# The Aluminium Smelting Industry

## Structure, market power, subsidies and greenhouse gas emissions

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## List of Abbreviations

| | |
|---|---|
| AAC | Australian Aluminium Council |
| ABARE | Australian Bureau of Agricultural and Resource Economics |
| AGO | Australian Greenhouse Office |
| AIGN | Australian Industry Greenhouse Network |
| Al | aluminium (chemical symbol) |
| $Al_2O_3$ | aluminium oxide, alumina |
| ALP | Australian Labor Party |
| ANZSIC | Australian and New Zealand Standard Industrial Classification |
| AWA - Australia | Alcoa World Alumina - Australia |
| BPA | Bonneville Power Administration |
| C | carbon |
| $C_2F_6$ | hexafluoroethane |
| $CF_4$ | tetrafluoromethane |
| $CO_2$ | carbon dioxide |
| $CO_2$-e | carbon dioxide equivalent |
| CPI | Consumer Price Index |
| CSIRO | Commonwealth Scientific and Industrial Research Organisation |
| GDP | gross domestic product |
| GHG | greenhouse gas |
| GPS | Gladstone Power Station |
| IAI | International Aluminium Institute |
| IPCC | Intergovernmental Panel on Climate Change |
| ISR | Industry, Science and Resources, Department of |
| J | joule(s) |
| m | million |
| NEM | National Electricity Market |
| NSW | New South Wales |
| PFC | perfluorocarbon |
| SECV | State Electricity Commission of Victoria |
| SUAL | Siberian-Urals Aluminium |
| t | tonne(s) |
| UK | United Kingdom of Great Britain and Northern Ireland |
| US/USA | United States of America |
| W | watt(s) |
| Wh | watt-hour(s) |
| WTO | World Trade Organization |

The following prefixes have been used with W, Wh, J and t (watt, watt-hour, joule and tonne) to denote larger quantities.

| | | |
|---|---|---|
| k | kilo- | $10^3$ |
| M | mega- | $10^6$ |
| G | giga- | $10^9$ |

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# Summary

The aluminium industry in Australia has been perhaps the most forceful opponent of policies to reduce greenhouse gas emissions, claiming that higher energy prices would damage its competitiveness and force it to move offshore. This paper analyses the structure, ownership, energy costs and greenhouse gas emissions of the aluminium smelting industry to examine the likelihood of it relocating and test the consequences, both economic and environmental, of such an outcome.

The smelting industry in Australia produced 1.76 million tonnes of aluminium in 2000, of which 1.42 million tonnes were exported. The revenue generated from exports was $3.9 billion, although the depreciation of the Australian dollar meant that the value of exports was unusually high in that year. The smelting industry provides 0.6 per cent of total manufacturing employment (or around 5,500 jobs) and contributes 1.3 per cent of the manufacturing sector's share of gross domestic product.

Smelters in Australia are located in NSW (Kurri Kurri and Tomago), Queensland (Boyne Island), Tasmania (Bell Bay) and Victoria (Point Henry and Portland) with a new smelter planned for Queensland, and expansions proposed in NSW and Queensland. The industry is almost entirely foreign-owned, with control exercised by parent companies in the United Kingdom, Japan, the USA, France and Germany. The smelting industry is dominated by Rio Tinto, Alcoa, Pechiney, VAW and a consortium of Japanese companies that are involved in smelters throughout the world.

The industry consumes over 25,000 gigawatt-hours (GWh) of electricity per year in Australia, or almost 15 per cent of all the electricity consumed in Australia. In addition, the industry consumes a small amount of natural gas and other fuels. The greenhouse gas emissions produced to satisfy this demand for energy are substantial. Further, smelters directly emit perfluorocarbons, themselves potent greenhouse gases, as well as carbon dioxide ($CO_2$). Overall, the activities of the aluminium smelting industry were responsible for greenhouse gas emissions in 1998-99 of around 27 Mt of $CO_2$-e, or around 5.9 per cent of Australia's total emissions (excluding land-use change).

Drawing on an extensive range of sources, this paper concludes that smelters in Australia pay, on average, around $21 per megawatt-hour (MWh) of electricity. The notable exceptions are Portland and Point Henry in Victoria, where the smelters pay closer to $14 per MWh. For other smelters, the best estimates are that Bell Bay pays at most $23 per MWh, Tomago $22 and Kurri Kurri closer to $27.

These prices are well below the market prices paid by other large industrial electricity customers with similar characteristics, and therefore represent subsidies. The Victorian smelters have been paying below-market prices for electricity equivalent to at least $110 million per year. This arrangement was secured in the early 1980s during the negotiations over the smelter and is locked in until 2016. In 1994, the Queensland Government sold the Gladstone Power Station to a Comalco-led consortium for around $400 million below its market value, enabling Comalco to either supply the Boyne Island smelter with electricity at below-market price or reap higher earnings on the power station investment. Although there is only scattered information available for other smelters, the annual subsidy to the industry in the form

of cheap electricity is estimated to be at least $210 million per annum (almost $40,000 per worker) and is probably in excess of $250 million.

In a competitive market, smelters would be expected to obtain cheaper power than many other business customers because they demand a continuous high-voltage base-load and often enter into take-or-pay contracts. They are also located reasonably close to generators (although the average distance is over 100 km in Australia). In estimating the extent of the subsidies to the smelting industry, these factors have been taken into account.

This is not to say that governments should avoid providing subsidies to industries that can provide a significant benefit to Australia over the long term. However, governments need to recognise, when assessing the overall benefits of providing assistance, that subsidising a highly polluting industry such as aluminium smelting will ultimately impose substantial costs on society. In the case of smelters, these costs include the environmental costs of climate change and the additional economic cost that other sectors of the economy will bear because they are required to undertake greater greenhouse gas abatement than would be the case in the absence of the smelting industry.

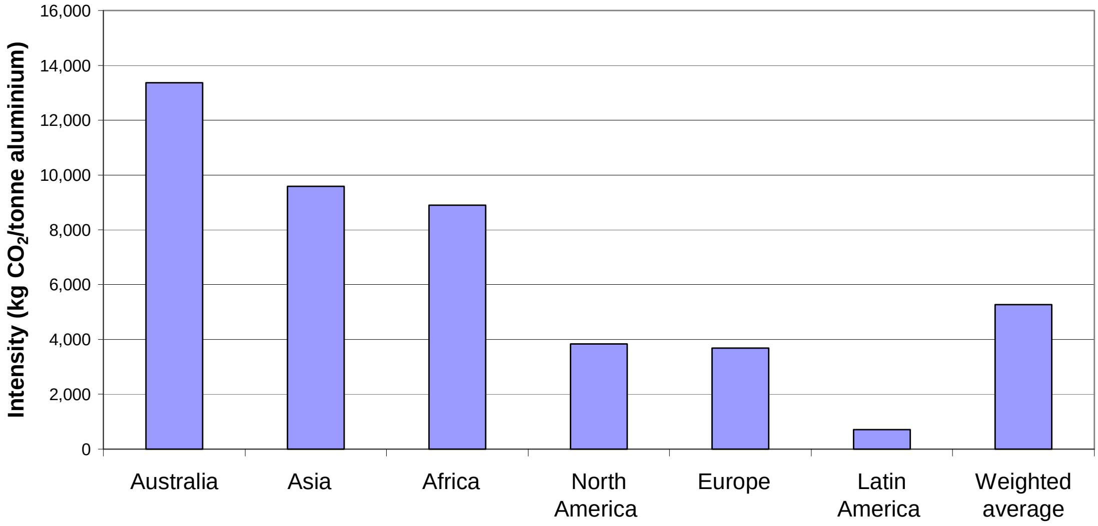
**The global industry**

The global aluminium smelting industry is dominated by a handful of companies. Only in those economies that have been largely closed to foreign investment (China, Eastern Europe and the former Soviet Union) do the major aluminium multinationals have little influence. The five largest players, Alcoa, Alcan, Pechiney, BHP-Billiton and Norsk Hydro, control 52 per cent of capacity outside China and former communist-bloc countries. The top ten companies control almost three-quarters of Western capacity. Ownership is even more highly concentrated in major aluminium-producing countries, where Alcoa and Alcan control around 40 per cent of production.

