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THE AUSTRALIA INSTITUTE

## Updating per capita emissions for industrialised countries

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### 1. Background

The Australia Institute has previously used data from United Nations Framework Convention on Climate Change (UNFCCC) secretariat to estimate comprehensive emissions per capita for Annex B (industrialised) countries. While many other groups have developed estimates of energy emissions per capita, the Institute calculates comprehensive emissions, that is, including all sources and sinks as reported in national communications to the UNFCCC secretariat. We are now in a position to update our earlier estimates of per capita emissions to include the year 1999. This paper also provides, for the first time, historical data on the per capita emissions of all Annex B countries for the years 1990-1999 inclusive.

While data are reported for all Annex B countries, the analysis of the data focuses on Australia's emissions.

### 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 (SBI 2001). 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 2001, which cover the year 1999. Exceptions (with most recent year indicated in brackets) include Liechtenstein (1990), Lithuania (1998), Romania (1994), the Russian Federation (1996), Slovenia (1990) and the Ukraine (1998). The UNFCCC does not provide any data on Croatia, presumably because it has not submitted any appropriate inventories.

The numbers presented in Table 1 are, in most cases, based on emissions of the six main greenhouse gases: carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF<sub>6</sub>). However, for those countries where data for years prior to 1999 are reported in Table

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1, emissions of HFCs, PFCs and SF<sub>6</sub> are not included.<sup>2</sup> Emissions are reported in terms of carbon dioxide equivalents (CO<sub>2</sub>-e) (SBI 2001, p. 8).

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). This is used to calculate comprehensive per capita emissions.

### 3. Results of analysis

#### *Per capita emissions in 1999*

Table 1 shows that Annex B countries produced total net emissions of almost 14.7 billion tonnes CO<sub>2</sub>-e in 1999.<sup>3</sup> This was fractionally less than the emissions reported for the same group of countries in 1998 (see Turton and Hamilton 2001), although this slight decline had an insignificant impact on average Annex B per capita emissions.

The average per capita emissions of Annex B countries in 1999 was 12.8 tonnes of CO<sub>2</sub>-e. The average is heavily influenced by the per capita emissions of the EU (which accounts for 26 per cent of the total emissions and 33 per cent of total Annex B population) and the USA (accounting for 39 per cent of emissions and 24 per cent of Annex B population).

Australia has the highest level of per capita greenhouse gas emissions in the industrialised world, with emissions of 27.9 tonnes of CO<sub>2</sub>-e per person in 1999. This is over twice the industrialised country average of 12.8 tonnes CO<sub>2</sub>-e, 25 per cent higher than the next highest per capita emitter, Canada, and 35 per cent higher than the world's largest polluter, the USA.<sup>4</sup> In comparison, per capita emissions in major industrialised European countries, such as France (8.2 tonnes per capita), Germany (11.6), Italy (9.1) and the UK (10.8) are substantially lower.

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<sup>2</sup> Note, of the countries for which complete 1999 figures are not available, only Russia has reported any emissions of these gases. Russia reported emissions of these gases equivalent to 36,177 Gg CO<sub>2</sub>-e in 1999 (although data from other sectors were missing for this year, hence 1996 data are reported in this analysis) (SBI 2001, Table A.13).

<sup>3</sup> Assuming that, for those countries for which 1999 data were unavailable, emissions in the most recent year available are equal to 1999 emissions. Croatia is excluded.

<sup>4</sup> The five countries with the highest per capita emissions are Australia (27.9), Canada (22.2), the USA (20.7), Ireland (15.6) and Belgium (14.6). In previous versions of this analysis, which examined previous years' data (see Turton and Hamilton 2001; Turton and Hamilton 1999), Luxembourg was reported to have the second-highest per capita emissions of the industrialised countries (24.2 tonnes CO<sub>2</sub>-e in 1995). However, the most recent data from the UNFCCC suggest that Luxembourg's per capita emissions declined dramatically from 24.2 tonnes in 1998 to only 13.2 tonnes in 1999. In 1990 it was 34.4 (see Table 1). Apart from a few minor reporting changes, this reduction arises mostly because of decrease of 67 per cent in emissions from manufacturing between 1990 and 1999, which occurred because of a decrease in coke consumption in the steel industry, following a conversion to electric arc furnaces (Luxembourg imports most of its electricity) (EEA 2001, p. 90).

