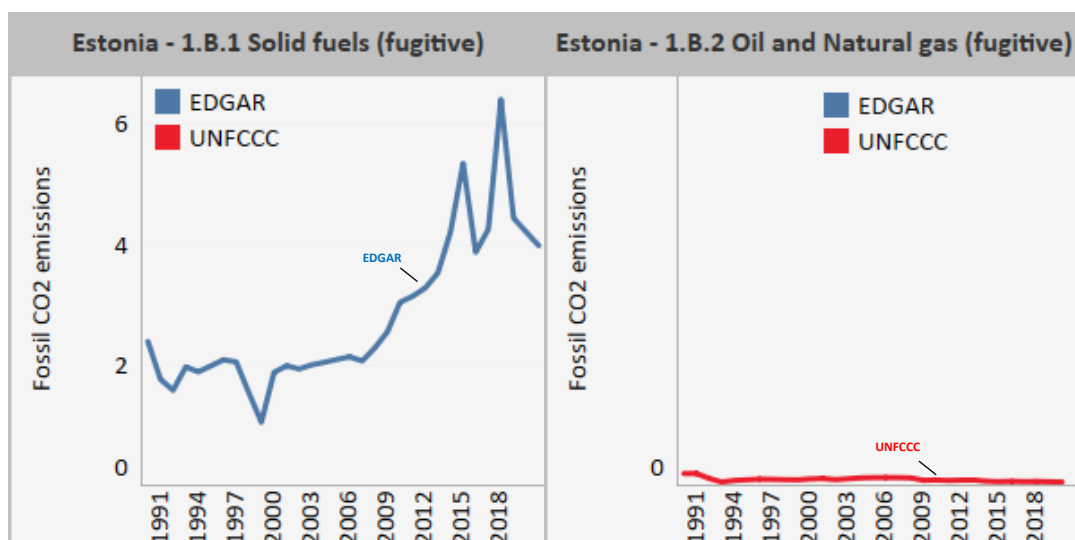


Figure S8 Fossil CO₂ emissions in Estonia – fugitive emissions from solid fuels (1.B.1): EDGAR vs UNFCCC

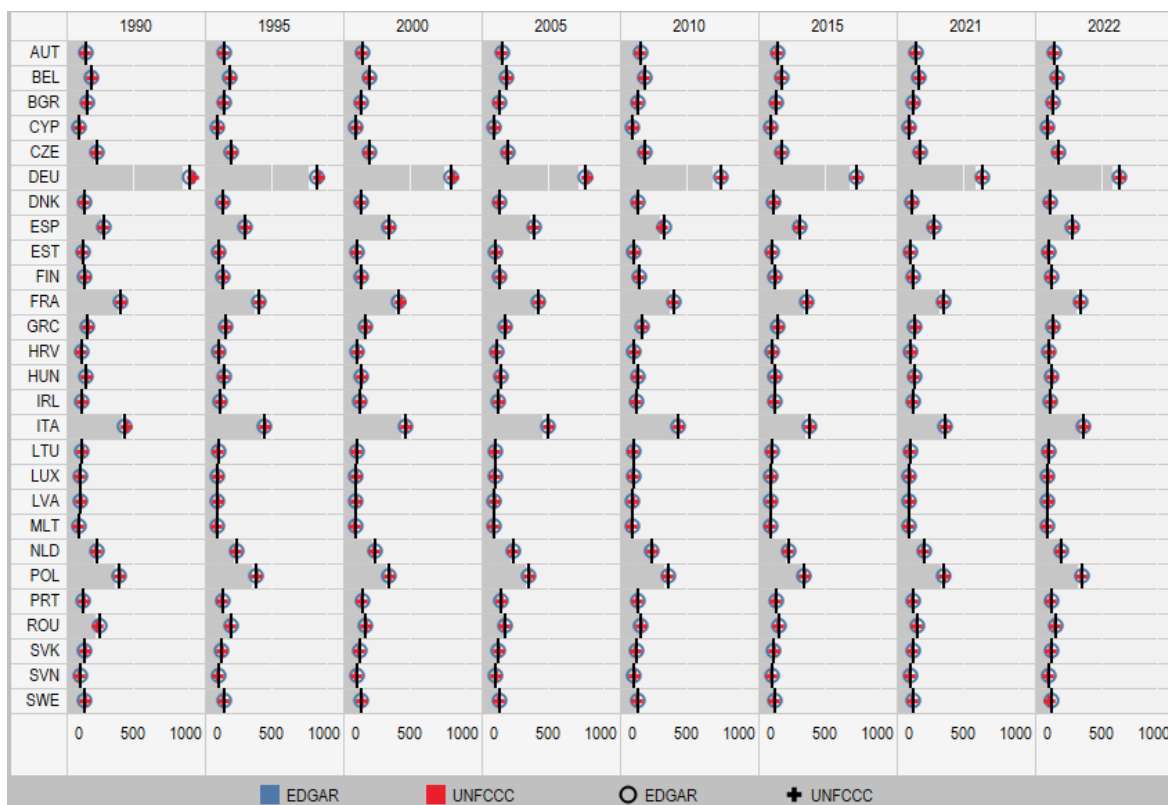


Figure S9. Fossil CO₂ emissions in EU27 MS: EDGAR vs UNFCCC submission every 5-years, 1990-2022, Mt

Source: UNFCCC CRT 2024, EDGAR 2024

NB. EDGAR (blue circles) and UNFCCC submissions (red crosses) shown by both colour and shape for accessibility.

Highlighted area represents up to 90% of UNFCCC EU27 emissions.

Vertical line represents the median value of EDGAR emissions

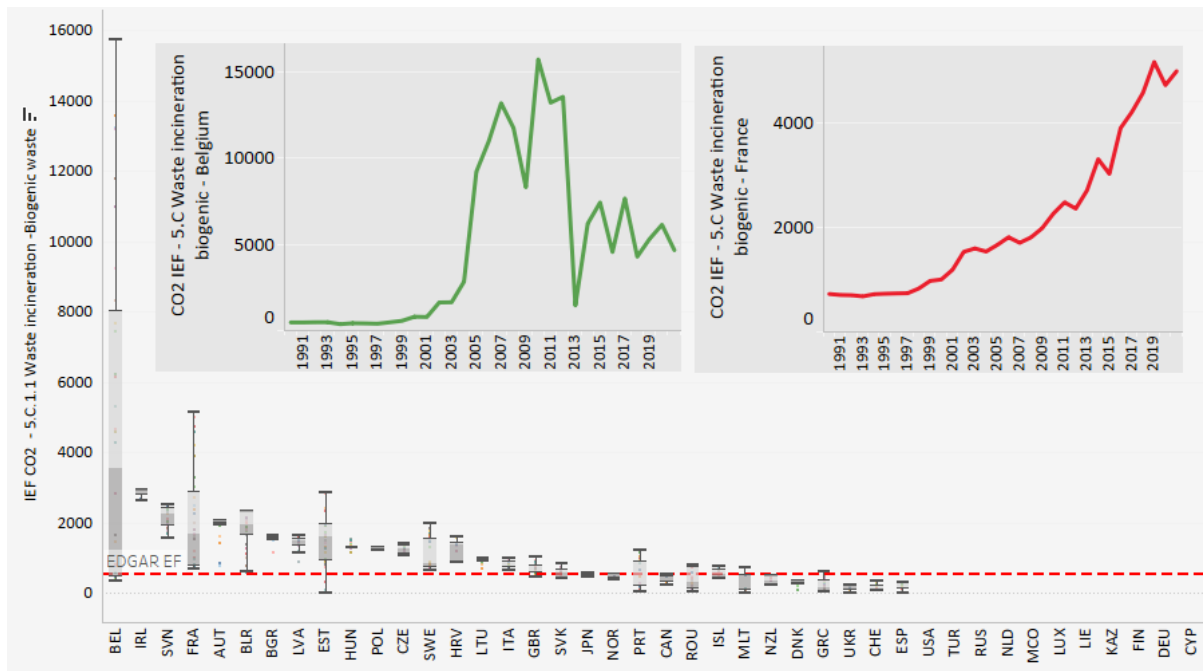


Figure S10. CO₂ biogenic waste implied emission factors in Annex I countries - temporal trend in Belgium and France, kg/t

Source: UNFCCC GHG Locator 2023, EDGARv8.0

NB. EDGAR CO₂ emission factor for biogenic waste is 550 kg CO₂/ton wet waste, based on assumption of 15% Degradable Organic Carbon (DOC) content of biogenic waste (IPCC 2006 default EF for food waste).