In each region, most smelters use a similar amount of electrical energy per unit of aluminium metal produced, and electricity costs typically constitute 20-30 per cent of production costs. Electricity prices therefore have an important influence on profitability. There is evidence that multinational smelting companies attempt to exercise undue power during negotiations with governments eager to promote industrial development in their country or region. A common negotiating tactic used by smelters is to threaten to relocate elsewhere or to withhold investment from a particular area if governments do not guarantee them low-priced power. Interestingly, in those countries that have been historically shielded from multinationals, electricity prices paid by smelters are significantly higher. The provision of cheap electricity to the aluminium smelting industry in Australia and other countries may constitute a form of subsidisation that can be challenged under the WTO Agreement on Subsidies and Countervailing Measures. There is at least one precedent of trade action being taken in response to a government-owned utility subsidising an industry with cheap electricity.

Unlike the Australian industry, which draws over 90 per cent of its electricity from coal-fired power stations, the global industry obtains electricity from a variety of

**Aluminium smelter greenhouse gas emissions from electricity use**




sources, with hydro predominating and coal contributing only 30 per cent. As a consequence, Australian production is the most greenhouse-intensive, followed by Asia, Africa, North America, Europe and Latin America. The smelting of aluminium in Australia produces around 2.5-times as much greenhouse gas from electricity generation per tonne of aluminium compared to the world average (see figure).

Accordingly, if greenhouse gas abatement policies in Australia were to lead to the relocation of the smelting industry to other parts of the world, global greenhouse gas emissions would be reduced. On average, each 125,000 tonnes of capacity that relocated from Australia would reduce global emissions by one million tonnes per annum, a fact that directly refutes claims by the Australian industry that going offshore would result in 'carbon leakage'.

However, it is unlikely that the Australian industry will shift or redirect investment to developing countries in response to greenhouse gas abatement policies because Australia has significant advantages, including low transport costs, political stability, excellent infrastructure, expertise, high-quality alumina, access to technology and a high tolerance of foreign investment, conditions which developing countries cannot match. In fact, a new aluminium smelter has recently been approved for Queensland, highlighting the divergence between the industry's claims and its actions. If the industry is to relocate or redirect investment from Australia, it will most likely be towards those countries endowed with similar advantages, which are also countries with abatement targets.

To summarise, the industry in Australia and throughout the world is dominated by a handful of multinationals that have obtained highly favourable arrangements from governments. The industry is very unlikely to relocate from Australia to developing countries because Australia has many advantages in addition to cheap energy. However, if the industry were to relocate, the global environment would benefit. Simultaneously, the Australian economy would also benefit because the subsidies to the industry, which are currently distorting investment allocation decisions, would be removed. Efforts to quarantine the aluminium industry in Australia from the impact of greenhouse gas abatement policies would impose higher costs on other economic sectors and be more costly overall.

# 1. Introduction[1]

The aluminium industry in Australia has been a vocal opponent of policy proposals to reduce greenhouse gas emissions from energy use and has continually sought to undermine the development of all but the most ineffective measures. Its constant refrain is that measures to restrict emissions will damage the industry's international competitiveness resulting in lost market share and a decline in Australian economic welfare.[2] The aluminium industry was one of the business groups to contribute $50,000 to gain a place on the Steering Committee for ABARE's MEGABARE model that was used to justify the Government's position in the preparation for the Kyoto conference. It is also a prominent member of the Australian Industry Greenhouse Network (AIGN), an industry lobby that has consistently sought to block or water down effective abatement policies.[3] The industry has continually relied on questionable research to make dubious claims about the impact of climate change policies, more recently suggesting that household energy and petrol costs could increase by more than 30 per cent if a strong Kyoto Protocol were adopted.[4]

Moreover, the industry has frequently threatened to direct investment offshore if governments introduce climate change policies that affect the industry's access to cheap electricity.[5] It has also argued that such a relocation of the industry would be environmentally damaging because smelters would move to countries with fewer environmental restrictions. Through its industry association, the Australian Aluminium Council (AAC), the industry consistently argues that it is of great economic importance to Australia, especially for the foreign exchange it earns. In the lead-up to the agreement to restrict greenhouse gas emissions at the Kyoto conference in November 1997 it was at the forefront of industry claims that mandatory targets would cause severe economic damage in Australia, and has produced dozens of media releases since then repeating this claim.

Interestingly, the members of the AAC include subsidiaries of a number of multinational aluminium companies, many of which have made statements in their home countries that reflect a much more responsible attitude to the need to restrict greenhouse gas emissions. For example, the USA-based Alcoa, which has operations in Australia, is committed to reducing direct greenhouse gas emissions to 25 per cent below 1990 baseline levels by 2010.[6] Alcoa and Rio Tinto (which owns Comalco) are prominent members of the Pew Center for Climate Change's Business Environmental Leadership Council, a high-level business group that accepts that climate change is a serious threat and supports measures to reduce greenhouse gas emissions.

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[1] Many thanks to Clive Hamilton, Hugh Saddler, John Young (Materials Efficiency Project), Andreas Missbach (Berne Declaration) and Geoff Evans (Mineral Policy Institute) for their suggestions and comments on a draft of this paper.

[2] For example, see Australian Aluminium Council website, www.aluminium.org.au. Of the 36 media releases on the website, 33 deal directly with climate change issues (as at 17 January 2002 and dating back to October 2000).

[3] For example, see AIGN submissions on efficiency standards and renewable energy (AIGN 1998) and the Kyoto Protocol (AIGN 2000).

[4] AAC 2001a. For a critique of the discredited economic research upon which the industry relies see Hamilton *et al.* 2001.

[5] See, for example, AAC 2000a

[6] See http://www.alcoa.com/site/community/ehs/ehs.asp. Importantly, this refers to direct emissions, so emissions from electricity obtained from outside Alcoa are not included in this target.

The various claims of the aluminium industry have not been seriously challenged, but *prima facie* there are doubts about the contribution of the industry, especially its smelting component, to Australia's economic welfare. The purpose of this analysis is to provide policy-makers and the public with an assessment of the legitimacy of these claims. Moreover, this paper examines whether Australia would be any worse off if the aluminium smelting industry carried through with its threat to relocate operations elsewhere.

The next section examines the aluminium smelting industry in Australia, including the location and scale of operations, smelter ownership and control, industry energy consumption and greenhouse gas emissions. It also assesses the favourable arrangements that smelters receive, particularly in relation to electricity prices. The political influence wielded by aluminium companies and the impact this has on the location and timing of smelter developments are also examined. Section 3 examines the world aluminium smelting industry, including location, scale, greenhouse gas emissions, electricity prices and market power. It also investigates the issue of 'carbon leakage' in response to greenhouse gas abatement policies by comparing greenhouse gas emissions per unit in various regions of the world, with a particular emphasis on the Australian industry's arguments about relocation.

The remainder of this section briefly describes how aluminium smelting produces greenhouse gas emissions.

*Aluminium and the environment*

The aluminium industry can be broken into four main areas of activity: bauxite mining, alumina refining, aluminium smelting and fabrication/semi-fabrication of final products. This study will focus on smelting, since this activity is extremely energy-intensive and consequently results in significant environmental impacts, particularly in terms of the emission of greenhouse gases.