### *Sources of emissions*

It has often been argued that although Australia has high per capita emissions, the country's small population means that in absolute terms it is not a major greenhouse polluter. However, this is not the case. While Australia accounts for 3.6 per cent of total Annex B emissions, Australia's total emissions exceed those of major European G8 economies, such as France and Italy, each of which have a little more than three times the population of Australia.<sup>5</sup> Among the industrialised countries presented in Table 1, Australia has the 13<sup>th</sup> largest population, but is the seventh largest emitter, exceeded only by the USA, Japan, Russia, Germany, the United Kingdom and Canada.<sup>6</sup>

Figure 1 shows, for selected countries, the contribution of different emitting activities to net per capita emissions. This shows that for most countries land-use change and forestry (LUCF) acts as a net sink, except in Australia where continued land-clearing results in substantial emissions. However, the role of land clearing gives cause for caution as there is significant uncertainty in measuring emissions from this source. The Australian Government has recently developed its National Carbon Accounting System, which is expected to result in more accurate, and possibly quite different, estimates of emissions from land use change in the inventory for the year 2000.

Figure 1 also shows that Germany, Japan, Russia and the United Kingdom all generate a similar amount of emissions per person from fuel combustion (9-10 tonnes per person), whilst Australia, Canada and the USA produce 70-100 per cent more per capita (17-20 tonnes). It is also interesting to note that although the USA generates the most emissions from fuel combustion in per capita terms, Australia's emissions from agriculture and LUCF are of a sufficient size to push Australia well ahead of the USA. New Zealand is also an interesting case, where around half of all emissions arise from agriculture (mainly methane from cattle and sheep).

### *Trends in per capita emissions*

Trends in per capita emissions for all industrialised countries between 1990 and 1999 are presented in Table 2. Some of the data appear unreliable, particularly for the Baltic states of Estonia, Latvia and Lithuania, where the trends in total emissions are extremely erratic, although generally downward. Much more reliable trends are visible in the emissions from other countries of Eastern Europe and the former Soviet Union, although these countries appear not to report as frequently as other industrialised countries. The severe economic depression that befell Eastern Europe and, in particular, the former Soviet Union post-communism is clearly evident in the data on emissions; per capita emissions in Bulgaria, Russia and the Ukraine more than halved after 1990, whilst those for the Czech Republic, Germany, Poland, Romania and Slovakia also exhibited a substantial decline. Interestingly, emissions in Hungary were affected less.

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<sup>5</sup> As shown in Table 1, Australia's total emissions are 529.9 Mt CO<sub>2</sub>-e, compared to 483.2 Mt CO<sub>2</sub>-e from France and 525.0 Mt CO<sub>2</sub>-e from Italy.

<sup>6</sup> Moreover, Australia's total emissions are roughly the same as the sum of emissions from Austria, Denmark, Finland, Ireland, New Zealand, Norway, Portugal, Sweden and Switzerland.