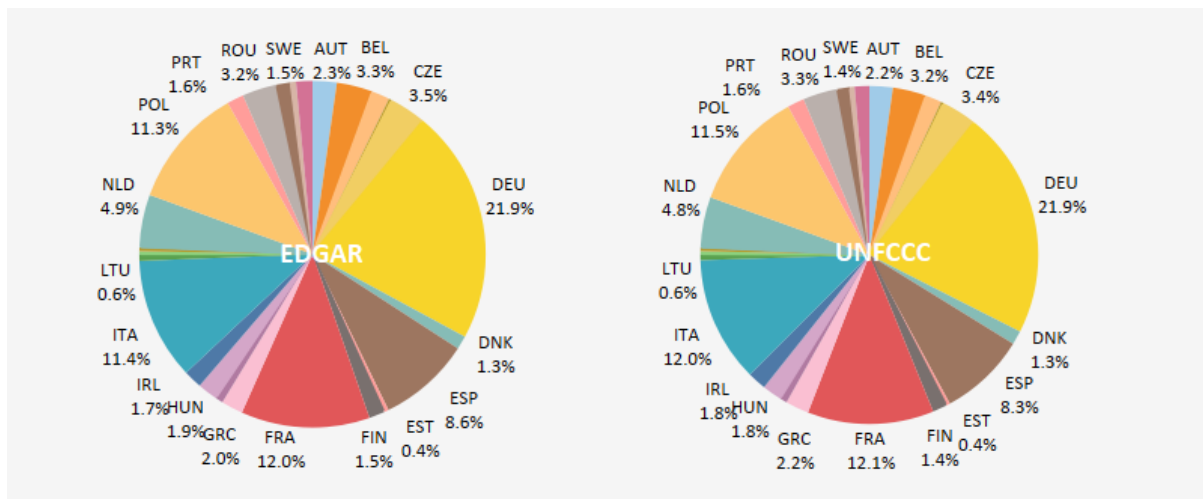
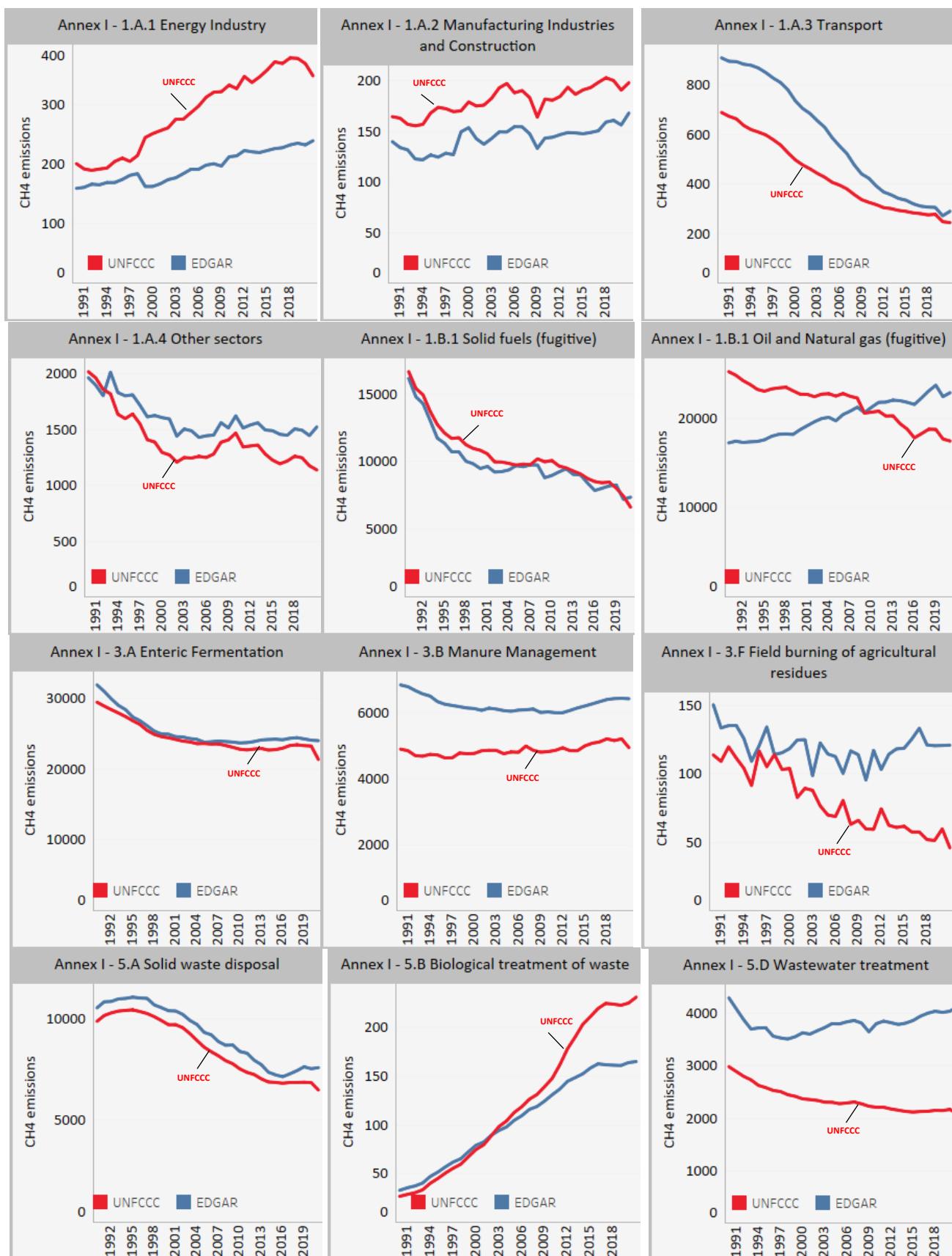


Figure S11. Relative contribution of EU27 MS in fossil CO₂ emissions, 2021, EDGAR vs UNFCCC



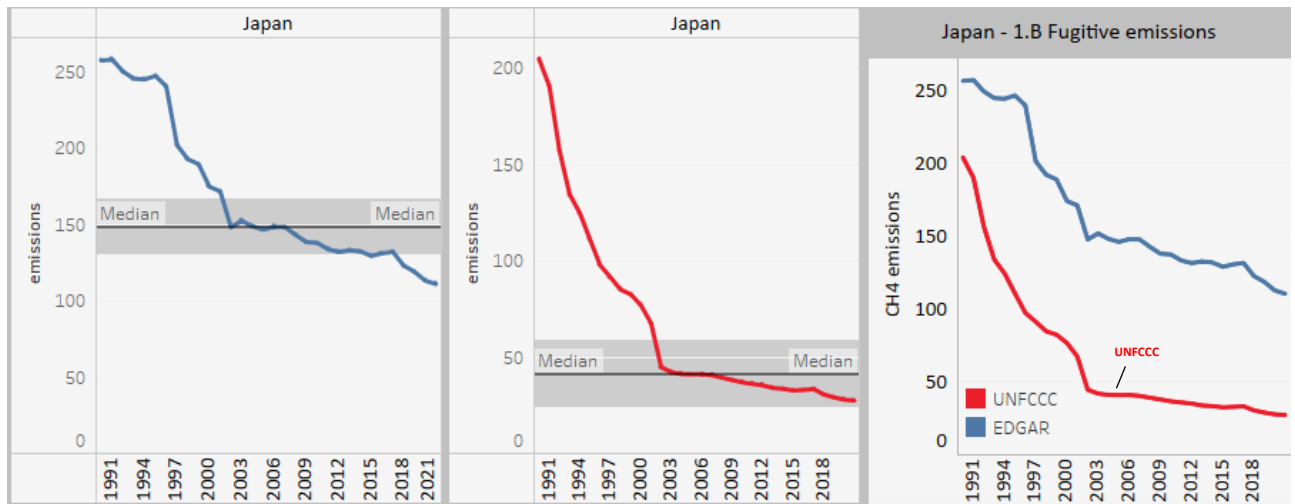


Figure S13. Japan CH₄ fugitive emissions: EDGAR (left) vs UNFCCC (middle), temporal trend (right), 1990-2021, kt

