PBA and CBA emissions: An international comparison w.r.t. Ireland

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13th MaREI Climate & Energy Research Seminar

16 June 2025, Dublin

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- Issue: Some of the consumed goods are imported, thus produced elsewhere.
- If the production process moves abroad, emission responsibility shifts to other countries.

Treaty on the Functioning of the European Union, article 191, paragraph 2:

"... environmental damage should as a priority be rectified at source and that the polluter should pay."

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Who is responsible for emissions?

- "... polluter should pay"
 - Who is responsible for the emissions created during the production of the goods produced abroad?
 - How to conceptualise relevant emissions?

Emission accounting

- Territorial emissions: Within a country's borders
- Production Based: Assign emission to where the production is done.
 - \rightarrow Correct for residency principle
- Consumption Based: Assign emission to where the consumption/use is done.
 - \rightarrow Correct for trade embedded emissions
- Aim: Calculate and compare PB and CB emissions for Ireland and selected countries.

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Literature

- Earlier studies focus on emissions embedded in trade.
 - \rightarrow Limited by harmonised trade and emissions data availability.
 - \rightarrow Domestic technology assumption used.
- International data availability (especially MRIO) increases.
- Country and region specific studies increase
 - \rightarrow New Zealand (Chandrakumar et al., 2020)
 - \rightarrow Turkey (Mangır & S_ahin, 2022)
 - \rightarrow UK (Wiedmann et al, 2010)
 - \rightarrow Many China studies



- de Bruin and Yakut (2022): An initial work that combines data from multiple sources.
- de Bruin et al (2024): Ireland CB and PB emissions using GTAP 11 data
- Current attempt:
 - Present PB and CB emissions for Ireland and selected countries.
 - Make comparisons across these countries.

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Data

The available data is GTAP 11:

- Refers to year 2017
- Covers 141 countries and 65 sectors

Some interventions were done:

- Electricity emissions were redistributed, and,
- Cattle related emissions were redistributed to meat exporting food manufacturing sectors

to better account for emissions embedded in trade.



How to select the countries to compare Ireland to?

- Use a similarity index due Krugman (1991)
- Consider other factors

End up with:

- UK and New Zealand.
- Mediterranean countries (Greece, Italy, Portugal, Spain)
- Similar EU countries (Denmark, Netherlands, Sweden)

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Ireland vs EU and OECD averages

Table: PB and CB: Ireland vs averages for selected regions (MtCO₂eq, 2017)

	PBA	CBA	PBA/CBA, %
Ireland	69.39	74.89	107.93
EU average	145.66	164.65	113.04
OECD average	397.88	429.89	108.05

Source: Authors' calculations based on GTAP11 data (Aaguiar et al, 2022).

Ireland PB and CB lower compared to EU and OECD averages.

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PBA and CBA comparisons

Table: Per capita and per GNI PBA and CBA, selected countries (2017)

	Per cap,	tCO2eq	Per USD GN	I, kgCO ₂ eq
	PBA	CBA	PBA	CBA
Ireland	14.43	15.58	0.26	0.28
Ireland*			0.33	0.36
New Zealand	18.12	16.81	0.44	0.41
United Kingdom	7.36	8.89	0.18	0.22
Greece	8.21	9.15	0.44	0.49
Italy	7.38	9.44	0.23	0.29
Spain	7.37	8.66	0.26	0.31
Portugal	6.85	9.19	0.33	0.44
Denmark	9.06	10.18	0.15	0.17
Netherlands	13.27	14.38	0.28	0.30
EU	9.54	10.89	0.39	0.44
OECD	10.34	11.25	0.36	0.39

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The analysis generates an excess supply of information.