**Table 1 Greenhouse gas emissions from Annex B countries (Mt CO<sub>2</sub>-e), 1999**

		Fuel Year combustion	Fugitive fuel	Industrial processes	Agriculture	Other	LUCF <sup>a</sup> (CO <sub>2</sub> )	Total	Population Population (millions)	Per capita emissions (t CO <sub>2</sub> -e)
Australia	1999	333.7	30.8	9.7	93.8	21.0	40.8	<b>529.9</b>	19.0	27.9
Austria	1999	51.8	2.8	13.8	5.0	6.0	-7.6	<b>71.6</b>	8.1	8.8
Belgium	1999	113.7	0.8	20.1	12.4	4.1	-1.8	<b>149.3</b>	10.2	14.6
Bulgaria	1999	47.0	2.7	4.9	18.0	5.1	-6.6	<b>71.1</b>	8.2	8.7
Canada	1999	508.0	52.8	50.7	60.7	26.4	-20.3	<b>678.3</b>	30.5	22.2
Croatia	na	na	na	na	na	na	na	<b>na</b>	na	na
Czech Rep.	1999	119.3	5.9	4.0	7.8	3.5	-3.4	<b>137.2</b>	10.3	13.3
Denmark	1999	56.3	1.2	2.3	12.0	1.2	-1.0	<b>72.2</b>	5.3	13.6
Estonia	1999	16.6	0.6	0.6	0.9	1.3	-8.1	<b>11.8</b>	1.4	8.2
Finland	1999	59.7	3.6	2.8	7.6	2.5	-10.8	<b>65.4</b>	5.2	12.7
France	1999	388.9	8.6	37.5	86.5	30.7	-69.0	<b>483.2</b>	58.6	8.2
Germany	1999	845.9	19.5	42.0	55.3	19.8	-33.4	<b>949.0</b>	82.1	11.6
Greece	1999	94.5	1.1	12.2	11.8	3.7	0.2	<b>123.4</b>	10.5	11.7
Hungary	1999	57.3	8.0	3.9	13.2	4.2	-4.5	<b>82.0</b>	10.1	8.1
Iceland	1999	2.0	0.0	0.9	0.4	0.1	0.0	<b>3.3</b>	0.3	11.9
Ireland	1999	41.2	0.1	3.0	19.4	1.6	-6.7	<b>58.6</b>	3.8	15.6
Italy	1999	439.2	7.1	31.8	44.3	18.7	-16.1	<b>525.0</b>	57.6	9.1
Japan	1999	1,157.0	2.8	94.6	19.2	33.8	0.0	<b>1,307.4</b>	126.6	10.3
Latvia	1999	7.7	0.3	2.4	1.7	1.5	-10.7	<b>2.9</b>	2.4	1.2
Liechtenstein	1990	0.0	0.0	0.0	0.0	0.0	0.0	<b>0.2</b>	0.0	7.4
Lithuania	1998	14.2	0.4	5.4	2.3	1.6	7.7	<b>31.6</b>	3.7	8.5
Luxembourg	1999	4.8	0.0	0.7	0.4	0.1	-0.3	<b>5.7</b>	0.4	13.2
Monaco	1999	0.1	0.0	0.0	0.0	0.0	0.0	<b>0.1</b>	0.0	4.2
Netherlands	1999	173.3	4.6	24.6	16.8	10.8	-1.7	<b>228.4</b>	15.8	14.5
New Zealand	1999	27.4	1.6	3.2	41.7	2.9	-22.1	<b>54.7</b>	3.8	14.4
Norway	1999	32.7	2.9	11.2	5.0	4.3	-17.7	<b>38.4</b>	4.5	8.6
Poland	1999	322.3	16.4	14.5	27.9	19.0	-43.5	<b>356.7</b>	38.7	9.2
Portugal	1999	54.0	0.4	5.5	11.9	7.5	-4.7	<b>74.6</b>	10.0	7.5
Romania	1994	125.7	17.8	6.1	9.6	4.8	-6.6	<b>157.4</b>	22.7	6.9
Russia	1996	1,469.2	284.1	19.7	103.2	40.7	-830.7	<b>1,086.3</b>	147.7	7.4
Slovakia	1999	41.2	1.3	3.7	3.7	1.8	-2.6	<b>49.2</b>	5.4	9.1
Slovenia	1990	13.6	1.1	0.6	2.3	1.6	-2.3	<b>16.9</b>	2.0	8.5
Spain	1999	263.9	6.4	32.8	56.8	20.3	-29.3	<b>350.9</b>	39.4	8.9
Sweden	1999	54.4	0.3	6.1	7.6	2.3	-24.3	<b>46.4</b>	8.9	5.2
Switzerland	1999	41.9	0.3	2.8	5.4	2.9	-4.2	<b>49.2</b>	7.1	6.9
Ukraine	1998	298.9	92.1	18.6	27.1	18.2	-68.7	<b>386.2</b>	50.3	7.7
UK	1999	520.7	24.3	25.4	50.6	16.9	4.7	<b>642.6</b>	59.5	10.8
USA	1999	5,544.8	217.2	234.0	488.8	261.3	-990.4	<b>5,755.7</b>	278.2	20.7
Annex B		13,343.2	819.8	752.1	1,331.4	602.2	-2,195.9	<b>14,653.2</b>	1,148.4	12.8
EU	1999	3,160.6	80.5	252.8	397.0	146.2	-201.0	<b>3,836.2</b>	375.5	10.2

a. Land-use change and forestry. Note, this column includes only CO<sub>2</sub> from LUCF, with emissions of other gases included under 'Other' (see SBI 2001, Table A.1, footnote b). Iceland and Monaco have not reported any emissions from LUCF.

na: not available.

