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Comprehensive emissions per capita for industrialised countries

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> "…the Parties included in Annex I shall implement domestic action in accordance with national circumstances and with a view to reducing emissions in a manner conducive to narrowing per capita differences between developed and developing country Parties while working towards achievement of the ultimate objective of the Convention".

1. Background

The resolution above formed part of the agreement on flexibility mechanisms reached at negotiations in Bonn in July 2001. This is one of the first times that official reference has been made in climate change negotiations to the concept of per capita emissions and reflects a growing level of support for some broader principle of equity that would, in time, permit developing countries to take on fair and reasonable targets. Perhaps the most systematic and influential proposal building on the idea of equal per capita entitlements to the use of the global atmospheric commons is the approach known as 'contraction and convergence' advocated by the Global Commons Institute (www.gci.org.uk).

Differences in per capita emissions have, nevertheless, had a substantial subterranean effect on climate change negotiations to date. The exclusion of developing countries from targets is due not only to their low incomes but their low emissions per capita. In the case of industrialised countries, expectations about the responsibility to take action have been influenced by recognition of each country's overall contribution to the climate problem as well as by perceptions of the profligacy of individual citizens in each country.

However, serious consideration of these issues can proceed only on the basis of good information on emissions. While any number of reports and papers have reported on energy emissions per capita, no-one has reported on comprehensive per capita emissions, taking account of all sources and sinks.[1] Yet the data required to calculate per capita emissions for industrialised countries are readily available from the official communications of the United Nations Framework Convention on Climate Change (UNFCCC) secretariat.

[1] With the exception of The Australia Institute's earlier calculations, published on the web, in 1999 for Annex B countries in 1995.

This paper uses UNFCCC data to calculate comprehensive per capita greenhouse gas emissions for Annex B countries for the most recently available year, 1998 in most cases. It also analyses the sectoral breakdown of per capita emissions for selected countries.

2. Data for comprehensive emissions

Under Articles 4 and 12 of the UNFCCC, Parties to the Convention submit national greenhouse gas inventories to the UNFCCC secretariat (UNFCCC 1992).

The information presented in Table 1 is based on recently submitted inventory data for Annex B (industrialised) countries, and has been reproduced as reported by the UNFCCC. The UNFCCC has modified the data slightly through rounding and correction of calculation and typographical errors. In most cases, the UNFCCC has made available greenhouse gas inventory submissions for 2000, which cover the year 1998. Exceptions (with most recent data indicated in brackets) include Iceland (1995), Japan (1997), Liechtenstein (1990), Luxembourg (1995), Romania (1994), the Russian Federation (1996) and Slovenia (1990). The UNFCCC does not provide any data on Croatia, presumably because it had not submitted any appropriate inventories.

The figures presented in Table 1 are based on emissions of the three main greenhouse gases: carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Emissions of perfluorocarbons, hydrofluorocarbons and sulfur hexafluoride are not included. For the three main gases included, we have used the following global warming potentials to convert the gases to carbon dioxide equivalents (CO_2-e): CO_2 – 1; CH_4 – 21; and N_2O – 310 (IPCC 1997).

The source categories (fuel combustion, agriculture, etc.) are defined according to IPCC guidelines. Emissions resulting from the combustion of fuel used in international shipping and aviation are not included in country totals, in accordance with IPCC methodology. Emissions and removals from the land-use change and forestry sector are included in the totals.

Table 1 also reports population data from the World Bank (2001), for each country (for the appropriate year). These are used to calculate comprehensive per capita emissions. The comprehensive per capita emissions shown in Table 1 are presented graphically in Figure 1.

3. Analysis of results

As can be seen from Table 1, Annex B countries (excluding Croatia) were responsible for emissions of more than 14.5 billion tonnes of CO_2-equivalent in 1998. The USA contributes the largest amount (39.5%), followed by Japan (8.7%), the Russian Federation (7.4%), Germany (6.6%) and the United Kingdom (4.6%).

The largest per capita emitters are Australia (27.6 tonnes), Luxembourg (24.2), Canada (21.9), the USA (21.1) and Ireland (15.4). The average for the European Union is 10.3 tonnes, a figure heavily influenced by its largest members, Germany (11.9), UK (11.4), France (8.2) and Italy (9.0).