Smelting involves electrolytically reducing alumina (aluminium oxide, $Al_2O_3$) to aluminium metal. Throughout the smelting industry this is carried out via the Hall-Heroult Process, which involves dissolving alumina in a bath of molten cryolite (sodium aluminium fluoride) and passing an electric current through the solution, via a carbon anode and carbon-lined metallic cathode. The net reaction is: $2Al_2O_3 + 3C \rightarrow 4Al + 3CO_2$.

In addition to consuming a large amount of electricity, which in Australia results in substantial greenhouse gas emissions, this process directly produces carbon dioxide ($CO_2$), the principal greenhouse gas. Moreover, under certain conditions, reactions between the carbon anode and the cryolite lead to the production of perfluorocarbons, including tetrafluoromethane ($CF_4$) and hexafluoroethane ($C_2F_6$), which are extremely potent greenhouse gases.

# 2. The Australian industry

## 2.1 Industry overview: Scale, exports and economic contribution

Australia is the world's largest producer of bauxite and alumina, accounting for 36 per cent and 30 per cent respectively of world production (ACIL 2000, p. 1). In 2000, Australia produced 53.8 million tonnes of bauxite and 15 million tonnes of alumina (AAC 2001). Only a small proportion of the bauxite, estimated at 5 million tonnes in 1998-99 (ACIL 2000, p. 8), is exported, with the remainder refined to alumina, of which 80 per cent is exported. Alumina and bauxite exports were valued at $4.14 billion and $145 million respectively in 2000 (AAC 2001). Table 1 presents an overview of the scale, exports and economic and employment contributions of the various activities that make up the aluminium industry.

Australia is also the world's fifth-largest producer of aluminium metal behind the USA, Russia, Canada and China, and the third-largest exporter (ACIL 2000, p. 23; see also Section 3 below). Australian production in 2000 was 1.76 million tonnes, of which 1.42 million tonnes were exported for $3.9 billion (AAC 2001). The remaining aluminium was fabricated into finished and semi-finished products for local use and export. Semi-fabricated product exports earned around $460 million in 1999-2000, and another $130 million was earned from the export of scrap (AAC 2001).

Export earnings were around 38 per cent higher in 2000 than in 1999. This was partly due to a fall in the value of the Australian dollar. For example, the Australian dollar value of aluminium metal exported increased by 33 per cent from 1999 to 2000, whereas the volume of metal exported increased by only 3 per cent (from AAC 2001) and the spot price of aluminium increased by around 14 per cent (LME 2001).

In sum, Australia is the world's major producer of bauxite and alumina and a major producer of aluminium metal. It is clear that the bauxite or alumina industries are not dependent on the domestic smelting industry for their viability.

Looking at the industry's contribution to employment and GDP, ACIL (2000) estimates that the entire Australian aluminium industry employed around 16,000 people at the end of June 1998 and generated value-added of around $3 billion during 1997-98. Of this, aluminium smelting accounts for around 34 per cent of total

**Table 1 Overview of the aluminium industry in Australia**

| **Product** | **Quantity produced (2000)** (million tonnes) | **Proportion exported** | **Exports (2000)** ($ billion) | **Industry value added (1997-98)** ($ million) | **Employ-ment (1997-98)** |
|---|---|---|---|---|---|
| Bauxite | 53.8 | <10% | 0.145 | 638 | 1662 |
| Alumina | 15.0 | ~80% | 4.142 | 1315 | 5650 |
| Aluminium | 1.76 | ~80% | 3.888 | 873 | 5462 |
| Products* | 0.475 | ~40% | 0.591 | 244 | 3314 |
| **Total** | | | **8.766** | **3070** | **16088** |

* Includes semi-fabricated, secondary aluminium and scrap.
Source: See text.

aluminium industry employment and 28 per cent of industry value-added (ACIL 2000, p. 28). Compared with the entire manufacturing industry, aluminium smelting comprises 0.6 per cent of employment and 1.3 per cent of value-added. Manufacturing itself represented about 11 per cent of total Australian employment at June 1998 (ABS 1999a, Table 1), indicating that smelting contributes around 0.06 per cent of total employment in Australia.

### 2.2 Smelting: Locations, history and scale

Following World War I there were several attempts to start an aluminium smelting industry in Australia, especially in the 1930s during a world-wide aluminium shortage. However, Alcoa in the USA refused to supply the technical expertise and it was the CSIRO's predecessor that led the development of the technology that was eventually used in Australia's first smelter at Bell Bay in Tasmania (Johnston *et al.*, 1996, pp. 110-113).

Australia now has six aluminium smelters, all of which are located in the eastern States. They are Tomago (commissioned in 1983) and Kurri Kurri (1969) in NSW, Portland (1986) and Point Henry (1963) in Victoria, Boyne Island (1982) in Queensland and Bell Bay (1955). All have been built in stages. Their current annual capacities are shown in Table 2.

Of the more recently developed smelters, the Tomago smelter in NSW was opened in 1983 and achieved full operation in 1984. A third potline (of 140,000 tonne capacity) was added in 1993 and expansion of Potlines 1 and 2 was completed 1998.[7] Construction of the Boyne Island smelter near Gladstone commenced in 1979, and was completed in 1982. Following the purchase of the Gladstone Power Station (GPS) by a Comalco-led consortium in 1994, the smelter was expanded, reaching its current capacity by 1997.[8] The first stage of the Portland smelter in Victoria opened in 1986 and the second in 1988.

**Table 2 Australian smelter capacities, 2001**

| **Smelter** | **Capacity (tonnes pa)** |
|---|---|
| Bell Bay | 142,000 |
| Boyne Island | 490,000 |
| Kurri Kurri | 150,000 |
| Point Henry | 185,000 |
| Portland | 345,000 |
| Tomago | 440,000 |
| **Total** | **1,752,000** |

Source: AAC 2001

VAW has indicated that it has plans to expand the Kurri Kurri smelter by around 100,000 tonnes per annum through the addition of a fourth potline, which will require an additional 200 MW of power.[9] Aldoga Aluminium Smelter Pty Ltd is proposing to build a 500,000 tonne per annum smelter in the Gladstone area costing an estimated $3 billion. This project will presumably require close to 900 MW of

[7] http://www.tomago.com.au/company/cohistory.html
[8] http://www.comalco.com.au/01_about/03_1990.htm#1994
[9] *Reuters News Service*, 28 February 2001

power.[10] Comalco (owned by Rio Tinto) is reported to be planning to upgrade the Boyne Island smelters to a capacity of around 700,000 tonnes (SKM 2001).

## 2.3 Industry ownership

The Australian aluminium smelting industry is owned largely by global corporations. Table 3 shows the direct ownership of each smelter. If these owners are controlled by other corporations, then details of those companies are also shown. The countries where the owners are based are also indicated.