Note: per capita figures for years other than 1999 exclude emissions of HFCs, PFCs and SF<sub>6</sub>. This is only relevant to Russia, where emissions of these gases were reported to be 36,177 Gg CO<sub>2</sub>-e in 1999 (although data from other sectors were missing for this year, hence 1996 data are reported) (SBI 2001, Table A.13).

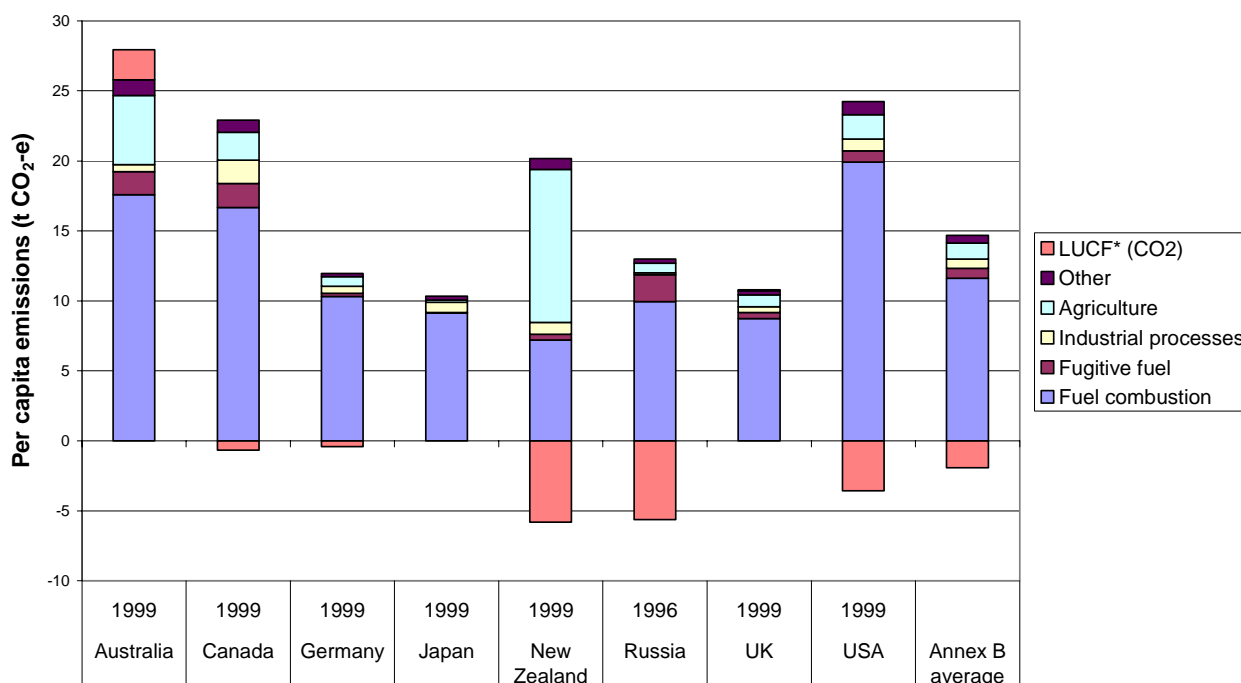
Source: SBI 2001, Table A.1; UNFCCC 2001a; UNFCCC 2001b; World Bank 2001

Average per capita emissions in industrialised countries as a whole declined by nearly 14 per cent between 1990 and 1999. Much of this decline can be attributed to the changes affecting Eastern Europe and the former Soviet Union, as discussed above. However, average per capita emissions in the European Union also declined, by over 7 per cent. In contrast, per capita emissions increased roughly 4 per cent in the USA, 13 per cent in Canada and 2 per cent in Japan.