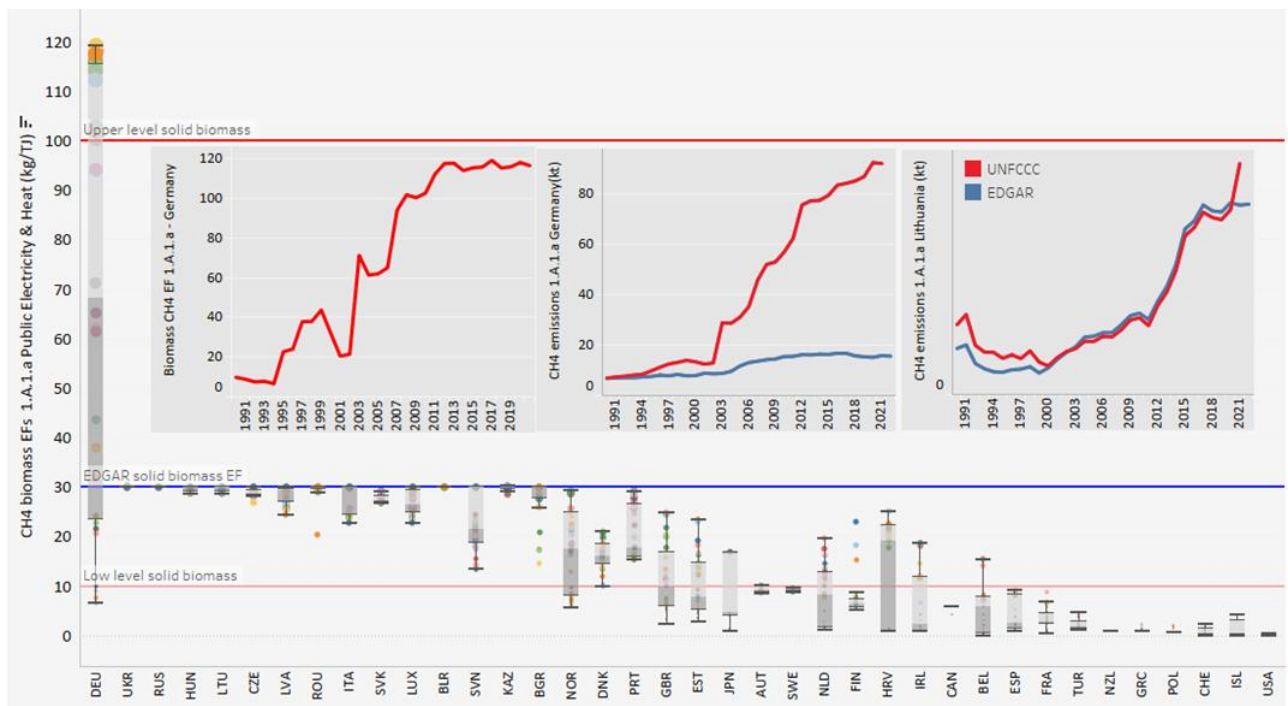


Figure S14. CH₄ biomass emission factors in Annex I countries, Germany temporal trend of CH₄ biomass EF and emissions, Lithuania CH₄ emissions in Public Electricity and Heat sector (1.A.1.a), 1990-2021, kg/TJ

Source: UNFCCC GHG Locator 2023, EDGARv8.0

NB. EDGAR line represents the default CH₄ emission factor for solid biomass as in the Chapter 2 of the IPCC 2006 Guidelines

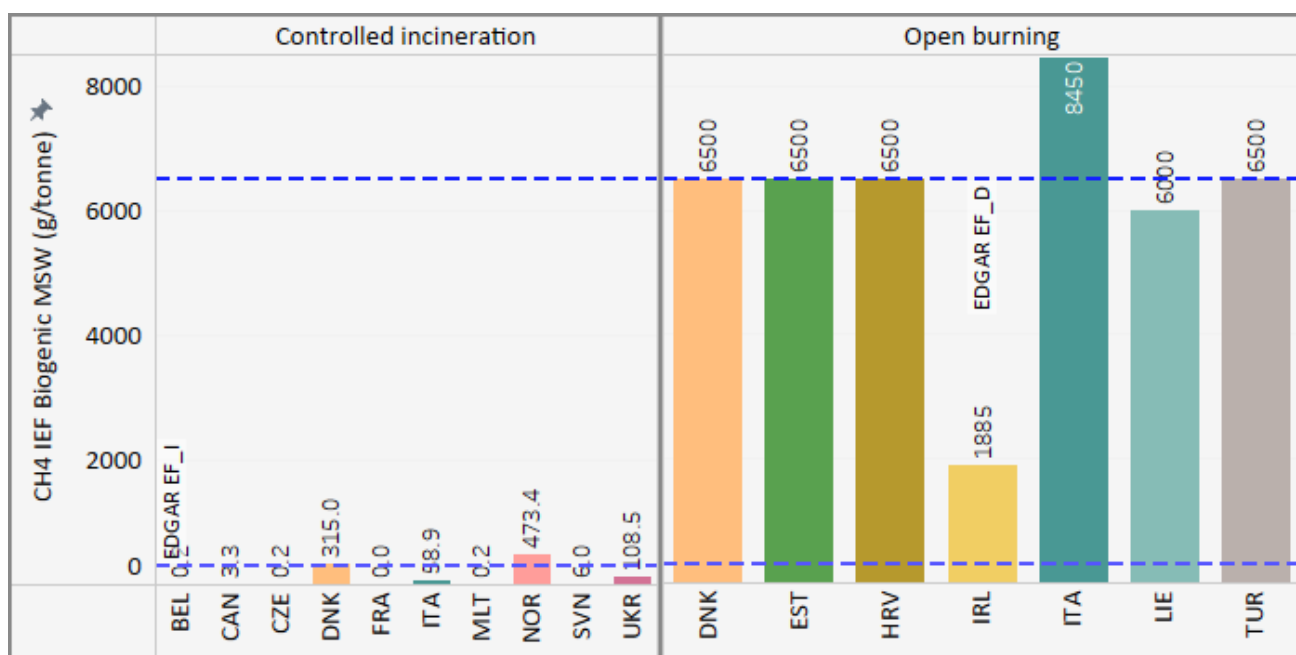


Figure S15. Biogenic MSW CH₄ IEF for controlled incineration and open burning of waste in some Annex I countries – waste incineration EDGAR CH₄ EFs for industrialised (RDGAR EF_I) and developing countries (EDGAR EF_D)

