Appendix 2. SECTORS AND END-USES

The definitions of the sectors and end-uses categories used in this report are in large part a function of what data is available, and how that data can be compiled into meaningful categories. This appendix provides a guide to what data and activities are included in specific sectors and end-use categories.

A. Sector Definitions

Table A2.1 shows datasets that are available at the sectoral level and used in this report (and in CAIT). These sectors pertain to the first column of the GHG Flow Diagram (Figure 1.3). In presenting sector data, the IPCC Common Reporting

Table A2.1. Summary of Sector Contents

Sector	Contents	IPCC Category	Gases	Data Source
Energy		1		
Electricity & Heat[1]	Electricity & heat plants (fossil fuels)			
	- Public plants (electricity, heat, CHP)	1 A 1 a	CO_2	IEA, 2004
	- Autoproducers (electricity, heat, CHP)	1 A	CO_2	IEA, 2004
	Other Energy Industries (fossil fuels)	1 A 1 b,c	CO_2	IEA, 2004
Manufacturing & Construction	Manufacturing & Const. (fossil fuels)	1 A 2	CO_2	IEA, 2004
Transport	Transport (fossil fuels)	1 A 3	CO_2	IEA, 2004
Other Fuel Combustion[2]	Other Sectors (fossil fuels)	1 A 4	CO_2	IEA, 2004
	Biomass Combustion	1 A 5	CH_4, N_2O	EPA, 2004
	Stationary and Mobile Sources	1 A 5	CH_4, N_2O	EPA, 2004
Fugitive Emissions	Gas Venting/Flaring	1 B 2c	CO_2	
	Oil & Natural Gas Systems	1 B 2	CH_4, N_2O	EPA, 2004
	Coal Mining	1 B 1	CH_4, N_2O	EPA, 2004
Industrial Processes	Cement	2 A 1	CO_2	Marland et al., 2005
	Adipic and Nitric Acid Production	2 B 2,3	N_2O	EPA, 2004
	Aluminum	2 C	CO_2	WRI estimate[3]
	Other Industrial non-Agriculture	2	CH_4, N_2O	EPA, 2004
	All F-gases	2	HFCs, PFCs, SF_6	EPA, 2004
Agriculture	Enteric Fermentation (Livestock)	4 A	CH_4	EPA, 2004
	Manure Management	4 B	CH_4, N_2O	EPA, 2004
	Rice Cultivation	4 C	CH_4	EPA, 2004
	Agricultural Soils	4 D	N_2O	EPA, 2004
	Other Agricultural Sources	4	CH_4, N_2O	EPA, 2004
Land-Use Change & Forestry	All	5	CO_2	Houghton, 2003a
Waste	Landfills (Solid Waste)	6 A	CH_4	EPA, 2004
	Wastewater Treatment	6 B	CH_4	EPA, 2004
	Human Sewage	6 B	N_2O	EPA, 2004
	Other	6 D	CH_4, N_2O	EPA, 2004
International Bunkers	Aviation Bunkers	1 A 3a*i*	CO_2	IEA, 2004
	Marine Bunkers	1 A 3d*i*	CO_2	IEA, 2004

Sources: IPCC, 1997; CAIT-UNFCCC.

Notes:

[1] Refers mainly, but not exclusively to electricity and heat (including CHP) produced by entities whose primary activity is to supply the public. Here, this category also includes autoproducers and other energy industries. Autoproducers should ideally be allocated to the sector for which the electricity and/or heat was generated. CO_2 and energy statistics from the IEA do not allow for this. Other energy industries refer to emissions from fuel combusted in association with production and processing (for example, petroleum refineries) of fossil fuels, and is thus not strictly electricity or heat.

[2] Emissions from fuel combustion in (1) commercial and institutional buildings, (2) residential buildings, (3) agriculture, forestry, or domestic inland, coastal and deep-sea fishing, and (4) remaining non-specified emissions.

[3] Estimate is derived from data from USGS (2004), IAI (2005b,c), IPCC (2005), and CAIT.

See Glossary for other terms.

Framework is used to the extent possible. This is the standardized approach used by governments in compiling official national GHG inventories under the UNFCCC (IPCC, 1997). Minor deviations from this approach are sometimes required due to data limitations. For more detail, see WRI (2005a).

The following sectors are included: energy, industrial processes, agriculture, land-use change and forestry, and waste. The energy sector also includes five subsectors (for example, electricity/heat). International Bunkers are shown as a sector, but separately from Energy, in accordance with IPCC Guidelines. All six GHGs are included within their appropriate sectors and subsectors, so far as the data will allow.

All sectors and subsectors here capture only "direct" emissions. Emissions resulting from public electricity consumption (that is, from the grid) in the course of manufacturing, construction, agricultural, or other activities are included only in "electricity and heat." Likewise, emissions released as byproducts of particular industrial processes—such as cement or aluminum manufacture—are categorized under "industrial processes." Emissions from the energy sector pertain only to fuel combustion (for example, fossil fuels, biomass).