- 9 countries x 65 sectors, year 2017
- Aggregate sectors
- Use heat maps to visualise

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PBA emissions (MtCO₂eq)

AGR -	2.98	4.27	10.36	2.98	10.15	12.59	1.98	3.37	8.77	2.41	
ANM -	22.75	43.09	44.75	6.47	31.45	37.5	7.1	9.68	22.49	5.39	
XTR -	0.49	0.34	0.8	0.39	0.74	1.84	0.34	0.13	0.6	0.85	
FUEL -	12.51	9.9	155.54	20.03	106.63	70.95	13.03	9.77	48.88	11.01	
FBT -	1.44	2.02	7.96	1.3	10.92	7.39	1.47	1.1	5.34	0.42	
CHM -	0.9	3.14	15.21	1.3	17.46	13.07	2.15	0.59	37.03	5.22	
BPH -	0.4	0.03	1.45	0.04	0.86	0.29	0.05	0.16	0.79	0.05	valu
S MTL-	5	2.61	27.77	12.94	51.13	42.91	8.4	3.12	11.96	7.64	
MANUF-	1.24	0.17	9.76	0.4	14.01	4.78	0.79	0.47	2.17	0.65	
OMANUF -	0.58	1.41	10.85	0.99	22.18	8.17	4.3	0.41	5.54	1.57	
ELY-	0.42	0.23	3.7	2.44	1.83	4.09	0.87	0.22	3.22	0.19	-
WTR -	1.28	4.65	13.16	5.73	18.58	20.68	5.23	1.5	6.45	8.12	
CNS -	0.37	1.02	6.85	1.21	5.03	5.81	1.27	0.96	2.32	2.18	
ATP -	2.83	3.46	29.83	0.85	13.43	18.56	3.17	1.42	13.13	1.73	
OTP -	11.33	8.41	98.34	18.99	86.02	60.74	12.17	15.79	33.75	14.12	
OSR -	4.86	2.49	49.53	12.17	56.65	33.88	8.26	3.51	24.82	2.26	
	IRL	NZL	GBR	GRC	ITA Cour	ESP	PRT	DNK	NLD	SWE	

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CBA emissions (*MtCO*₂*eq*)

AGR -	3.47	1.96	16.19	3.75	15.28	14.88	3.79	3.65	5.58	3.3
ANM -	15.34	31.09	50.1	7.66	46.86	38.52	7.82	6.42	20.16	6.47
XTR -	0.49	0.38	1.16	0.25	1.62	2.7	0.21	0.14	0.84	0.71
FUEL -	19.82	11.52	173.89	32.55	161.73	114.99	30.56	11.52	73.08	18.11
FBT -	0.66	0.8	10.04	1.43	10.23	7.96	1.52	1.08	4.44	1
CHM-	2.85	4.63	19.66	3.65	29.5	22.02	5.01	2.42	29.32	5.33
BPH -	0.35	0.12	1.5	0.14	0.98	0.75	0.12	0.14	0.41	0.13
MTL-	6.27	3.8	49.03	11.26	74.19	49.48	9.64	6.41	18.47	11.71
MANUF-	1.07	0.83	12.1	0.82	11.51	5.79	1.29	1.75	4.83	2.26
OMANUF -	1.32	2.12	19.55	1.93	24.01	11.68	3.58	1.81	8.36	2.7
ELY -	0.41	0.23	3.85	2.61	2.17	4.1	0.82	0.27	3.05	0.22
WTR -	1.29	4.66	13.25	5.73	18.68	20.71	5.24	1.53	6.48	8.13
CNS -	0.37	1.02	6.88	1.18	5.04	5.79	1.24	0.91	2.33	2.22
ATP -	3.79	5.91	56.66	3.03	28.21	25.81	5.64	4.03	21.37	6.26
OTP -	10.92	8.92	98.04	11.18	84.81	45.83	10.28	11.93	20.83	11.76
OSR -	6.48	2.92	55.15	11.23	56.62	32.58	7.86	4.66	26.84	4
	IRL	NZL	GBR	GRC	ITA Cour	ESP	PRT	DNK	NLD	SWE

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- IRL emissions in animal agriculture, fuels and other transport (non-air).
- Lack of consistency across countries and sectors
- Let us also look at:
 - PB emissions per output
 - CB emissions per capita

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PBA emissions per output (MtCO₂eq per billion USD of output)