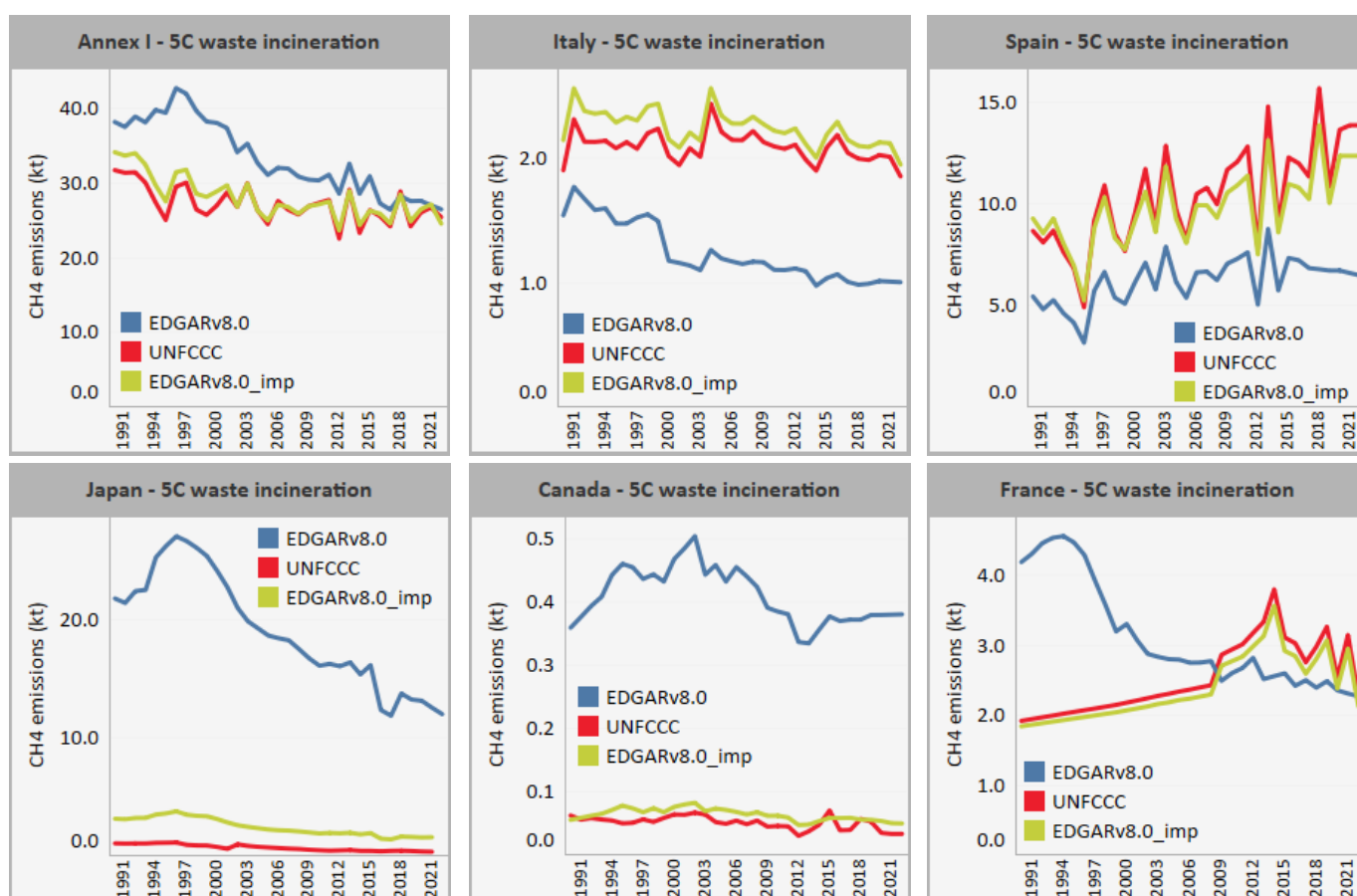
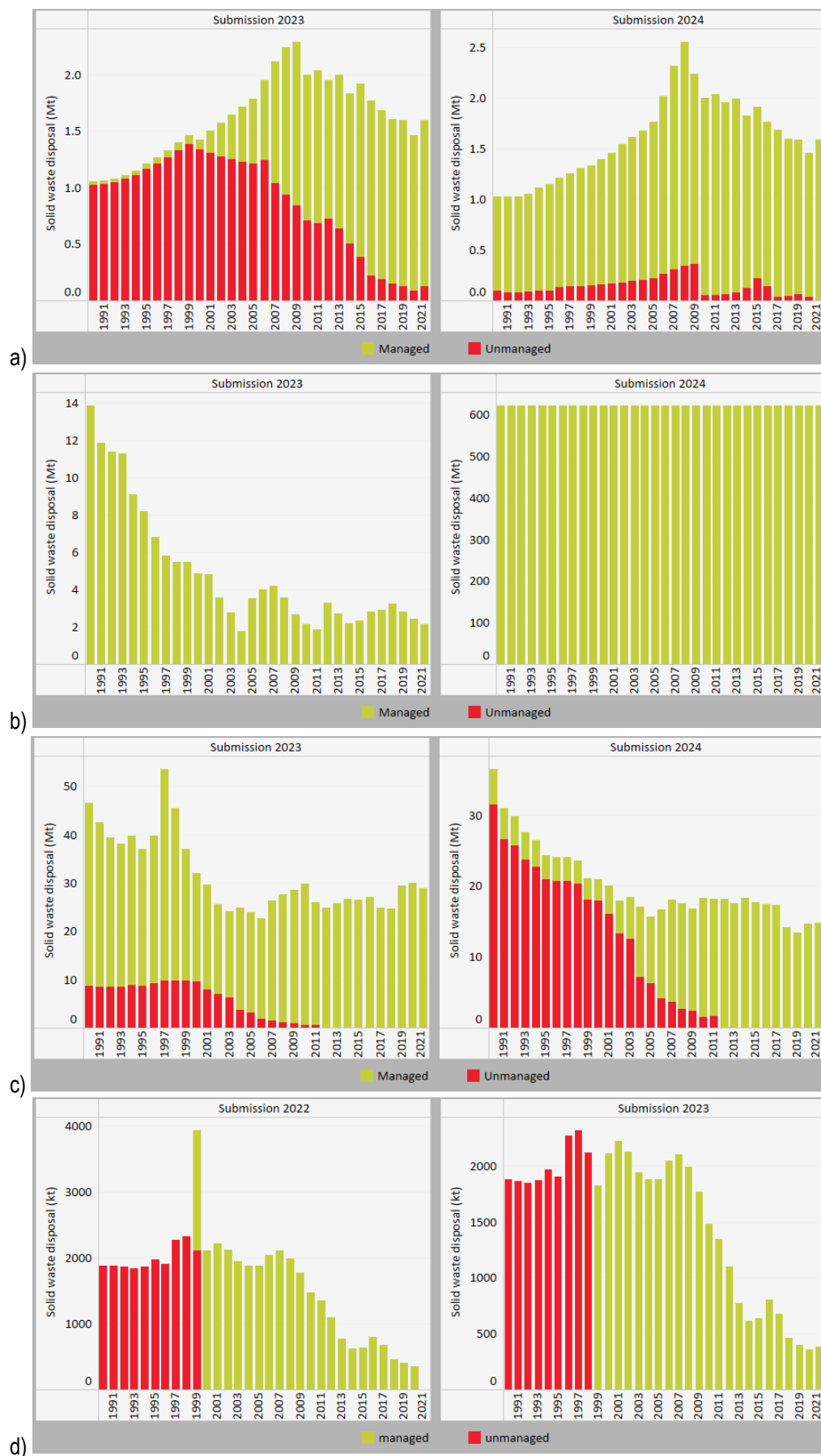


Figure S16. Temporal trend of CH₄ emissions from waste incineration in some Annex I countries: EDGARv8.0, 2023, UNFCCC 2023, and EDGARv8.0 2023 improved, 1990-2021