Figure 1 illustrates ownership of Australian aluminium smelting capacity by country. Overall, the smelting industry in Australia is 78 per cent foreign-owned and is wholly foreign controlled. The only significant Australian holdings are those of WMC and CSR, which own collectively around 15 per cent of total capacity. Recent reports indicate that WMC may sell its share of Alcoa World Alumina and Chemicals (AWAC), including its share of Alcoa World Alumina - Australia (AWA - Australia),

**Table 3 Ownership of Australian smelters, 2001**

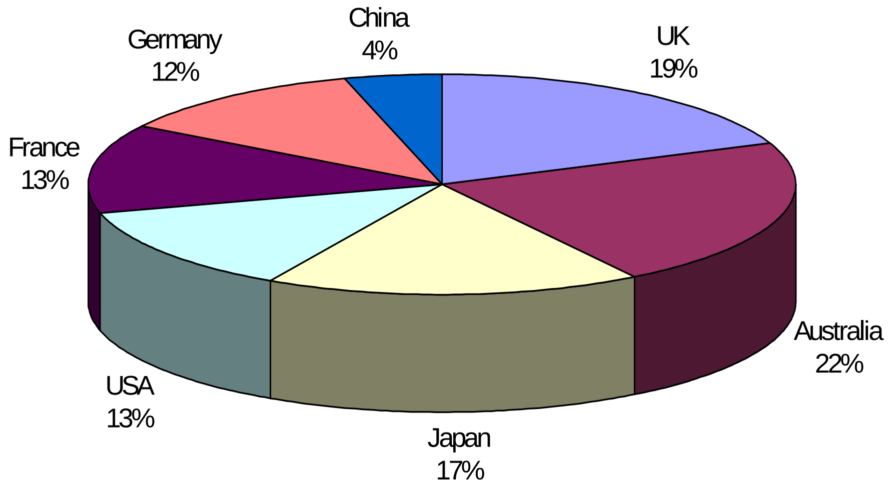
| Smelter | Capacity (tonnes pa) | Owners | Parent companies | Country |
|---|---|---|---|---|
| Bell Bay | 142,000 | Comalco Aluminium Ltd (100%) | Rio Tinto (100%) | UK# (80.1%) |
| Boyne Island | 490,000 | Comalco Aluminium Ltd (54.2%) | Rio Tinto (100%) | UK# (80.1%) |
| | | Sumitomo Light Metal Corp (17%) | | Japan |
| | | Mitsubishi Corp. (11.6%) | | Japan |
| | | Yoshida Kogyo (9.5%) | | Japan |
| | | Sumitomo Chemical Co. (2.5%) | | Japan |
| | | Kobe Aluminium (5.2%) | | Japan |
| Kurri Kurri | 150,000 | VAW (100%) | | Germany |
| Point Henry | 185,000 | AWA - Australia (100%) | Alcoa (60%) | USA |
| | | | WMC (39.25%) | Aust (98.6%) |
| Portland | 345,000 | AWA - Australia (55%) | Alcoa (60%) | USA |
| | | | WMC (39.25%) | Aust (98.6%) |
| | | CITIC Nominees Pty Ltd (22.5%) | | China |
| | | Marubeni Aluminium Australia Pty Ltd (22.5%) | | Japan |
| Tomago | 440,000 | Pechiney Pacific (36.05%) | | France |
| | | TOA (AMP) (15.5%)* | Pechiney (100%) | France |
| | | Gove Aluminium (36.05%) | CSR (70%) | Aust |
| | | | AMP (30%) | Aust |
| | | VAW Tomago (6.2%) | | Germany |
| | | VAW Australia (6.2%) | | Germany |

* On 3rd October 2000 Pechiney and AMP announced that they had entered into an irrevocable agreement for AMP to sell its direct holding in Tomago to Pechiney in around 12 months from the date of announcement (Pechiney 2000). Accordingly, the AMP stake is listed as being controlled by Pechiney.
# The Rio Tinto Group is made up of Rio Tinto plc in the UK and Rio Tinto Ltd in Australia. Rio Tinto plc accounts for 68 per cent of the combined equity and Rio Tinto plc also owns around 38 per cent of Rio Tinto Ltd (Rio Tinto 2001, pp. 130-131), giving Rio Tinto plc effectively 80 per cent of equity for economic purposes and 77 per cent of voting rights (Rio Tinto 2001, pp. 62-3).

Source: AAC 2001, Aluminium smelting, http://www.aluminium.org.au/Smelter.html; Alcoa 2001, p. 11; Rio Tinto 2001, pp. 62, 130-131; Pechiney 2000; Australia Institute 1999

[10] *Australian Financial Review*, 8 February 2001, pp. 1,10

**Figure 1 Ownership of Australia's primary aluminium capacity, 2001**




to Alcoa.[11] Should the sale proceed, the level of foreign ownership of the Australian smelting industry will increase to around 87 per cent.

The multinational dominance of the Australian smelting industry can be traced back to the 1960s when a number of international companies took an interest in Australia because of the willingness of Australian governments to accept high levels of foreign ownership (Johnston *et al.*, 1996, pp. 110-113).

## 2.4 Energy use

Aluminium smelting is an energy-intensive activity, with electricity purchases accounting for around 21 per cent of production costs (Industry Commission 1998, pp. 26-27). There are a number of different ways to estimate the Australian industry's total energy consumption and energy intensity. The simplest is to examine the capacities, production and power demand of Australian smelters and apply assumptions to convert this to energy consumption. Table 4 lists the Australian smelters and provides an indication of the power demand or contracted power for each (and information on electricity supplier where available). Some simple assumptions have been applied to convert this to energy consumption and determine energy intensity, and it is calculated that Australian smelters consume an average of 15.2 megawatt-hours (MWh) of electricity per tonne of aluminium produced.

An alternative source of energy use and intensity information is the International Aluminium Institute (IAI), which surveys the industry worldwide. The IAI estimates that aluminium smelters in the Oceania region (which includes the six smelters located in Australia and one smelter in New Zealand) consumed on average 14.85 MWh per tonne of aluminium produced in 1999 (IAI 2000a). Other IAI data show

[11] *Australian Financial Review*, 12 October 2001, pp. 1,63; *Australian Financial Review*, 13 October 2001

**Table 4 Smelter power demand**

| Smelter | Capacity (tonnes pa) | Power demand (MW) | Supplier |
|---|---|---|---|
| Bell Bay | 142,000 | 256 | Hydro Tasmania |
| Boyne Island | 490,000 | 800 | GPS |
| Kurri Kurri | 150,000 | 300[#] | Delta Electricity |
| Point Henry | 185,000 | ~360 | SECV + Anglesea |
| Portland | 345,000 | 520 + 120 | SECV |
| Tomago | 440,000 | 690 | Macquarie Generation |
| **Total** | **1,752,000** | **3045** | |
| | | **Energy consumption (GWh)** | **Energy intensity (MWh/tonne)** |
| Total | 1,752,000* | 26,700* | 15.2 |

* Based on smelters operating at full capacity.
# Kurri Kurri smelter power demand has been estimated based on similar smelters.

Source: Bell Bay (http://www.comalco.com.au/05_operations/05_bellbay.htm)
Boyne Island (http://www.comalco.com.au/05_operations/06_boyneisland.htm)
Kurri Kurri (Personal communication, VAW Australia)
Point Henry (Victorian Auditor-General's Office 1998, Section 8.98)
Portland (Victorian Auditor-General's Office 1998, Section 8.98)
Tomago (http://www.tomago.com.au/company/technical.html)

that in 1998 Oceania smelters consumed 30,400 GWh and produced 1,934,000 tonnes, indicating an intensity of 15.7 MWh/tonne (IAI 2000a, 2000b).[12]

As a best estimate, 15 MWh of electricity is consumed in the production of each tonne of aluminium metal (from alumina). Based on 1998-99 production of 1.69 million tonnes of aluminium, the industry consumed a little over 25,000 GWh of electricity in that year. This estimate is consistent with figures from the Australian Bureau of Agricultural and Resource Economics (ABARE), which regularly surveys Australian industry to estimate energy use by different economic sectors. Energy consumption by the aluminium smelting industry is included within estimates of use by the non-ferrous metal manufacturing sectors (ANZSIC 272-273),[13] which was estimated to have consumed 30,400 GWh net in 1998-99 (Bush *et al.* 1999, p. 121). This is consistent with the above estimate of 25,000 GWh, particularly as smelting and alumina refining dominate energy use for these combined sectors.[14]