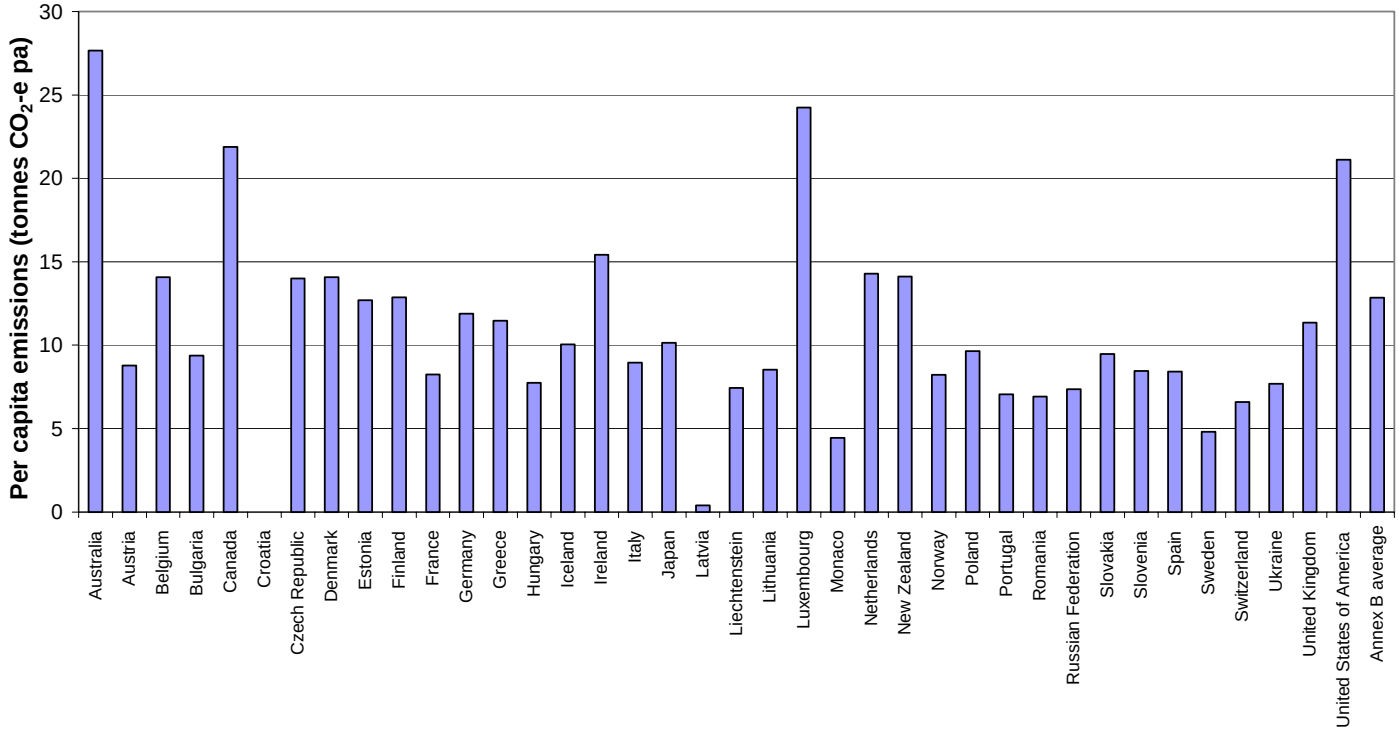
Table 1 Greenhouse gas emissions of Annex B countries (Mt CO_2-e)