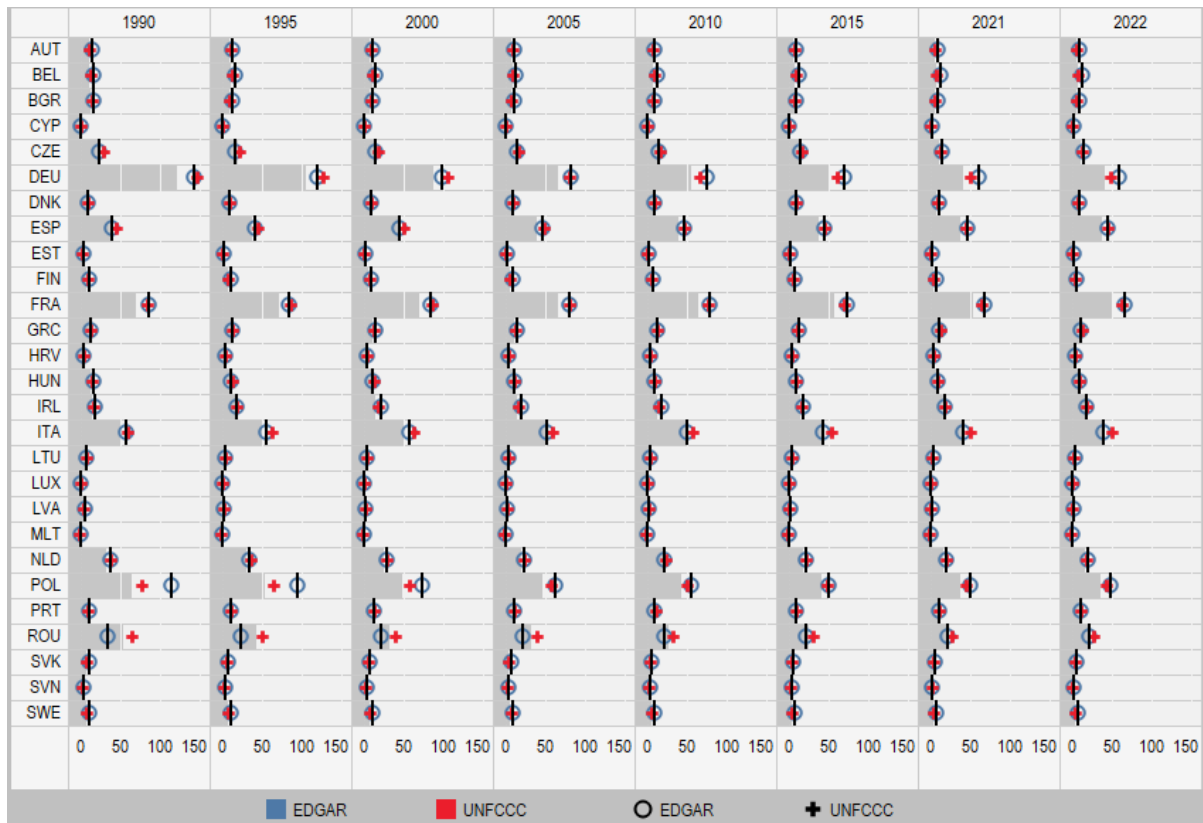


Figure S18. CH₄ emissions in EU27 MS: EDGAR vs UNFCCC submission every 5-years, 1990-2022, Mt CO₂-eq
EDGAR (blue circles) and UNFCCC submissions (red crosses) shown by both colour and shape for accessibility.
Highlighted area represents up to 90% of UNFCCC EU27 emissions.
Vertical line represents the median value of EDGAR emissions
Source: UNFCCC CRT 2024, EDGAR 2024

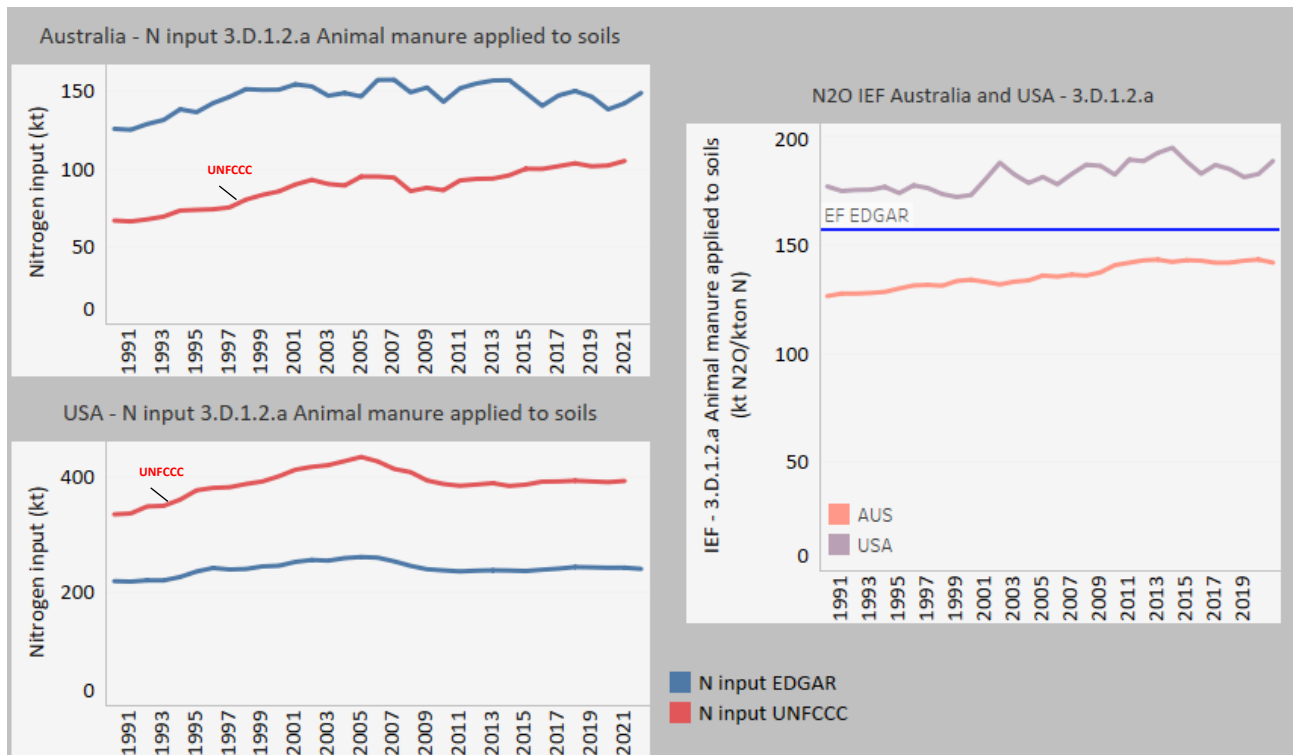


Figure S19. Nitrogen input for N₂O emissions from animal manure applied to soils and N₂O emission factors for Australia and USA, 1990-2021, EDGARv8.0 vs UNFCCC 2023