For Australia, per capita emissions declined by just over 3 per cent between 1990 and 1999. It is surprising that Australia's emissions declined so little over this period when the inventories show that the reduction in land-clearing alone reduced per capita emissions by around 2 tonnes CO<sub>2</sub>-e (or close to 7 per cent)<sup>7</sup> between 1990 and 1995. However, closer examination reveals that Australia's per capita emissions grew by over 7 per cent between 1995 and 1999 (see Table 2). Figure 2 presents trends in total emissions (not per capita) for selected industrialised countries.

Australia's total and per capita emissions fell significantly in the early 1990s as emissions from land clearing declined, but this was soon offset by rapid growth in emissions from the energy sectors as Australia emerged from the recession of the early 1990s. However, rapid and sustained growth in emissions in the late 1990s was driven by reforms to the electricity market that saw the expansion of brown-coal fired generation at the expense of black coal and natural gas (Hamilton and Denniss 2001). It is expected that the effects of market liberalisation will have tailed off by the year 2000 and emissions growth will return to 'normal' in the inventory for that year (due to be published later this year).

**Figure 1 Per capita emissions for selected countries**



\* note, where land-use change and forestry appears below the horizontal axis it represents a sink, and should be subtracted from the emissions above the axis to realise total net emissions.

<sup>7</sup> Emissions of CO<sub>2</sub> from LUCF in 1990 where roughly 70 Mt, compared with roughly 40 Mt in 1999 and 35 Mt in 1995 (SBI 2001, Table B.8).

**Table 2 Trends in per capita emissions (tonnes CO<sub>2</sub>-e per capita), 1990-1999**

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Australia	28.9	27.0	26.6	26.3	26.0	26.5	26.8	26.9	28.0	27.9
Austria	8.8	8.6	8.3	8.1	8.4	8.8	9.2	9.1	8.9	8.8
Belgium	13.5	14.2	14.1	13.9	14.4	14.6	15.0	14.1	15.0	14.6
Bulgaria	17.5	12.5	11.2	11.2	10.1	10.8	11.3	10.1	9.1	8.7
Canada	19.6	19.0	19.9	20.1	20.8	21.8	21.9	22.1	22.1	22.2
Croatia	na	na	na	na	na	na	na	na	na	na
Czech Republic	18.1	16.5	15.0	14.4	13.9	13.8	14.5	14.9	14.0	13.3
Denmark	13.4	15.5	14.3	14.6	15.3	14.6	17.0	15.0	14.3	13.6
Estonia	18.7	18.7	18.7	18.7	9.2	6.3	6.3	21.3	12.7	8.2
Finland	10.7	7.3	7.8	8.4	11.9	11.8	11.6	13.0	13.0	12.7
France	8.7	9.1	8.8	8.2	8.1	8.3	8.5	8.3	8.5	8.2
Germany	14.8	14.0	13.3	12.9	12.6	12.6	12.7	12.3	12.0	11.6
Greece	10.5	10.3	10.5	10.5	10.6	10.6	10.9	11.4	12.1	11.7
Hungary	9.5	8.2	7.3	7.2	7.1	7.1	7.4	7.2	7.8	8.1
Iceland	11.5	10.9	10.7	10.7	10.5	10.7	10.9	11.2	11.4	11.9
Ireland	13.8	13.9	13.9	13.7	14.2	14.3	14.6	15.0	15.4	15.6
Italy	8.8	8.9	8.8	8.5	8.4	8.9	8.8	8.9	9.0	9.1
Japan	9.3	9.5	9.7	9.5	10.1	9.7	9.9	9.8	9.4	9.6
Latvia	7.6	5.3	3.6	2.3	1.8	1.2	0.9	0.6	0.7	1.2
Liechtenstein	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
Lithuania	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	4.4	4.4
Luxembourg	34.4	34.4	34.4	34.4	30.7	24.2	24.2	24.2	24.2	13.2
Monaco	3.1	3.6	3.9	3.9	4.0	3.9	4.0	4.1	3.9	4.2
Netherlands	14.3	14.7	14.4	14.4	14.5	15.0	15.4	15.1	15.0	14.5
New Zealand	15.0	15.0	15.8	15.9	16.1	15.7	15.7	15.4	14.3	14.4
Norway	10.0	8.9	8.1	8.5	8.4	8.8	8.5	8.8	8.6	8.6
Poland	13.9	10.3	10.4	10.1	10.3	9.7	10.2	10.0	9.6	9.2
Portugal	6.1	6.4	6.7	6.5	6.6	6.9	6.7	6.9	7.3	7.5
Romania	11.3	7.5	7.3	7.1	6.9	6.9	6.9	6.9	6.9	6.9
Russia	17.9	17.9	17.9	17.9	10.7	8.3	7.6	7.6	7.6	7.6
Slovakia	13.3	11.6	10.7	9.9	9.1	9.5	9.2	9.2	9.0	9.1
Slovenia	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Spain	7.1	7.3	7.5	7.1	7.5	7.8	7.7	8.1	8.4	8.9
Sweden	5.8	4.8	5.3	4.6	5.4	5.8	6.2	5.0	5.4	5.2
Switzerland	7.4	7.6	7.5	6.9	6.7	6.8	6.8	6.7	6.9	6.9
Ukraine	16.7	14.1	13.7	12.0	10.0	9.4	8.5	7.8	7.7	7.7
United Kingdom	13.0	13.0	12.5	12.1	12.0	11.8	12.1	11.7	11.6	10.8
USA	20.0	19.6	20.0	20.1	20.3	20.3	20.8	21.0	20.7	20.7
Annex B	14.7	14.1	14.1	13.9	13.0	12.7	12.8	12.8	12.7	12.6
European Union	11.0	10.9	10.6	10.3	10.4	10.5	10.6	10.4	10.5	10.2