AGR -	1.09	0.52	0.82	0.18	0.3	0.37	0.27	0.7	0.38	0.3	
ANM -	1.79	1.91	0.87	1.07	0.6	0.67	1.12	0.7	0.81	0.58	
XTR -	0.14	0.21	0.12	0.4	0.08	0.17	0.21	0.2	0.18	0.11	
FUEL-	5.1	1.7	2.52	1.09	2.38	1.75	1.62	1.12		0.98	
FBT -	0.09	0.08	0.06	0.07	0.08	0.05	0.08	0.05	0.06	0.02	
CHM-	0.04	0.77	0.28	0.43	0.25	0.23	0.28	0.08	0.54	0.42	
BPH -	0.01	0.02	0.03	0.03	0.02	0.02	0.02	0.01	0.05	0.01	2.0
S MTL-	0.43	0.24	0.2	1.04	0.22	0.34	0.4	0.18	0.19	0.18	1.5
S MANUF-	0.04	0.02	0.04	0.08	0.04	0.03	0.02	0.01	0.02	0.01	1.0
OMANUF -	0.02	0.1	0.06	0.08	0.07	0.06	0.11	0.01	0.06	0.03	0.5
ELY-	0.09	0.04	0.07	0.41	0.04	0.1	0.13	0.04	0.24	0.01	0.0
WTR -	0.22	1.64	0.3	2.61	0.6	0.87	1.38	0.36	0.49	1.01	
CNS -	0.01	0.03	0.02	0.09	0.02	0.03	0.04	0.03	0.02	0.04	
ATP -	0.24	0.85	0.62	0.31	0.96	1.23	0.55	0.32	0.69	0.3	
OTP -	0.93	0.86	0.7	0.77	0.56	0.65	0.87	0.35	0.47	0.3	
OSR -	0.01	0.01	0.01	0.06	0.03	0.03	0.04	0.01	0.02	0	
	IRL	NZL	GBR	GRC	ITA Cour	ESP	PRT	DNK	NLD	SWE	

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CBA per capita emissions (tCO₂eq per person)

AGR -	0.72	0.41	0.25	0.35	0.25	0.32	0.37	0.63	0.33	0.33	
ANM -	3.19	6.46	0.76	0.71	0.77	0.83	0.76	1.11	1.18	0.64	
XTR -	0.1	0.08	0.02	0.02	0.03	0.06	0.02	0.02	0.05	0.07	
FUEL -	4.12	2.39	2.63	3.03	2.67	2.47	2.97	2	4.27	1.8	
FBT -	0.14	0.17	0.15	0.13	0.17	0.17	0.15	0.19	0.26	0.1	
CHM -	0.59	0.96	0.3	0.34	0.49	0.47	0.49	0.42	1.71	0.53	volu
BPH -	0.07	0.03	0.02	0.01	0.02	0.02	0.01	0.02	0.02	0.01	Valu
MTL-	1.3	0.79	0.74	1.05	1.23	1.06	0.94	1.11	1.08	1.16	
MANUF -	0.22	0.17	0.18	0.08	0.19	0.12	0.12	0.3	0.28	0.22	
OMANUF -	0.27	0.44	0.3	0.18	0.4	0.25	0.35	0.31	0.49	0.27	
ELY -	0.09	0.05	0.06	0.24	0.04	0.09	0.08	0.05	0.18	0.02	-
WTR -	0.27	0.97	0.2	0.53	0.31	0.44	0.51	0.27	0.38	0.81	
CNS -	0.08	0.21	0.1	0.11	0.08	0.12	0.12	0.16	0.14	0.22	
ATP -	0.79	1.23	0.86	0.28	0.47	0.55	0.55	0.7	1.25	0.62	
OTP -	2.27	1.85	1.48	1.04	1.4	0.98	1	2.07	1.22	1.17	
OSR -	1.35	0.61	0.83	1.04	0.94	0.7	0.76	0.81	1.57	0.4	
	IRL	NZL	GBR	GRC	ITA Cour	ESP ntries	PRT	DNK	NLD	SWE	

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More key points:

- Still a lack of similarity
- Emissions concentration in agriculture, fuels and transport reaffirmed.