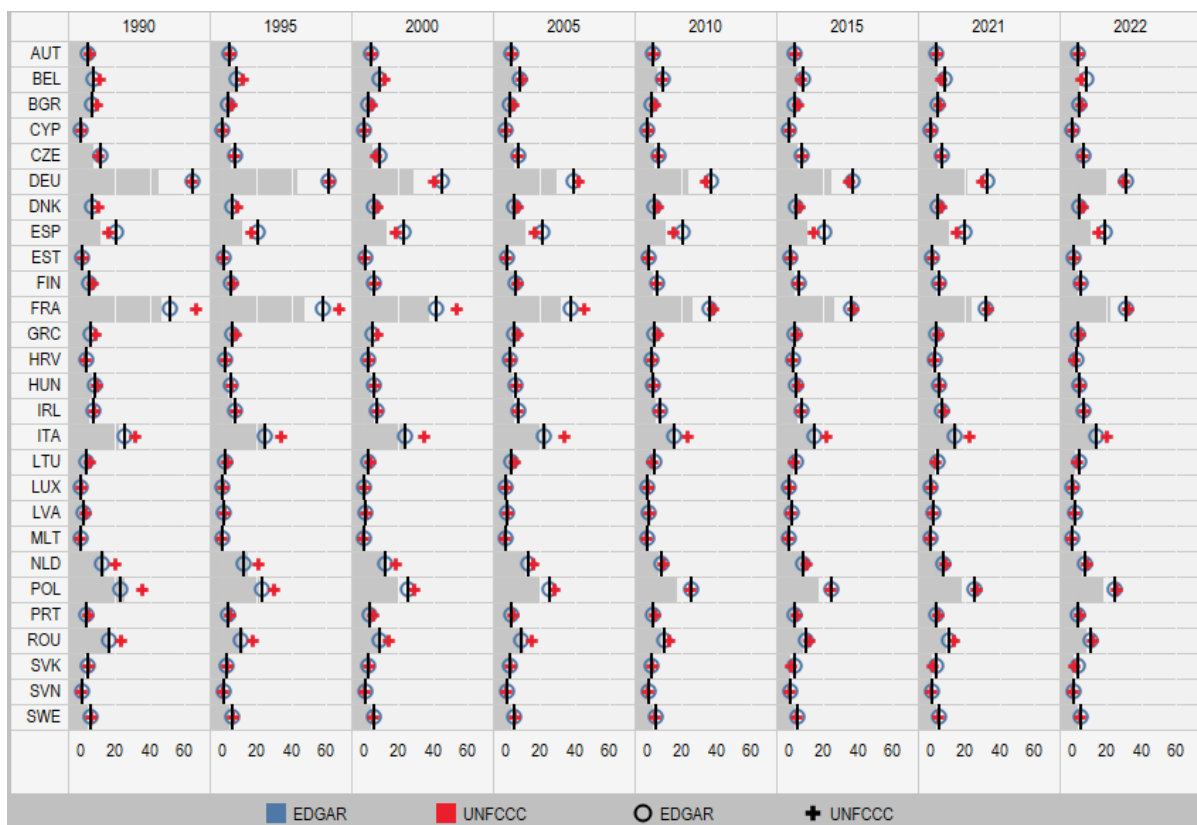


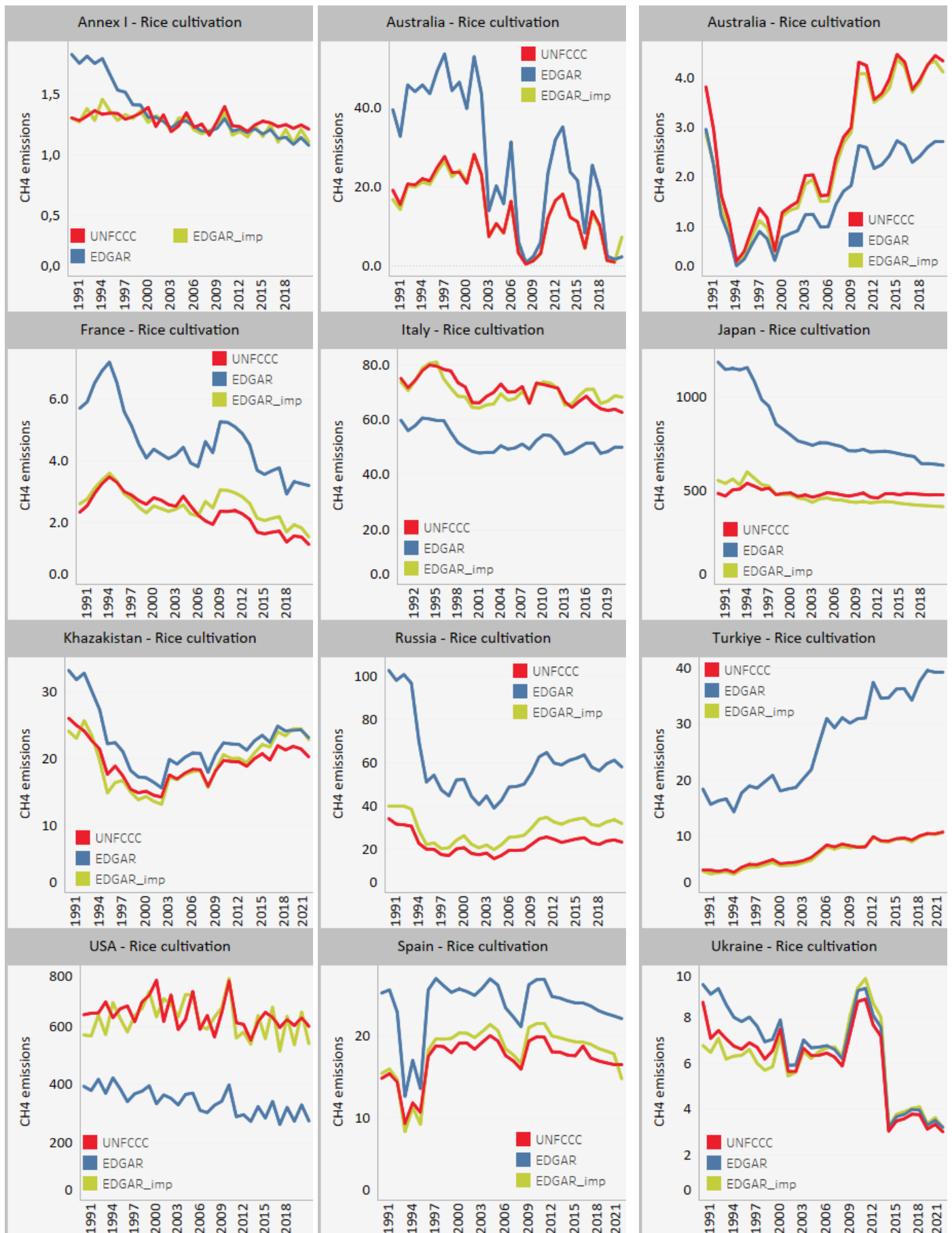
Figure S20. N_2O emissions in EU27 MS: EDGAR vs UNFCCC submission every 5-years, 1990-2022, Mt CO_2 -eq

EDGAR (blue circles) and UNFCCC submissions (red crosses) shown by both colour and shape for accessibility.

Highlighted area represents up to 90% of UNFCCC EU27 emissions.