The Department of Industry, Science and Resources (ISR 2000, p. 11) has estimated the consumption of all fuels in aluminium smelting. They estimate 1998 total energy use at 78.4 GJ/tonne, of which 52 GJ/tonne represents electricity used in the

[12] Closer inspection of the IAI data reveals that 1999 electricity consumption for Oceania was 30,427 GWh (based on reported consumption of 2,048,655 tonnes production and 14.852 MWh/tonne), which is identical to the consumption they report for 1998. This surprising coincidence indicates there may be some small errors in the IAI data.
[13] Which also include the following: alumina refining; copper, zinc, silver and lead smelting and refining; other non-ferrous metal manufacture; and, all non-ferrous metal extruding, rolling, drawing and casting.
[14] For example, it is estimated that in 1998-99 alumina refining consumed 113.2 PJ of natural gas, and smelting 3.6 PJ (ACIL 2000, p. 33), compared with total sector consumption of 119.3 PJ projected by ABARE for 1998-99 (Bush et al. 1999, p. 121).

electrolytic process and 18.6 GJ/tonne consumed in anodes. The remaining 7.8 GJ/tonne is made up of around 3.7 GJ/tonne of electricity, 3.8 GJ/tonne of gas and 0.2 GJ/tonne of petroleum products and coal (ISR 2000, p.11). For comparison, total electricity consumption of 55.7 GJ/tonne is equivalent to 15.5 MWh/tonne, conforming closely to the above estimates of 15 MWh/tonne.

## 2.5 Greenhouse gas emissions

As discussed above in Section 1, aluminium smelting produces greenhouse gas emissions directly from the oxidation of carbon anodes and from perfluorocarbon (principally $CF_4$ and $C_2F_6$) emissions. The above analysis indicates that to this can be added emissions from direct fuel combustion (mainly natural gas) and the emissions associated with the production of the 15 MWh of electricity required for each tonne of aluminium produced.

The greenhouse gas emissions from electricity generation depend principally on the fuel used. So the question to be resolved is what fuel to assume when calculating the greenhouse gas emissions from electricity produced for aluminium smelting. Based on the supply contracts (suppliers were listed in Table 4 and contracts are discussed in more detail in Section 2.7), the smelting industry obtains power from brown coal fired electricity generation in Victoria, black coal generation in NSW and Queensland and hydroelectric generation in Tasmania. Accordingly, one approach would be to calculate greenhouse gas emissions on the basis of these fuels. However, the issue is somewhat more complicated if one wishes to determine the net contribution of the industry, i.e. by how much does the industry increase Australia's emissions from electricity generation? Returning to the fuel sources used, the hydroelectric and brown coal fired generation have the lowest marginal cost (for comparison of fossil fuel fired generation see Naughten 2000, p. 5), so in the absence of the smelters these low cost generators would sell their spare power elsewhere in the National Electricity Market (NEM) and displace higher-cost generators. Considering the size of the block of brown coal power used by Victorian smelters (~1000 MW), the high-cost generators displaced would be predominantly black coal fired. Tasmania's hydroelectric generation is a special case where spare capacity might not displace fossil fuel generation. However, the absence of the Bell Bay smelter would obviate any need to operate the Bell Bay oil-fired power station (which is operated at times when hydroelectric dam water levels are low). Accordingly, to account for the net contribution of the mainland smelters to greenhouse gas emissions from electricity generation, an emission factor of 1 tonne of $CO_2$/MWh has been used, which roughly approximates the emission factor for marginal black coal generation.[15] For Tasmania, an emission factor of zero has been used.

Table 5 shows that in 1998-99, total greenhouse gas emissions from aluminium smelting in Australia were approximately 27 Mt $CO_2$-e. This equals 5.9 per cent of Australia's total emission in 1998-99 (excluding land-use change),[16] or 7.2 per cent of

[15] In 1998-99, total black coal generation was 104 TWh (ESAA 2000) and total carbon dioxide emissions from black coal electricity and heat production were 98 Mt (AGO 2001a, p. B-76), indicating an average emission factor of 0.94 tonnes $CO_2$/MWh. However, it is expected that marginal black coal fired generation (which is less efficient) will have a slightly higher emission factor.

[16] Or 5.1 per cent including land-use change.

**Table 5 Greenhouse gas emissions from the Australian smelting industry, 1998-99**

| | Indirect emissions | | Direct emissions | | | | |
|---|---|---|---|---|---|---|---|
| Production (tonnes) | Electricity consumed (GWh) | Electricity emissions (kt $CO_2$) | Other energy use (kt $CO_2$) | Oxidation of anodes (kt $CO_2$) | PFCs (tonnes)[#] | PFCs (kt $CO_2$-e) | Total (kt $CO_2$-e) |
| 1,686,000 | 25,290* | 23,050[§] | 330 (gas)<br>25 (other)[¶] | 2551 | 135($CF_4$)<br>13.5 ($C_2F_6$) | 1,002 | ~26,950 |

* Based on 15 MWh per tonne. Of the total, 2,240 GWh is assumed to be hydroelectricity consumed by the Bell Bay smelter. Electricity consumption by aluminium smelters accounts for almost 15% of total consumption (Bush *et al.* 1999, p. 99).
§ For smelters operating in the National Electricity Market, an electricity emission co-efficient of 1 tonne $CO_2$/MWh has been assumed. Although Portland and Point Henry smelters obtain their power from brown coal generation, which has a substantially higher emission coefficient, this approach is designed to incorporate the effective coefficient based on marginal generation – that is, because brown coal generators have lower marginal costs (Naughten 2000, p. 5) they will tend to displace higher cost black coal generation in the NEM and any changes to the demand of Portland and Point Henry will flow through to other generators.
¶ For the 0.2 GJ of petroleum and coal products consumed per tonne of aluminium (Section 2.4), emissions have been estimated conservatively by using the emission factor for LPG.
# Global Warming Potential (GWP) of $CF_4$ = 6500, $C_2F_6$ = 9200. Note, the figures in Table 5 take account of changes to pot design and smelter management and a shift to less PFC-intensive smelters that have already reduced annual PFC emissions by around 3.8 Mt $CO_2$-e compared to 1989-90 levels (AGO 2001b, p. 67).

Source: Section 2.4; AGO 2001a, pp. B-116-7; ISR 2000, p.18

energy and industrial emissions.[17] The aluminium industry itself reports higher total smelting emissions of 30.9 Mt of $CO_2$-e in 1999, of which 4.1 Mt was direct emissions and 26.8 Mt from electricity production (AAC 2000b). For reasons described above, the industry's figure for emissions from electricity production does not reflect the marginal impact of the smelting industry on total electricity sector emissions.