Country	Year	Energy		Industry & Solvents	Agricult-ure	LUCF*	Waste & Other	Total	Population	Per capita emissions
		Combustion	Fugitive						(millions)	(t CO_2-e)
Australia	1998	331.3	31.5	8.4	92.2	39.5	15.5	**518.5**	18.75	27.6
Austria	1998	52.6	2.9	12.7	5.0	-7.6	5.3	**70.9**	8.08	8.8
Belgium	1998	117.0	0.8	12.2	10.7	-1.0	3.9	**143.7**	10.20	14.1
Bulgaria	1998	54.2	3.6	4.8	13.3	-6.2	7.8	**77.4**	8.26	9.4
Canada	1998	492.7	52.4	44.4	69.5	-20.1	23.1	**662.0**	30.25	21.9
Croatia	na	na	na	na	na	na	na	**na**	na	na
Czech Rep.	1998	126.3	6.3	4.5	7.9	-3.7	2.6	**144.0**	10.29	14.0
Denmark	1998	59.7	0.7	1.6	12.4	-1.0	1.2	**74.6**	5.30	14.1
Estonia	1998	19.0	0.6	0.3	1.0	-3.4	0.8	**18.4**	1.45	12.7
Finland	1998	60.3	3.6	2.4	7.1	-9.7	2.7	**66.3**	5.15	12.9
France	1998	395.8	9.0	36.7	87.2	-62.1	15.0	**481.6**	58.40	8.2
Germany	1998	875.5	22.0	35.9	58.7	-33.5	16.8	**975.4**	82.05	11.9
Greece	1998	95.1	1.1	9.0	12.0	0.0	3.3	**120.5**	10.52	11.5
Hungary	1998	55.5	8.4	2.2	13.2	-4.4	3.5	**78.3**	10.11	7.7
Iceland	1995	1.8	0.1	0.5	0.3	0.0	0.0	**2.7**	0.27	10.0
Ireland	1998	39.2	0.1	3.1	19.7	-6.4	1.6	**57.3**	3.71	15.4
Italy	1998	439.2	7.2	31.8	44.0	-23.6	17.1	**515.8**	57.59	9.0
Japan	1997	1159.1	2.9	69.7	18.6	0.0	30.1	**1280.4**	126.09	10.2
Latvia	1998	8.4	0.5	0.2	1.7	-10.5	0.6	**1.0**	2.45	0.4
Liechtenstein	1990	0.0	0.0	0.0	0.0	0.0	0.0	**0.2**	0.03	7.4
Lithuania	1998	14.2	0.4	5.4	2.3	7.7	1.6	**31.6**	3.70	8.5
Luxembourg	1995	9.2	0.0	0.4	0.5	-0.3	0.1	**9.9**	0.41	24.2
Monaco	1998	0.1	0.0	0.0	0.0	0.0	0.0	**0.1**	0.03	4.4
Netherlands	1998	179.6	4.0	12.2	17.2	-1.7	13.0	**224.2**	15.70	14.3
New Zealand	1998	26.0	1.6	2.7	41.2	-20.8	2.8	**53.5**	3.79	14.1
Norway	1998	32.6	2.6	9.7	5.1	-17.6	4.2	**36.5**	4.43	8.2
Poland	1998	330.3	17.4	14.7	21.9	-29.8	18.3	**372.7**	38.67	9.6
Portugal	1998	50.6	0.3	5.2	8.1	-3.6	9.6	**70.2**	9.97	7.0
Romania	1994	125.7	17.8	6.1	9.6	-6.6	4.8	**157.4**	22.73	6.9
Russian Fed.	1996	1469.2	284.1	19.7	103.2	-830.7	40.7	**1086.3**	147.74	7.4
Slovakia	1998	39.4	2.6	4.8	4.2	-1.7	1.7	**51.1**	5.39	9.5
Slovenia	1990	13.6	1.1	0.6	2.3	-2.3	1.6	**16.9**	2.00	8.5
Spain	1998	252.6	5.9	27.1	56.2	-29.3	18.6	**331.2**	39.37	8.4
Sweden	1998	55.7	0.0	5.1	8.2	-27.7	1.3	**42.6**	8.85	4.8
Switzerland	1998	42.0	0.3	2.4	5.5	-6.1	2.8	**46.9**	7.11	6.6
Ukraine	1998	298.9	92.1	18.6	27.1	-68.7	18.2	**386.2**	50.30	7.7
UK	1998	532.6	23.5	33.9	50.6	15.0	17.1	**672.7**	59.26	11.4
USA	1998	5475.3	225.7	97.4	540.7	-773.0	240.1	**5806.2**	274.89	21.1
EU	1998	3205.7	80.9	229.0	396.9	-192.1	126.6	**3847.0**	374.57	10.3
Annex B		13330.6	832.7	546.6	1378.1	-1950.7	547.5	**14685.2**	1143.29	12.8

* Land-use change and forestry

Source: UNFCCC 2001a; UNFCCC 2001b; World Bank 2001

Figure 1 Per capita net greenhouse gas emissions, Annex B countries, 1998 (or most recent year)



Source: Table 1

A cursory analysis indicates that Ireland's high emissions can be explained by the large contribution made by its agricultural sector, which accounts for around one-third of total emissions. Luxembourg's high per capita emissions are related to its large steel industry (which has contracted significantly since 1995). Australia, Canada and the USA are all large consumers of energy, but Australia also generates a large proportion of emissions from agriculture and land-use change and forestry. These three countries are examined in more detail below.