Note: some countries did not provide data to the UNFCCC for every year. Where this is the case, the previous year's per capita figure has been used.

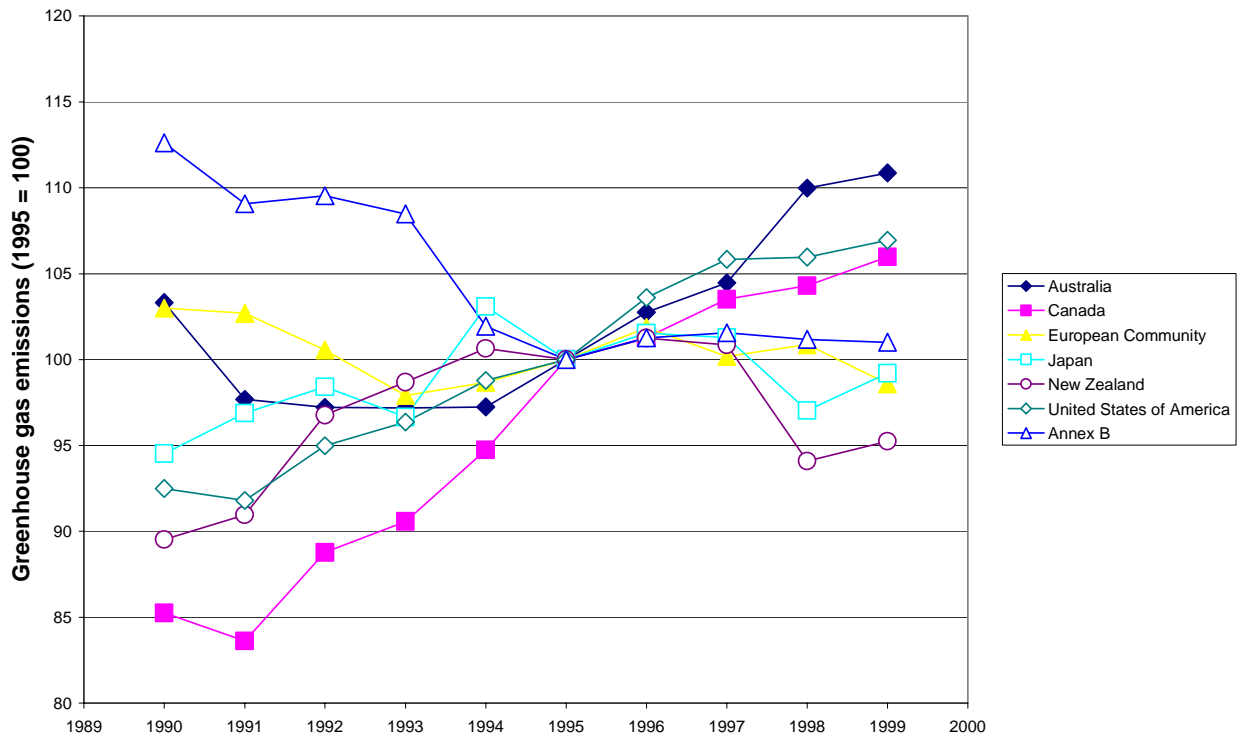
When comparing data in Tables 1 and 2, note the discussion of emissions of HFCs, PFCs and SF<sub>6</sub> in the footnote to Table 1.