B. End-Use / Activity Definitions

Table A2.2 shows the contents of individual end-use/activities used in this report. These end uses appear in the middle column of the GHG Flow Diagram (Figure 1.3), including the sectors and subsectors discussed in Part II of this report.

End-uses/activities described here represent an attempt to aggregate all emissions that pertain to a common "downstream" activity, such as agricultural activities or the manufacture of cement. End-uses deviate from the above-described IPCC sectors in the following respects:

- ***Electricity and Heat*** is distributed to end-uses, rather than treated as a discrete sector. Estimates of CO_2 shares for subsectors and end-uses are based on IEA *Energy Statistics* (IEA, 2004b). Separate allocations were made for electricity, heat, and energy industries.
- ***Industrial Processes***-related emissions are allocated to end uses.
- ***Other IPCC-related sectors*** (for example, transport), where possible, are divided into subsectors (such as road, aviation, rail, ship, and other). This was done for the datasets pertaining to CO_2 from fossil fuel combustion (IEA, 2004a) and non-CO_2 gases (EPA, 2004). Other datasets, such as for CO_2 emissions from cement manufacture (Marland et al., 2005) and for gas flaring (EIA, 2004), already provide data at the end-use level.

Table A2.2. End-Use / Activity Definitions

End Use / Activity	Contents	Gases	Related IPCC Category(s)
Road	Direct fuel combustion	CO_2	Energy: Transport
Air	Domestic air (direct fuel combustion)	CO_2	Energy: Transport, including bunkers
	International air (direct fuel combustion)	CO_2	
Rail, Ship, & Other	Rail (electricity)	CO_2	Energy: Electricity & Heat
	International marine (direct fuel combustion)	CO_2	Energy: Transport, including bunkers
	Pipeline transport, national navigation, and others (direct fuel combustion)	CO_2	
	Pipeline transport (electricity)	CO_2	"
	Non-specified transport (electricity)	CO_2	"
Transmission & Distribution Losses	Distribution losses	CO_2	Energy: Electricity & Heat
	Electrical transmission & distribution.	SF_6	Industrial Processes
Residential Buildings	Direct fuel combustion (on-site)	CO_2	Energy: Other Fuel Combustion
	Electricity and heat consumption (indirect)	CO_2	Energy: Electricity & Heat
Commercial Buildings	Direct fuel combustion (on-site)	CO_2	Energy: Other Fuel Combustion
	Electricity and heat consumption (indirect)	CO_2	Energy: Electricity & Heat
Unallocated Fuel Combustion	Forestry/fishing and other direct fossil fuel combustion not specified elsewhere	CO_2	Energy: Other Fuel Combustion
	Biomass combustion	CH_4, N_2O	"
	Stationary & mobile sources	CH_4, N_2O	"
	Own use in electricity, CHP and heat plants (elect. & heat)	CO_2	Energy: Electricity & Heat
	Pumped Storage (electricity)	CO_2	"
	Nuclear Industry (electricity & heat)	CO_2	"
	Non-specified & other (electricity & heat)	CO_2	"