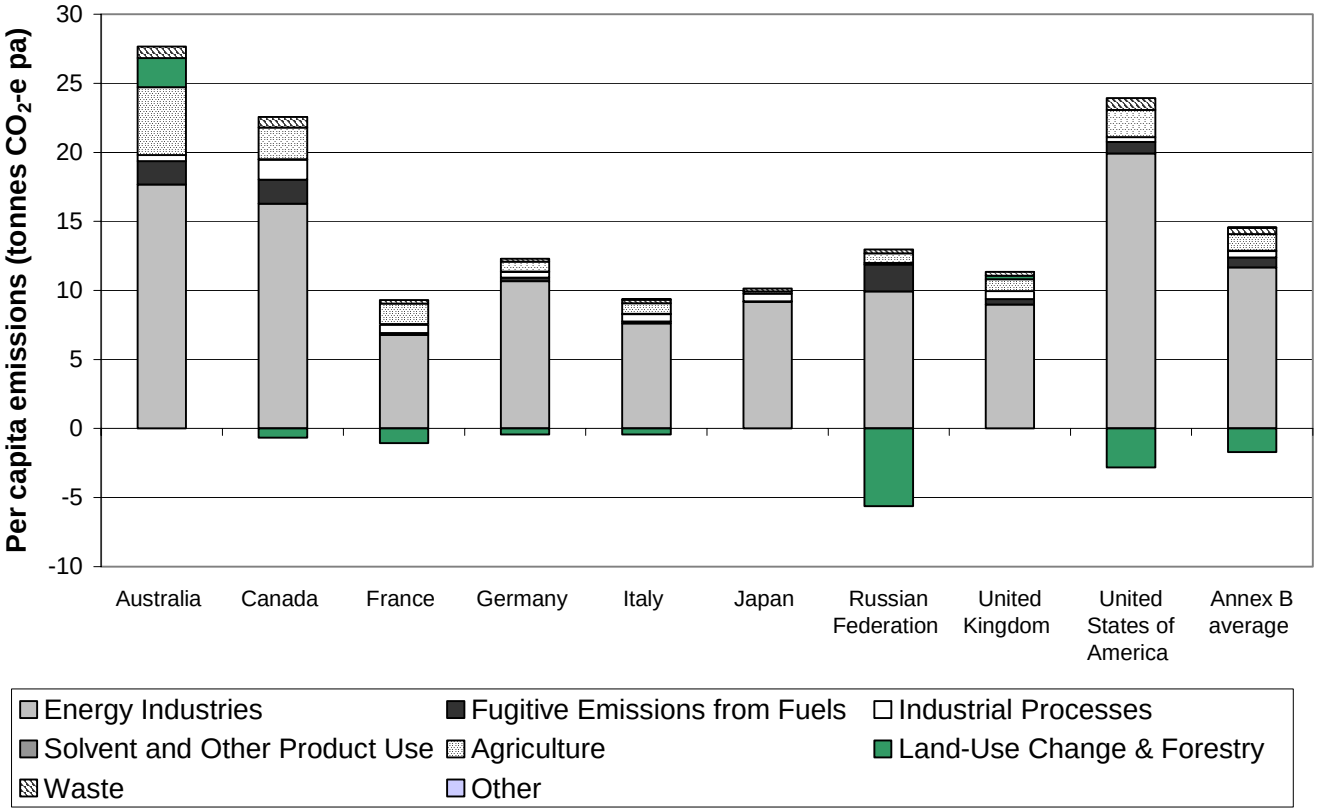
Figure 2 presents a sectoral breakdown of per capita emissions for selected Annex B countries.[2] For land-use change and forestry, net removals are shown below the horizontal axis. For those countries with net removals from this sector, the amount shown below the axis should be subtracted from the aggregate emissions above the axis to give net emissions per capita.

It is apparent that the USA generates the largest emissions per capita from fuel combustion, but falls behind Australia and Canada when emissions and removals from all sources are compared. Canada's per capita emissions exceed those of the USA due to higher per capita fugitive emissions and a lower contribution from sinks. Australia's emissions per capita are especially high because land-use change remains a net source of emissions, and emissions from agriculture are high. As a result, Australia has the highest per capita emissions of any industrialised country. By

[22] A systematic analysis of the sources of growth in energy-related greenhouse gas emissions in OECD countries over 1982-1997 (including the effects of changes in population, economic growth, energy intensity, primary energy use, share of fossil fuels and the carbon intensity of fossil fuels) can be found in Hamilton and Turton (2002).

contrast, land-use change and forestry makes a relatively large contribution to reducing net emissions in the USA and the Russian Federation.

Figure 2 Comprehensive per capita greenhouse gas emissions for selected Annex B countries, 1998 (or most recent year)



Source: Table 1 above

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