Japan reported emissions from LUCF from 1990 to 1995, but has not reported them since (SBI 2001, Table B.8). In the construction of Table 2, it has been assumed that Japan's LUCF emissions in 1996 to 1999 were the same as in 1995.

There are also some inconsistencies in the data used for Lithuania and presented in Tables 1 and 2. In latest data compendium from the UNFCCC, LUCF was reported to be a net sink in 1998, sequestering 7,712 Gg CO<sub>2</sub>-e (SBI 2001, Table B.8), in contrast to the previous UNFCCC dataset which reported net emissions of 7,712 Gg CO<sub>2</sub>-e (UNFCCC 2001a).

Source: SBI 2001, Tables B.1, B.2; World Bank 2001

**Figure 2 Trends in total net greenhouse gas emissions for selected countries, 1990-1999**



Note: Net LUCF emissions for Japan for 1996 to 1999 are assumed to be the same as in 1995.  
 Source: SBI 2001, Tables B.1 and B.2

## References

- EEA 2001, European Community and Member States greenhouse gas emission trends 1990-99, Topic Report 10/2001, prepared by Gugele, B. and Ritter, M., European Environment Agency, August, [http://reports.eea.eu.int/topic\\_report\\_2001\\_10/en/topic\\_10\\_web.pdf](http://reports.eea.eu.int/topic_report_2001_10/en/topic_10_web.pdf)
- Hamilton, C. and Denniss, R. 2001, 'Generating Emissions: The impact of microeconomic reform on the electricity industry' *Economic Papers*, Vol. 20, No. 3, September
- SBI 2001, National Communications from Parties included in Annex I to the Convention, Report on national greenhouse gas inventory data from Annex I Parties for 1990 to 1999, Subsidiary Body for Implementation (UNFCCC), Fifth session, Marrakesh, 29 October - 6 November 2001, Item 5 (c) of the provisional agenda, FCCC/SBI/2001/13, 25 October, <http://unfccc.int/resource/docs/2001/sbi/13.pdf>
- Turton, H. and Hamilton, C. 1999, Greenhouse gas emissions per capita for Annex B Parties to the Kyoto Protocol, A submission to the Senate Environment References Committee Inquiry into Australia's Response to Global Warming, November, [http://www.tai.org.au/Publications\\_Files/Papers&Sub\\_Files/BP19.pdf](http://www.tai.org.au/Publications_Files/Papers&Sub_Files/BP19.pdf)
- Turton, H. and Hamilton, C. 2001, Comprehensive emissions per capita for industrialised countries, The Australia Institute, September, [http://www.tai.org.au/Publications\\_Files/Papers&Sub\\_Files/Per\\_Capita.pdf](http://www.tai.org.au/Publications_Files/Papers&Sub_Files/Per_Capita.pdf)
- UNFCCC 1992, United Nations Framework Convention on Climate Change, <http://www.unfccc.de/resource/conv/index.html>
- UNFCCC 2001a, Greenhouse Gas Inventory Database, United Nations Framework Convention on Climate Change, <http://ghg.unfccc.int/>
- UNFCCC 2001b, Greenhouse Gas Inventory Database: Sources of data for Annex I Parties, United Nations Framework Convention on Climate Change, <http://ghg.unfccc.int/infosrc.htm>
- World Bank 2001, Health, Nutrition and Population Statistics, Development Data Group, Human Development Network, <http://devdata.worldbank.org/hnpstats/>