Vertical line represents the median value of EDGAR emissions

Source: UNFCCC CRT 2024, EDGAR 2024



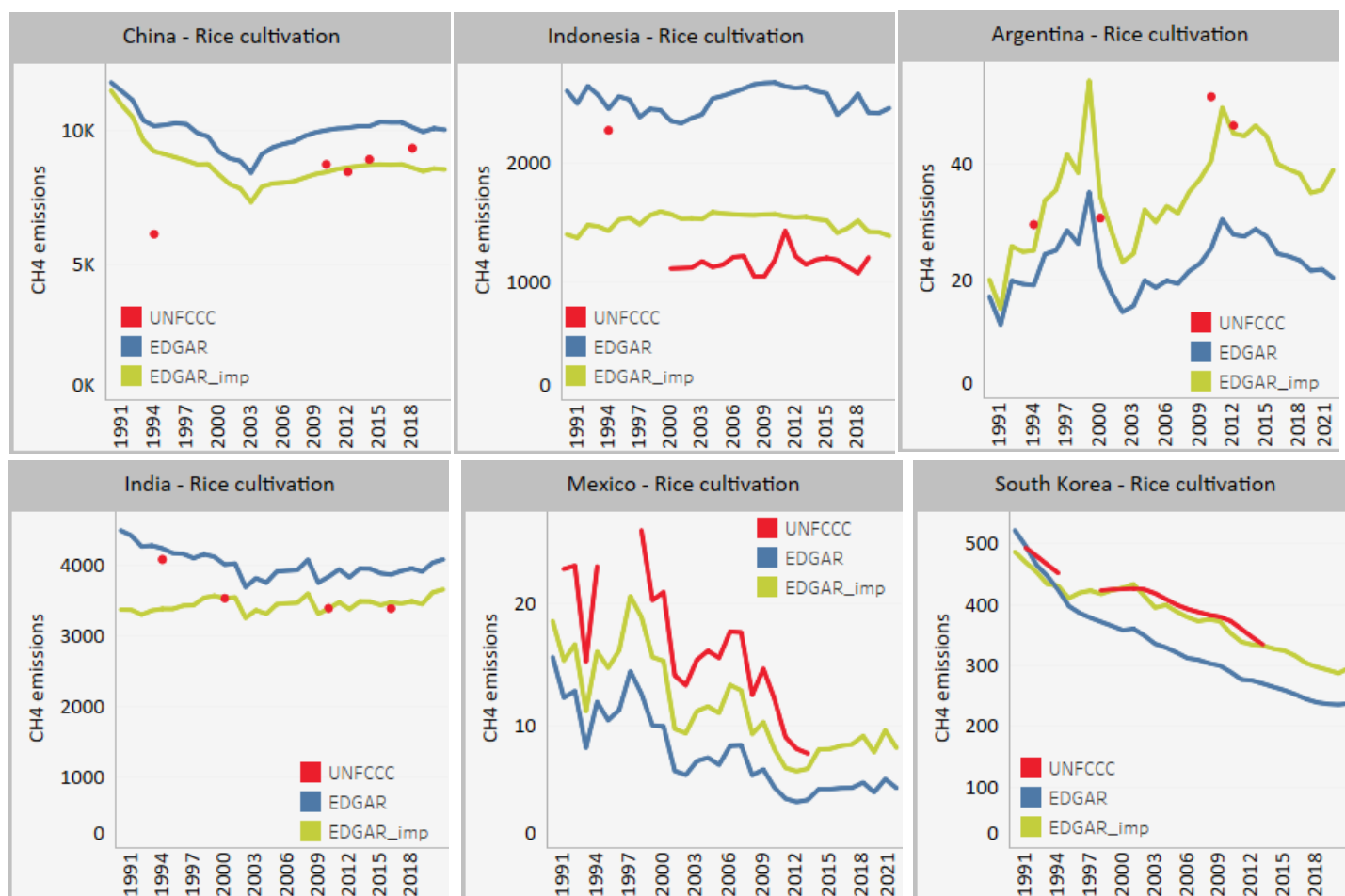


Figure S21. Temporal trend of CH4 emissions from rice cultivation in Annex I countries: EDGARv8.0, 2023, UNFCCC 2023, and EDGARv8.0 2023 improved (EDGAR_imp), 1990-2021, kt

Supplementary tables

Table S1. G20, Annex I and EU27 country names and ISO 3 codes

Country name	iso 3 code	Group	Country name EU27	iso 3 code
Argentina	ARG	G20 / non-Annex I	Austria	AUT
Australia	AUS	G20 / Annex I	Belgium	BEL
Brazil	BRA	G20 / non-Annex I	Bulgaria	BGR
Canada	CAN	G20 / Annex I	Croatia	HRV
China	CHN	G20 / non-Annex I	Cyprus	CYP
European Union	EU27	G20 / Annex I	Czechia	CZE
Germany	DEU	G20 / EU27 /Annex I	Denmark	DNK
France	FRA	G20 / EU27 /Annex I	Estonia	EST
United Kingdom	GBR	G20 / Annex I	Finland	FIN
Indonesia	IDN	G20 / non-Annex I	Greece	GRC
India	IND	G20 / non-Annex I	Hungary	HUN
Italy	ITA	G20 / EU27 /Annex I	Ireland	IRL
Japan	JPN	G20 / Annex I	Latvia	LVA
South Korea	KOR	G20 / non-Annex I	Lithuania	LTU
Mexico	MEX	G20 / non-Annex I	Luxembourg	LUX
Russia	RUS	G20 / Annex I	Malta	MLT
Saudi Arabia	SAU	G20 / non-Annex I	Netherlands	MLD
Turkiye	TUR	G20 / Annex I	Poland	POL
United States	USA	G20 / Annex I	Portugal	PRT
South Africa	ZAF	G20 / non-Annex I	Romania	ROU
Iceland	ISL	Annex I	Slovakia	SVK
New Zealand	NZL	Annex I	Slovenia	SVN
Norway	NOR	Annex I	Spain	ESP
Switzerland	CHE	Annex I	Sweden	SWE
Ukraine	UKR	Annex I		
Belarus	BLR	Annex I		
Kazakhstan	KAZ	Annex I		

Table S2. Methodologies applied in some Annex I countries for CO₂ and CH₄ emission estimation upon sectors (UNFCCC CRT tables codes)

sector	substance	CAN	DEU	FRA	ITA	JPN	RUS	TUR	USA
1.A.1	CH ₄	T2	T2	T2	T3	T3	T1	T2,T3	T2
	CO ₂	CS	CS	CS,PS	CS	CS	CS,D	CS,D,PS	CS
1.A.2	CH ₄	M,T2,T3	CS	T1,T2,T3	T2	CS,T1,T3	T1	T1	T1
	CO ₂	M,T2	CS,T1	T2,T3	T2	CS,T2	T1,T2,T3	T1,T2	T2
1.A.3.b	CH ₄	M,T3	CS,M,T2,T3	T3	T3	T3	T1,T2,T3	T1	M,T3
	CO ₂	M,T2	CS,M,T1,T2,T3	T3	T2	T2	T1,T2	T1,T2	CS,M,T2
1.A.4	CH ₄	M,T1,T2,T3	CS,T2,T3	T1,T2	T2	CS,T1,T3	T1	T1	T1
	CO ₂	M,T2	CS,T1,T2,T3	T1,T2	T2	CS,T2	T1,T2	T1,T2	T2
1.A.5.a	CO ₂		CS				T1,T2		CS,T2
1.A.5.b	CH ₄	M,T1,T3	CS,D,M		T2				T1
	CO ₂	M,T2	CS,D,M		T2				CS,T2
1.B.1	CH ₄	CS	CS,T2,T3	T2,T3	T1,T2	T1,T2,T3	T1,T2	T1	T2,T3
	CO ₂		CS,T3			CS,T2			T1
1.B.2	CH ₄	CS	T1,T2,T3	T1,T2,T3	T1,T2	CS,T1,T2	T1b,T2	T1	CS
	CO ₂	CS	T1,T2,T3	T1,T2,T3	T1,T2	CS,T1,T3	T1b,T2	T1	CS
2.A	CO ₂	T1,T2,T3	T1,T2	T1,T2,T3	T2	CS,T2	T1,T2	T1,T2	T1,T2,T3
2.B	CH ₄	T1,T2,T3	T1,T2	T2,T3	D,T1	CS,T1	T1,T2		T1
	CO ₂	T1,T2,T3	T1,T2,T3	T1,T2,T3	D,T2,T3	CS,T1,T2,T3	T1,T1a,T2,T3	T1,T2	CS,T1
2.C	CH ₄	T1	T2	T2,T3	D	CS	T1	T1	T1
	CO ₂	T2,T3	T1,T2,T3	T1,T2,T3	T2	T1,T2	T1,T2,T3	T1,T2,T3	T1,T2,T3
3.A	CH ₄	T1,T2	T1,T2,T3	T2,T3	T1,T2	CS,T1	CS,T1,T2	T1,T2	M,T1,T2
3.B	CH ₄	T1,T2	T2	T2	T1,T2	CS,T1	CS,T1,T2	T1	M,T1,T2
3.C	CH ₄			T1	T2	T3	T1	T1	OTH
5.A	CH ₄	CS	T2	T2	T2	T3	T3	T2	CS
5.B	CH ₄	T3	T2	T2	D	T2	T1	T1	D,T1
5.C	CH ₄	T2,T3		T1,T2	D,T1	CS,T2		T1	
5.D	CH ₄	CS,T3	CS,D,T2	T1	D,T1	CS,D	T1,T2,T3	T2	CS,D,T2