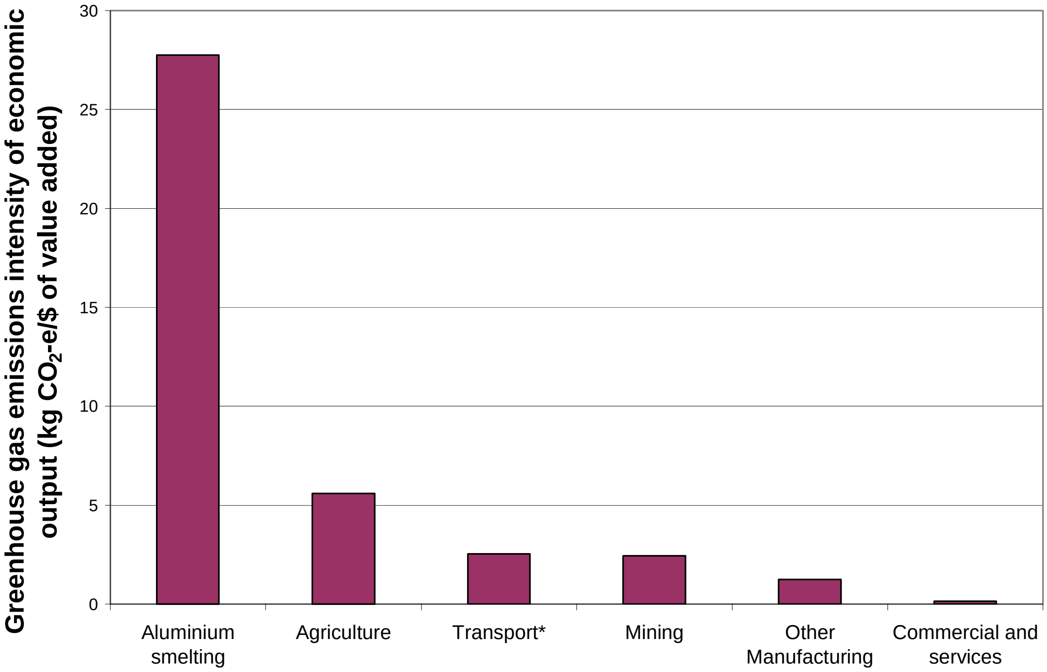
Aluminium smelting is responsible for almost 6 per cent of Australia's greenhouse gas emissions partly because it is a reasonably significant industry, contributing 1.3 per cent of GDP from manufacturing (see Section 2.1), but mainly because it is greenhouse gas intensive. Figure 2 shows the relative greenhouse gas intensities per dollar of value-added for various industries (accounting for direct and indirect emissions, but not emissions embodied in intermediate inputs). Per dollar contributed to GDP, aluminium smelting produces 5 times as much greenhouse gas as agriculture, 11 times as much as mining and 22 times as much as other manufacturing activities.

## 2.6 Electricity costs and prices for the smelting industry

Two key inputs for aluminium smelting are alumina and electricity. In Australia, these two inputs accounted for 29 per cent and 21 per cent of total operating costs respectively in 1996-97 (ACIL 2000, pp. 19-20). Alumina is an internationally traded commodity, for which accurate price information is readily available (although prices will vary in long-term contracts). By contrast, the actual prices paid by aluminium smelters for electricity are a closely kept secret. However, there are enough pieces of information available to build a reasonably accurate picture.

[17] That is, excluding agriculture, land-use change and forestry and waste.

**Figure 2 Greenhouse gas intensity of various sectors, 1998-99**




* A large proportion of transport emissions arise from private vehicle use, which does not value-add. Transport emissions include those from international air and sea transport.

Source: Bush *et al.* 1999, p. 99; ABS 2000, p. 54; ABS 1999b, p. 56; ACIL 2000, p. 31; AGO 2001a, pp. A-5, B-116-7

It is possible to estimate electricity costs using the cost breakdown information above, combined with the actual price of alumina. The world price of alumina in 1996-97 was $236/tonne (WA DME 2000). Approximately two tonnes of alumina are required for the production of one tonne of aluminium, depending on the efficiency of the operation.[18] Using a range of 1.9-2.0 tonnes of alumina per tonne of aluminium, alumina accounts for between $448 and $472 of the production costs per tonne. As mentioned above, alumina accounts for 29 per cent of costs, while electricity accounts for 21 per cent. On the basis of this cost breakdown, electricity costs were $324-342/tonne. As discussed in Section 2.4, around 15 MWh of electricity is required per tonne of aluminium, indicating that Australian smelters paid on average $21.60-22.80 per MWh in 1996-97.[19]

An alternative approach to determine electricity prices paid by the smelting industry is to examine estimates of total cost. It was estimated that in 1997 average total operating costs for the Australian industry were US$1100 per tonne (Bird 1997 in Industry Commission 1998, p. 37). If electricity accounts for 21 per cent of the total

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[18] With 100 per cent conversion, 1.89 tonnes of alumina are required to produce each tonne of aluminium. In reality, the amount will be slightly higher – for example, Tomago indicates consumption of 1.92 tonnes of alumina per tonne of aluminium metal produced (http://www.tomago .com.au/company/technical.html).

[19] Because many smelters do not obtain alumina on the open market, but rather through long-term contracts, prices paid by smelters will vary in the short-term from spot prices.

operating costs, then electricity costs were equal to US$231 per tonne or US$15.40/MWh, equivalent to A$20.80 per MWh in 1997.[20]

The most recent estimate of smelting industry energy costs has been produced by the Department of Industry, Science and Resources (ISR). It estimates that total energy costs in 1998 were $520 million, excluding the cost of coke and liquid pitch for anodes, or $320/tonne of aluminium produced (ISR 2000, pp. 7, 18). This indicates that smelters paid at most $21/MWh for electricity in 1998.[21]

The estimates using the above approaches are consistent with other available information. For example, while noting that the price paid for electricity 'is not publicly available', the Industry Commission confirms common knowledge in the electricity industry that smelters receive cheaper power than similar large industrial consumers (IC 1998, p. 69). A 1992 ABARE study into the aluminium industry concluded that in 1991 electricity prices for aluminium producers 'in Australia are around the world average in the range US1.6-2.1c/kWh' (ABARE 1992, p. 28). Accordingly, the ABARE report suggests Australian prices were paying between $20 and $27/MWh in 1991.[22] Since smelters typically operate under long-term contracts it is reasonable to assume similar, if not lower, prices are paid now.

Other information confirms the above range of prices for at least one Australian smelter. A 1997 study by ING Barings compared the electricity costs for the Bell Bay smelter with the costs paid by a number of other smelters around the world (ING Barings 2000, Figure 12). Per tonne of aluminium produced, Bell Bay was estimated to pay US$258 for electricity, which was more than was paid by the smelters studied in Bahrain, Cameroon and France, but less than the amount paid in Canada, Germany, the USA and Eastern Europe. With an efficiency of 15 MWh/tonne of aluminium, Bell Bay was paying around A$23/MWh in 1997.[23]

## 2.7 Subsidies

The Industry Commission has confirmed that smelters receive cheaper electricity than similar large industrial consumers (IC 1998, p. 69). The question then arises as to how these lower prices are sustained in a competitive market and whether they represent a subsidy to the industry. Cheap electricity represents a subsidy if the prices are below those that would be paid in a freely competitive market, where electricity suppliers charge prices that reflect long-run marginal costs. Generally, lower prices are locked in by long-term contracts, often covering 20 to 30 year periods, and have come about through agreements with State governments seeking to attract new aluminium smelters with low-priced electricity (see discussion below). On the other

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[20] The average exchange rate in 1997 was US0.74cents/A$ (US Federal Reserve 2001).

[21] Assuming that electricity accounted for all energy costs. However, ACIL has estimated that electricity accounts for around 21 per cent of total costs and other fuels for approximately 1 per cent (ACIL 2000, p. 20), suggesting that ISR's estimate of the $320/tonne in total energy costs is made up of electricity costs of around $305/tonne. This equates to an electricity price of close to $20/MWh.

[22] The Australian dollar was worth on average 78 US cents during 1991 (US Federal Reserve 2001).