Traded emissions?

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Export emissions (MtCO₂eq)

12.28 38 12.28 07 0.01 29 0.58 05 1.54 35 0.74 4 0.01 01 0.77	3.72 0.25 8.91 1.4 9.36 1.08	0.21 0.19 3.11 0.29 0.69	1.63 0.07 7.49 2.92 8.02	5.04 0.59 7.49 1.49	1.11 0.16 1.89 0.42	4.58 0.02 1.31 0.57	7.69 0.17 14.51 2.58	0.6 0.35 1.95 0.12	
07 0.01 29 0.58 05 1.54 35 0.74 4 0.01 01 0.77	0.25 8.91 1.4 9.36 1.08	0.19 3.11 0.29 0.69	0.07 7.49 2.92 8.02	0.59 7.49 1.49	0.16 1.89 0.42	0.02 1.31 0.57	0.17	0.35 1.95 0.12	
0.01 29 0.58 05 1.54 35 0.74 4 0.01 01 0.77	8.91 1.4 9.36 1.08	0.13 3.11 0.29 0.69	7.49 2.92 8.02	7.49 1.49	1.89 0.42	1.31 0.57	14.51 2.58	0.33 1.95 0.12	
0.38 05 1.54 35 0.74 4 0.01 01 0.77	1.4 9.36 1.08	0.29	2.92 8.02	1.49	0.42	0.57	2.58	0.12	
35 0.74 4 0.01 01 0.77	9.36	0.69	8.02	1.43	0.42	0.57	2.30	11 12	
4 0.01 01 0.77	1.08	0.00	0.02	6.43	0.79	0.42	19.76	4.03	
0.01	1.00		0.71	0.43	0.02	0.42	0.69	0.05	valu
0.11	7.67	4 90	15.22	12.0	2.0	1.02	5.49	2.09	
0.05	6.97	0.24	0.12	2.01	0.46	0.22	1.25	0.49	
0.03	2.02	0.24	6.06	2.29	1.94	0.22	2.09	0.93	
12 0.00	0.03	0.20	0.00	0.15	0.1	0.10	0.26	0.03	
	0.03	0.07	0.02	0.13	0.01	0.02	0.01	0.02	
	0.02	0.04	0.04	0.04	0.04	0.1	0.07	0.03	
64 3 51	25.39	1 19	6.76	14 91	6.37	2 19	14 79	2.1	
0.59	0.32	13.63	0.70	18.01	2.41	12.26	17.46	3.0	
0.55	4.82	1.48	3 37	3.75	1.01	0.28	2.82	0.2	
1 N7I	GBR	GRC	ITA	ESP	PRT	DNK	NLD	SWE	
)) ()	12 0 0 0 64 3.51 01 0.59 22 0.15 L NZL	12 0 0.03 0 0.02 0.07 0 3.51 25.39 11 0.59 9.32 12 0.15 4.82 14 NZL GBR	12 0 0.03 0.07 0 0.02 0.02 0 0.07 0.04 3.51 25.39 1.19 11 0.59 9.32 13.63 12 0.15 4.82 1.48 L NZL GBR GRC	12 0 0.03 0.07 0.02 0 0.02 0.02 0.01 0 0.07 0.04 0.04 84 3.51 25.39 1.19 6.76 11 0.59 9.32 13.63 9.29 12 0.15 4.82 1.48 3.37 L NZL GBR GRC GRC	12 0 0.03 0.07 0.02 0.15 0 0.02 0.02 0.01 0.02 0 0.07 0.04 0.04 0.04 64 3.51 25.39 1.19 6.76 14.91 11 0.59 9.32 13.63 9.29 18.01 12 0.15 4.82 1.48 3.37 3.75 L NZL GBR GRC GRC TA ESP Countries	12 0 0.03 0.07 0.02 0.15 0.1 0 0.02 0.02 0.01 0.02 0.01 0 0.07 0.04 0.04 0.04 0.04 0 0.07 1.04 0.04 0.04 0.04 64 3.51 25.39 1.19 6.76 14.91 6.37 11 0.59 9.32 13.63 9.29 18.01 2.41 12 0.15 4.82 1.48 3.37 3.75 1.01 L NZL GBR GRC TA ESP PRT	12 0 0.03 0.07 0.02 0.15 0.1 0.02 0 0.02 0.02 0.01 0.02 0.01 0.02 0.01 0 0 0.07 0.04 0.04 0.04 0.04 0.01 0 0 0.07 0.04 0.04 0.04 0.04 0.01 0 0 0.07 0.04 0.04 0.04 0.04 0.01 0 0 0.07 0.04 0.04 0.04 0.04 0.01 0 0 0.07 0.03 0.07 0.07 0.04 0.04 0.01 0 0 0.07 0.04 0.04 0.04 0.04 0.01 0 0 0 9.32 13.63 9.29 18.01 2.41 12.26 12 0.15 4.82 1.48 3.37 3.75 1.01 0.28 14 NZL GBR GRC <td< td=""><td>12 0 0.03 0.07 0.02 0.15 0.1 0.02 0.26 0 0.02 0.02 0.01 0.02 0.01 0.02 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01</td><td>12 0 0.03 0.07 0.02 0.15 0.1 0.02 0.26 0.02 0 0.02 0.02 0.01 0.02 0.01 0.02 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03</td></td<>	12 0 0.03 0.07 0.02 0.15 0.1 0.02 0.26 0 0.02 0.02 0.01 0.02 0.01 0.02 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01	12 0 0.03 0.07 0.02 0.15 0.1 0.02 0.26 0.02 0 0.02 0.02 0.01 0.02 0.01 0.02 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.01 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03 0.03