Table A2.2. End-Use / Activity Definitions *(continued)*

End Use / Activity	Contents	Gases	Related IPCC Category(s)
Iron & Steel	Direct fuel combustion	CO_2	Energy: Manufacturing & Const.
	Electricity and heat consumption (indirect)	CO_2	Energy: Electricity & Heat
Non-Ferrous Metals	Direct fuel combustion (on-site)	CO_2	Energy: Manufacturing & Const.
	Electricity and heat consumption (indirect)	CO_2	Energy: Electricity & Heat
	Aluminum	PFCs	Industrial Processes
	Aluminum[1]	CO_2	Industrial Processes
	Magnesium	SF_6	Industrial Processes
Machinery	Direct fuel combustion	CO_2	Energy: Manufacturing & Const.
	Electricity and heat consumption	CO_2	Energy: Electricity & Heat
Pulp, Paper, & Printing	Direct fuel combustion	CO_2	Energy: Other Fuel Combustion
	Electricity and heat consumption	CO_2	Energy: Electricity & Heat
Food & Tobacco	Direct fuel combustion	CO_2	Energy: Manufacturing & Const.
	Electricity and heat consumption	CO_2	Energy: Electricity & Heat
Chemicals & Petrochemicals	Direct fuel combustion	CO_2	Energy: Other Fuel Combustion
	Electricity and heat consumption	CO_2	Energy: Electricity & Heat
	Adipic and nitric acid	N_2O	Industrial Processes
	ODS Substitutes	HFCs	Industrial Processes
	HCFC-22 production	HFCs	Industrial Processes
Cement Manufacture	Direct fuel combustion	CO_2	Energy: Other Fuel Combustion
	Electricity and heat consumption	CO_2	Energy: Electricity & Heat
	Clinker production	CO_2	Industrial Processes
Other Industry	Transport equipment (direct combustion, electricity, heat)	CO_2	Energy: Manufacturing & Const.
	Mining and quarrying (direct combustion, electricity, heat)	CO_2	Energy: Electricity & Heat
	Wood/wood products (direct combustion, electricity, heat)	CO_2	"
	Construction (direct combustion, electricity, heat)	CO_2	"
	Textile and leather (direct combustion, electricity, heat)	CO_2	"
	Non-metallic minerals excluding cement (direct combustion, electricity, heat)	CO_2	"
	Other & non-specified (direct combustion, electricity, heat)	CO_2	"
	Semiconductors	F-gases	Industrial Processes
	Other industrial non-agriculture	CH_4, N_2O	"
	Other high GWP gases	F-gases	"
Coal Mining & Manufacture	Coal mining	CH_4, N_2O	Energy: Fugitives
	Coal mines (electricity and heat)	CO_2	Energy: Electricity & Heat
	Fuel combustion for the manufacture of hard coal, coke oven coke, and other coal-related fuels	CO_2	"
Oil & Gas Extraction, Refining, Processing	Gas flaring	CO_2	Energy: Fugitives
	Oil & natural gas systems	CH_4	"
	Oil and gas extraction (electricity and heat)	CO_2	Energy: Electricity & Heat
	Electricity and heat (public) consumed in oil refineries, coke ovens and other energy producing plants.	CO_2	"
	Fuel combusted in refineries, gas processing plants, and other energy-producing industries.	CO_2	"
Land-Use Change & Forestry	Land clearing for permanent croplands (cultivation) or pastures (no cultivation), abandonment (with subsequent regrowth), shifting cultivation, and wood harvest.	CO_2	Land-Use Change & Forestry
Energy-Related Agriculture	Direct fuel combustion	CO_2	Energy: Other Fuel Combustion
	Electricity and heat consumption	CO_2	Energy: Electricity & Heat
Agricultural Soils	Fertilizer Application	N_2O	Agriculture
Livestock & Manure	Enteric Fermentation (Livestock)	CH_4	Agriculture
	Manure Management	CH_4, N_2O	"
Rice Cultivation	Rice cultivation	N_2O	Agriculture
Other Agriculture	Miscellaneous Agricultural Processes	CH_4, N_2O	Agriculture

Notes: "F-gases" refers to HFCs, PFCs, and SF_6 collectively. ODS refers to ozone depleting substances.
[1] WRI emissions estimate is derived from data from USGS (2004), IAI (2005b,c), IPCC (2005), and CAIT.

- ***Land-Use Change and Forestry*** includes both emissions and absorptions of CO_2. For this reason, it is not possible to graphically illustrate subsectoral activities in the GHG Flow Diagram (Figure 1.3. Instead, this is done in Figure 17.2 (see Chapter 17).

It is important to note that this report does not assess end use/activity-level emissions using a full life-cycle approach. In particular, "upstream" emissions pertaining to mining, extraction, and processing of fossil fuels and other minerals are not allocated to end uses (such as transport and aluminum production), but to their own end uses. Similarly, transport-related emissions do not include emissions associated with the actual manufacture of motor vehicles or other transport-related equipment, which are included under "Other Industry."

The end-use/activities shown in Table A2.2 can also be aggregated to create broader end-use sectors. This has been attempted in Part II of this report. In particular:

- ***Transport*** (Chapter 12) includes a small amount of electricity (indirect emissions) as well as all direct emissions of fossil fuel combustion associated with transport activities. This sector does not include, however, emissions pertaining to the manufacture of motor vehicles or other transport equipment. Those emissions are contained in Industry.
- ***Industry*** (Chapter 13) includes direct emissions from fossil fuel combustion, indirect emissions from electricity and heat consumption, and emissions from industrial processes (for chemicals, aluminum, and cement). Several additional steps were taken to estimate emissions from two industry subsectors:
  - ***Cement.*** Estimates of direct fossil fuel combustion for cement manufacture and electricity-related emissions (indirect) are estimated by WRI based on IEA (2004a,b) and Hendriks (1999). Industrial process-related emissions (from clinker production) are from Marland et al. (2005).
  - ***Aluminum.*** Industrial process-related CO_2 emissions are estimated based on total world aluminum production (USGS, 2004), CO_2 emission factors (IPCC, 2005), and further information on the relative prevalence of different aluminum production processes (Watson et al., 2005). Energy-related CO_2 emissions are estimated based on national aluminum production statistics (USGS, 2004), CO_2 emission factors (IAI, 2005b,c) and country-level carbon intensity of electricity supply (CAIT, based on IEA). PFC emissions are drawn from EPA (2004).
- ***Buildings*** (Chapter 14) includes direct fossil fuel combustion and indirect emissions attributable to public heat and electricity consumption in residential, commercial, and public buildings.
- ***Agriculture*** (Chapter 15) includes all contents of the IPCC Agriculture sector described in Section A of this appendix, as well as energy-related emissions that can be allocated to agriculture activities (direct fossil fuel combustion and electricity).

In some cases, data limitations prevented a detailed breakdown of end-use activities. For example, detailed data on the relative contribution of different activities in the buildings sector is unavailable at the global level.