[23] Being an older smelter, the energy intensity figure would be somewhat higher. The impact of an efficiency of 18 MWh/tonne, for example, implies an electricity price of less than A$20/MWh (as discussed above, the average exchange rate in 1997 was 0.74 US$/A$).

hand, the former head of the Australian Aluminium Council, addressing a Senate committee, justified the low prices in the following way:

> For the electricity market to be efficient…electricity prices must not be related to cost of production – that is not the way business operates anywhere now – but rather related to what the market will bear by competitive market forces. (David Coutts in SECITA 2000, p. 161)

This statement is contradictory. Any basic economics text will point out that, in a competitive market, prices are related to the marginal costs of production (for example, see Jackson *et al.* 1999, pp. 26:10-11). Only in instances of excessive market power is the price related to what the market will bear. The only conclusion that can be drawn from this statement is that the AAC believes that the electricity industry operates at its best when being manipulated by a monopsonistic aluminium smelting industry.[24]

Of course, the issue is slightly more complicated. In most cases the industry approached state governments with proposals for aluminium smelters, arguing that supporting a new smelter would promote regional development (this is revisited below). In these situations, governments are vulnerable and sometimes fail to make the best long-term decisions, particularly where commercial arrangements can be hidden behind the veil of 'commercial-in-confidence' (Baragwanth and Howe 2000, pp. vi-vii). At the same time, state governments had built overcapacity in the electricity generation industry (Booth 2000) that created a situation ripe for exploitation by the aluminium industry, particularly where jurisdictions were competing for smelter developments.

*Calculation of actual prices and subsidies*

VICTORIA

Direct confirmation of the prices paid for electricity is available only for the Victorian smelters. The State Electricity Commission of Victoria (SECV) (which is now the shell of the organisation that ran the Victorian electricity industry before privatisation) supplies electricity to the Portland and Point Henry smelters under a flexible tariff contract established by the Cain Labor Government in 1984 and running to 2016.[25] Former Victorian Treasurer Alan Stockdale described the contracts as 'manifestly unjust' (Stockdale 1995, p. 3) and the Victorian Department of Treasury and Finance agreed, describing them as 'onerous and unfavourable' (Department of Treasury & Finance 1997, p. 19). These arrangements were 'costing the Government over $200

[24] Although electricity generators have other customers, there are few of the scale of the aluminium industry. More to the point, most of the electricity supply contracts were signed with state governments before the introduction of the NEM and competition.

[25] The electricity supply contract for the Portland and Point Henry smelters is made up of a number of parts. These comprise the supply of 520 MW to Portland, the supply of up to 375 MW to Point Henry and a supplementary agreement to supply up to an additional 120 MW to Portland. When negotiating in 1997 the supply of the additional 120 MW, the government secured 'full pass-through of all costs, expense and liabilities associated with the provision of this supply,' (Victorian Auditor-General's Office 1998, Section 8.103) effectively meaning that the Portland smelter pays a market price for this 120 MW. In relation to Point Henry, the 160 MW Anglesea power station (owned by AWA - Australia, which is owned by Alcoa and WMC) supplies approximately 40 per cent of the smelter's power needs, and it appears that the SECV in practice supplies around 200 MW (see discussion below).

million per year' in 1997, with the actual amount being around $188 million in 1998-99 (Department of Treasury & Finance 1997, p. 19; Victorian Auditor-General's Office 1999, Section 7.67). Effectively, the SECV operates as a loss-making middleman between the generator and smelters, with the loss funded partly from other electricity customers and partly from the Victorian budget.[26] The Auditor-General has estimated in 2000 that the net present value of Victoria's liabilities under this pricing contract amounts to $1.3 billion (Victorian Auditor-General's Office 2000, Table 7J).[27]

The flexible tariff arrangement agreed between Alcoa and the Cain Government in 1984 was intended to cover 'the cost of generating and transmitting power to the Portland smelter and [earn] a real rate of return of four per cent on the replacement value of the relevant SECV assets used to generate and transmit power to the site' (State of Victoria 1984, p. 26).[28] The tariff consisted of an operating and maintenance cost component as well as a capital cost component that varied according to the world aluminium price. The intended return was based on an aluminium price per tonne of US$1700 at 1982 prices, around which the actual tariff was expected to fluctuate over the 30-year course of the contract. Simultaneously, the Victorian Government entered into an arrangement with the SECV where the government 'bears the short-term cost and receives the short-term benefit arising from deviations of the actual tariff from the base tariff' (State of Victoria 1984, p. 30).[29]

World aluminium prices have fallen in real terms to such an extent that the Portland and Point Henry smelters now rarely pay any part of the capital cost component of the flexible tariff,[30] costing the government around $200 million per year by 1997 in payments to the SECV (Department of Treasury and Finance 1997, p. 16). In April 1998, Treasurer Stockdale issued a directive that suspended the arrangement by which the Treasury reimbursed the SECV for differences between the amounts received from the smelters and the amount that would have been received under the base tariff (SECV 1998, p. 22), effectively transferring the liability for the smelter contracts to the SECV.

The SECV currently obtains electricity supplied to Portland and Point Henry from the pool, but has a contract with Edison Mission Energy Australia (EME), owner of Loy Yang B, to 'hedge the cost of energy for a load equivalent to that supplied by the SECV to aluminium producers from the year 2001 to 2016, at $23.95 per megawatt

[26] The Victorian Auditor-General continues to describe these contracts as 'onerous' (Victorian Auditor-General's Office 1999, Section 7.102). Alcoa is in the process of negotiating a power interruptibility agreement with the SECV (Alcoa 2001, p. 11), allowing Portland and Point Henry to effectively sell the power obtained at very low prices back into the grid during periods of peak demand (and high prices). The SECV and the smelters are expected to share the profits generated from this practice.
[27] The SECV collects a 'smelter reduction amount levy' payable by wholesale electricity market participants. The most recent estimate of the net present value of future levy payments is $1.2 billion, covering most of the future liabilities associated with the smelter contracts (SECV 2001, p. 16). Effectively, other electricity consumers are subsidising the Point Henry and Portland smelters.
[28] The same principle was adopted for the electricity tariff for the Point Henry smelter (State of Victoria 1984, p. 26).
[29] That is, the Victorian Treasury and the SECV entered into an electricity hedge contract at a price based on the expected tariff at US$1700 (in 1982 prices) per tonne of aluminium.
[30] Below an aluminium price of US$936 in 1982 dollars (over US$1700 in 2001 terms, US BLS 2002) the capital cost component is reduced to zero (State of Victoria 1984, p. 28). The actual price in 2000-01 was around US$1550 per tonne (LME 2001).

hour' (Victorian Auditor-General's Office 1998, Paragraph 4.57). EME has indicated that this hedge covers approximately 77-79 per cent of the output of Loy Yang B (or 720 MW)[31] until 2014, at which time the supply contract with Point Henry ends, and 56-57 per cent of the output from 2014 to 2016 (EME 2001, p. 11, EME 1997). This latter amount corresponds to the 520 MW supplied to Portland (Victorian Auditor-General's Office 1999, Paragraph 8.98), indicating that the load supplied by the SECV to Point Henry is only 200 MW. The remainder of Point Henry's power needs are supplied by the 160 MW Anglesea power station, which is owned by AWA - Australia (Alcoa 2001, p. 11).