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Import emissions (MtCO₂eq)

AGR -	1.01	0.4	6.62	1.05	7.15	7.48	1.98	1	7.25	1.17	
ANM -	1.35	0.34	8.67	1.32	16.36	6.16	1.81	1.6	6.79	1.57	
XTR -	0.06	0.05	0.65	0.07	0.8	1.91	0.03	0.02	0.3	0.23	
FUEL -	4.47	2.02	36.73	15.64	61.71	56.96	11.56	3.59	41.08	9.29	
FBT -	0.51	0.33	3.31	0.4	2.37	1.99	0.48	0.69	2.07	0.66	
CHM -	3.15	1.89	14.49	2.46	18.34	14.39	3.06	2.51	11.78	4.45	
BPH -	0.45	0.1	1.14	0.11	1.02	0.78	0.09	0.28	0.54	0.14	
MTL-	1.74	2.05	38.47	3.44	41.16	18.25	4.27	5	11.88	6.33	
MANUF-	0.89	0.56	9.06	0.58	5.49	4.18	0.91	1.27	3.72	2.15	
OMANUF -	0.94	1	10.93	1.11	7.75	5.6	1.14	1.64	4.93	2.09	
ELY -	0.01	0	0.17	0.23	0.31	0.15	0.05	0.08	0.1	0.05	
WTR -	0.01	0.01	0.1	0.02	0.11	0.05	0.02	0.03	0.04	0.03	
CNS -	0.01	0	0.09	0.01	0.05	0.02	0.01	0.06	0.08	0.07	
ATP -	1.29	2.18	35.6	2.05	12.73	6.78	2.68	3.86	9.04	5.12	
OTP -	0.56	0.63	5.08	14.15	5.67	3.25	0.55	10.22	5.74	1.48	
OSR -	3.64	0.59	10.56	0.55	3.26	2.67	0.57	1.51	5.08	1.94	
	IRL	NZL	GBR	GRC	ITA Cour	ESP	PRT	DNK	NLD	SWE	

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Traded emissions takeaway

- Exported emissions concentrated in animal agriculture and air transport
- Imported emissions concentrated in fuels, chemicals and services.