Source: UNFCCC GHG Locator, 2023

NB: D (IPCC default), CS (Country specific), T1 (IPCC Tier1), T2 (IPCC (Tier 2), T3 (IPCC Tier 3), M (Model), OTH (Other)

Table S3. UNFCCC and EDGAR classification systems (Diego check)

EDGAR booklet sectors	EDGAR codes/process group name	UNFCCC non Annex I (IPCC 1996)	UNFCCC Annex I (IPCC 2006)
Power Industry	1.A.1.a Main Activity Electricity and Heat Production	1.A.1.a Public Electricity and Heat Production	1.A.1.a Main activity Electricity and Heat production (1.A.1.a.i, ii, iii)
Fuel exploitation	1.A.1.b Oil refineries	1.A.1.b Petroleum Refining	1.A.1.b Petroleum Refining
Fuel exploitation	1.A.1.c Transformation Industry	1.A.1.c Manufacture of Solid Fuels and Other Energy Industries	1.A.1.c Manufacture of Solid Fuels and Other Energy Industries (1.A.1.c.i, ii)
Industrial combustion	1.A.2 Manufacturing Industry	1.A.2 Manufacturing Industries and Construction	1.A.2 Manufacturing Industries and Construction (subdivided 1.A.2.f - 1.A.2.m)
Transport	1.A.3.a Non-road transport	1.A.3.a Civil Aviation	1.A.3.a Civil Aviation
Transport	1.A.3.a.ii Non-road transport	1.A.3.a.ii Domestic	1.A.3.a.ii Domestic Aviation
Transport	1.A.3.b_noRES Road transport	1.A.3.b Road Transportation	1.A.3.b Road Transportation
Transport	1.A.3.c Non-road transport	1.A.3.c Railways	1.A.3.c Railways
Transport	1.A.3.d Non-road transport	1.A.3.d Navigation	1.A.3.d Water-borne Navigation
Transport	1.A.3.d.ii Non-road transport	1.A.3.d.ii National Navigation	1.A.3.d.ii Domestic Navigation
Transport	1.A.3.e Non-road transport	1.A.3.e Other Transportation	1.A.3.e Other Transportation
Buildings	1.A.4 Residential	1.A.4 Other Sectors	1.A.4 Other Sectors (subdivided 1.A.4.c.i, ii, iii)
Buildings	1.A.5 Residential	1.A.5 Other	1.A.5 Other (Not specified elsewhere) (subdivided 1.A.5.b.i, ii, iii)
Fuel exploitation	1.A.5.b.iii Transformation Industry		
Fuel exploitation	1.B.1.a Fuel production/transmission	1.B.1.a Solid Fuels (coal mining and handling)	1.B.1.a Coal mining and handling
Fuel exploitation	1.B.1.b Transformation Industry	1.B.1.b Solid fuel transformation	1.B.1.b Fuel transformation
Fuel exploitation	1.B.1.c Transformation Industry	1.B.1.a Coal mining	1.B.1.c Others (please specify)
Fuel exploitation	1.B.2 Transformation Industry	1.B.2 Oil and Natural Gas	1.B.2 Oil and Natural Gas and Other Emissions from Energy Production
Fuel exploitation	1.B.2.a.ii / iii Fuel production (Venting & Flaring)/Transmission (Oil)		1.B.2.a.ii / iii Production and upgrading/Transport (Oil)
Fuel exploitation	1.B.2.b.ii / iii Fuel production (Venting)/Transmission (Gas)		1.B.2.b.ii / iii Production and gathering/Processing (Natural gas)
		1.B.2.c Venting and flaring	1.B.2.c Venting and flaring (Oil, gas, combined)
Processes	2.A.1 Production of non-metallic minerals (Cement)	2.A.1 Cement Production	2.A.1 Cement Production
Processes	2.A.2 Production of non-metallic minerals (Lime)	2.A.2 Lime Production	2.A.2 Lime Production
Processes	2.A.3 Production of non-metallic minerals (Glass)	2.A.7 Other (Glass production)	2.A.3 Glass production
Processes	2.A.4 Production of non-metallic minerals (Carbonates)	2.A.3 Limestone and Dolomite use	2.A.4 Other Process Uses of Carbonates
Processes	2.B Production of chemicals	2.B Chemical Industry	2.B Chemical Industry
Processes	2.C Production of iron & steel/non-ferrous metals	2.C Metal Production	2.C Metal Industry
Processes	2.D Production and use of other products	3. Solvent and Other Product Use	2.D Non-energy Products from Fuels and Solvent Use
Processes	2.E Production and use of other products	2.E Production of Halocarbons and SF ₆	2.E Electronics Industry
Processes	2.F Production and use of other products	2.F Consumption of Halocarbons and SF ₆	2.F Product Uses as Substitutes for ODS
Processes	2.G Production and use of other products	2.G Other	2.G Other Product Manufacture and Use
Agriculture	3.A.1 Enteric Fermentation	4.A Enteric Fermentation	3.A Enteric Fermentation
Agriculture	3.A.2 Manure management	4.B Manure Management	3.B Manure Management
Agriculture	3.C.7 Rice cultivation	4.C Rice Cultivation	3.C Rice Cultivation
Agriculture	3.C.4 Agricultural soils (Direct N ₂ O from managed soils)	4.D.1 Direct soil emissions	3.D.1 Direct N ₂ O Emissions From Managed Soils
Agriculture	3.C.5 Indirect N ₂ O emissions	4.D.3 Indirect emissions	3.D.2 Indirect N ₂ O Emissions From Managed Soils
Agriculture	3.C.1 Agriculture waste burning	4.F Field Burning of Agricultural Residues	3.F Field Burning of Agricultural Residues
Agriculture	3.C.2 Agricultural soils (lime application)	4.D.4.b CO ₂ from agricultural lime application	3.G Liming
Agriculture	3.C.3 Agricultural soils (urea application)		3.H Urea Application
Agriculture	3.C.6 Indirect N ₂ O emissions	4.G Other	3.J Other
Waste	4.A Solid Waste Disposal (Landfill)	6.A Solid Waste Disposal on Land	5.A Solid Waste Disposal
Waste	4.B Solid Waste Disposal (Composting)	6.D Other	5.B Biological Treatment of Solid Waste
Waste	4.C Solid Waste Disposal (Incineration)	6.C Waste Incineration	5.C Incineration and Open Burning of Waste
Waste	4.D Waste water	6.B Wastewater Handling	5.D Wastewater Treatment and Discharge
Agriculture	5.A Indirect N ₂ O emissions from the atmospheric deposition of nitrate	Other	6. Other
Fuel exploitation	5.B Fossil fuel fires		

Source: UNFCCC inventory system, EDGAR 2024
the IPCC, classification the Land Use, Land-Use Change, and Forestry (LULUCF) is Sector 5. Under UNFCCC, inventory system (CRF/CRT) for Annex I the LULUCF is Sector 4.

Table S4. Sub-sectors included in EDGAR emissions estimation from waste incineration – Biogenic waste

BIOGENIC		
5.C.1.1.a	SWD.INC.BIO	Biogenic - 5.C.1.1.a Municipal Solid Waste
5.C.1.1.b_Clinical Waste	SWD.INC.BIO	Biogenic - 5.C.1.1.b Others (please specify)
5.C.1.1.b_Hazardous Waste	SWD.INC.BIO	Biogenic - 5.C.1.1.b Others (please specify)
5.C.1.1.b_Industrial Solid Wastes	SWD.INC.BIO	Biogenic - 5.C.1.1.b Others (please specify)
5.C.1.1.b_Sewage Sludge	SWD.INC.BIO	Biogenic - 5.C.1.1.b Others (please specify)
5.C.2.1.a	SWD.INC.BIO	Open burning of waste: Biogenic - 5.C.2.1.a Municipal Solid Waste
5.C.1.1.b_Cremation	SWD.INC.CRM	Biogenic - 5.C.1.1.b Others (please specify)