- CTL: Live bovine animals, other ruminants, horses and equines, bovine semen
- OAP: Swine, pigs, poultry, eggs, honey, snails, edible products of animal origin, ras hides and skins, insect waxes...
- RMK: Raw milk
- WOL: Wool, silk-worm cocoons; raw animal materials used in textiles
- FSH: Fishing, aquaculture, hunting, trapping and related activities
- CMT: Bovine meat products
- OMT: Meat products not elsewhere classified

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Animal agriculture sector - Ireland

The aggregate ANM sector:

- PBA emission value of 22.75 MtCO₂eq.
- PBA emissions per output value for this aggregated sector is 1.79 MtCO₂eq per billion USD of output

Details? (versus all of EU, not just the nine country sample above)

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Animal agriculture sub-sectors (CTL)

	CTL	OAP	RMK	WOL	FSH	CMT	OMT
Output rank	24	16	20	27	18	20	15
Output share of IRL in sector (%)	7.98	1.68	3.69	13.98	2.81	2.98	1.11
Ratio of exports in output (%)	17.28	21.46	0.02	5.79	45.37	86.14	87.91
PBA value (MtCO2eq)	10.73	0.63	3.91	0.01	0.12	6.75	0.60
PBA rank	26	15	22	26	18	22	20
PBA shares (%)	10.11	1.00	5.36	10.91	1.18	6.11	2.61
PBA per output rank	14	1	22	13	10	27	26
CH4 (CO2eq) rank	13	8	11	14	10	10	8
CH4(CO2eq) per output rank	10	5	23	22	24	21	21
CH4 shares (%)	8.04	1.04	5.48	23.26	4.16	3.87	1.34

UK (18%), FRA (19%), GER (12%), ITA (11%) much bigger producers.

- Output focused in manufactured meat products.
- PB rank high, but PB/output rank "average".
- CH4 rank 13, CH4/output rank 10.

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Imported emiss by source (%)

Ireland	New Zealand	UK	Greece	Italy
UK (40)	Untd. Arab Emirates (22)	Norway (20)	Iraq (39)	Algeria (21)
USA (14)	Korea (15)	Russia (18)	Russia (16)	Russia (16)
Russia (9)	Australia(14)	Qatar (13)	Algeria (10)	Iraq (9)
Nigeria (7)	Malaysia (11)	USA (8)	Iran (10)	Qatar (8)
Norway (7)	Singapore (7)	Nigeria (7)	Kazakhstan (8)	Iran (6)
Spain	Portugal	Denmark	Netherlands	Sweden
-	1 of tugui	200000	1 (ether funds	Sweden
Nigeria (22)	Nigeria (17)	Russia (44)	Russia (33)	Nigeria(29)
Nigeria (22) Algeria (16)	Nigeria (17) Algeria (12)	Russia (44) Norway (12)	Russia (33) Iraq (9)	Nigeria(29) Russia (29)
Nigeria (22) Algeria (16) Russia (8)	Nigeria (17) Algeria (12) Russia (12)	Russia (44) Norway (12) USA (7)	Russia (33) Iraq (9) Norway (9)	Nigeria(29)Russia (29)Norway (10)
Nigeria (22)Algeria (16)Russia (8)USA (5)	Nigeria (17)Algeria (12)Russia (12)USA (10)	Russia (44)Norway (12)USA (7)Qatar (8)	Russia (33) Iraq (9) Norway (9) Kazakhstan (7)	Nigeria(29)Russia (29)Norway (10)Denmark (5)

- IRL emission sources deviate from the rest.
- CAUTION: year 2017.

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Conclusion

- No consistent pattern observed across countries.
- Ireland's PB and CB emissions are concentrated in animal agriculture, fuels and other transport.
- Exported emissions concentrated in agriculture and air transport.
- Imported emissions concentrated in fuels, chemicals and services.

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Cautions and further work

Caution:

- Data refers to a single year, 2017.
- GTAP database is a collected CGE database, some interventions done.

Ongoing:

- How do PB and CB evolve through time?
- It would be preferable to rely heavily on "first hand" data from Ireland's institutions (CSO, EPA, SEAI)

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Thank you.