Table 6 summarises the loss made by the SECV as a result of the contracts with the aluminium smelters for 1996-97 to 2001-02 and calculates the loss per MWh based on supplying 720 MW at full capacity to the smelters. Although the SECV purchases electricity from the pool, prior to 1 January 2001 it managed its exposure to the electricity spot market under vesting contracts. From 1 January 2001 onwards this

**Table 6 Loss on the sale of electricity to the Victorian smelters**

| Year | Loss on sale to smelters ($ million) | Loss per MWh (assuming 6300 GWh of electricity)* ($/MWh) |
|---|---|---|
| 1996-97 | 175 | 27.7 |
| 1997-98 | 180 | 28.5 |
| 1998-99 | 188 | 29.8 |
| 1999-00 | 168[a] | 26.6 |
| 2000-01 | 150[b] | 23.8 |
| 2001-02 | 110[b#] | 17.4 |

a. The loss was somewhat lower in this year because for a period of a little over two months from late December 1999 to March 2000 the US$ spot price of aluminium exceeded the level above which the smelters are required to pay some of the capital cost component of the tariff. The highest price reached during this period was US$1745 (or around US$1030 in 1982 dollars) (LME 2001; US BLS 2002). This resulted in the smelters paying a very small percentage of the capital cost component of the tariff.
b. The SECV purchases the electricity supplied to Portland and Point Henry from the pool. However, prior to 1 January 2001 the SECV managed its exposure to the electricity spot market under vesting contracts. From 1 January 2001 onwards this exposure is managed through the hedging arrangements with EME (NECA 2001, Schedule 9A2 Clause 6.2). Shifting from vesting contracts to the hedge resulted in a substantial decline in the SECV's loss on selling electricity to the smelters.
# In 2000-01 the SECV made a discounted current provision of $103.8 million for losses under the 'onerous' electricity supply contracts in 2001-02 (SECV 2001, pp. 16, 19). Based on the discount rate employed in 2000-01 (5.87 %), this equates to an undiscounted net loss in 2001-02 of $110 million.
* By assuming this level of consumption (which is 100% of capacity) the loss per MWh is reduced and the price paid by the smelters is increased, i.e. it is more conservative.

Source: Victorian Auditor-General's Office 1998, Section 8.94; Victorian Auditor-General's Office 1999, Section 7.102; Victorian Auditor-General's Office 2000, Section 7.102; SECV 2000, p. 17; SECV 2001, p. 16

[31] Loy Yang B is rated at 1000 MW (although some analysts have indicated that it regularly runs at 1080 MW, Booth 2000, p. 71). However, EME has indicated for the purpose of the contracts that it expects the entire output of Loy Yang B to be equivalent to 920 MW, indicating that EME expect the power station to operate at 92 per cent capacity, after own use and losses (EME 2001, p. 11; Victorian Auditor-General's Office 1998, Para 4.57).

exposure was managed through the hedging arrangements with EME (NECA 2001, Schedule 9A2 Clause 6.2). Table 6 clearly shows that the hedge contract has significantly reduced the effective loss per MWh and hence the price at which the SECV is obtaining electricity.[32]

The mere fact that the SECV makes a loss does not necessarily mean there is a subsidy to the smelters (particularly as the loss has varied significantly in recent years).[33] However, a subsidy exists when the market price of electricity is greater than the price paid by the smelters. An unsubsidised, or market, price for electricity supplied to the Portland and Point Henry smelters can be calculated from the following information. In May 1997, to control future liabilities, SECV entered into a long-term hedge contract with Edison Mission Energy Australia Limited (the owner of Loy Yang B) for the supply of power to the Victorian aluminium smelters at $23.95/MWh for 2001-2016. SECV negotiated for 'a load equivalent to that supplied…to the aluminium [smelters]' (Victorian Auditor-General's Office 1998, Section 8.95) and it is reasonable to assume that a smelter negotiating on its own behalf would have achieved a similar price with a private generator.[34] To this can be added the costs of transmission that would be paid in a competitive market, a cost that is currently paid by the SECV for electricity supplied to the smelters. The regulated transmission use of system (TUOS) charges are estimated to be around $9/MWh for Portland and $7 for Point Henry (VENCorp 2000). This indicates that an unsubsidised price would be about $33/MWh for supply of Portland and slightly less for Point Henry. From January 2001 the SECV has been paying these market prices. Accordingly, the net subsidy is equal to the loss the SECV is anticipating for 2001-02, which is $110 million or around $17.50/MWh. The overall smelter electricity supply arrangements are summarised in Figure 3.[35]

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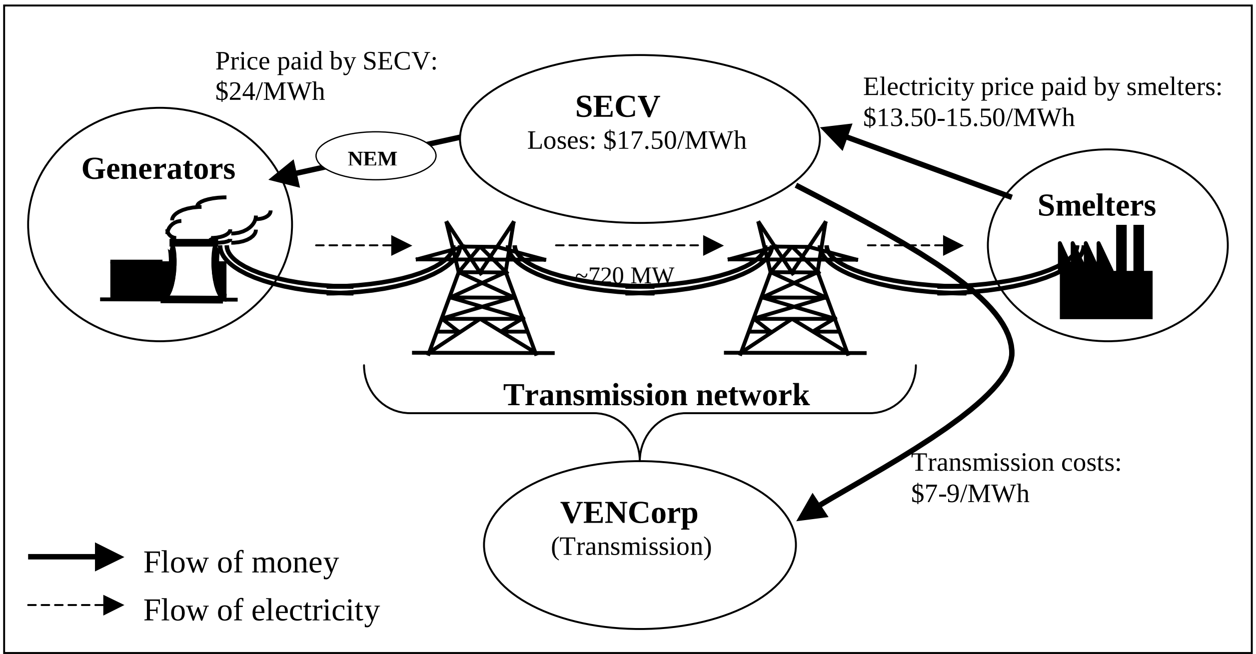
[32] The operating and maintenance cost component of the flexible tariff is increasing at a rate no greater than CPI (State of Victoria 1984, Table 4.8). Accordingly, this means that most of the decrease in the SECV's loss per MWh is attributable to the SECV paying lower prices for its electricity.

[33] Until at least the end of 1998, the losses made by the government and the SECV were based on the difference between the base tariff in the 1984 contract and the actual tariff paid by the smelters. The electricity tariff arrangements in the 1984 contract between the SECV and Alcoa were developed according to the principle that there was 'no electricity subsidy to or from the project' (State of Victoria 1984, p. 26). Consistent with this principle, the long run marginal cost of generation at Loy Yang (A&B) was used to determine the tariff. This leads to the conclusion that the losses experienced by the SECV represented a subsidy to the smelters. However, at the time the contracts were made the generation sector in Victoria was relatively inefficient compared with current practice. For example, it was assumed that plant availability would be 75 per cent and in-station losses would be around 10 per cent (State of Victoria 1984, p. 40). The introduction of competition resulted in significant cost savings and improvements in performance in the generation sector (Booth 2000, p. 88), reducing the long run marginal costs of generation and the unsubsidised price of power.

[34] This hedge was entered into when Edison Mission Energy was negotiating the purchase of the remaining 49 per cent of the Loy Yang B power station from the Victorian government (Victorian Auditor-General's Office 1997, Section 4.57). Accordingly, Edison Mission may have offered a favourable arrangement to secure the remainder of Loy Yang B at an attractive price, indicating that the $23.95/MWh may be below what a smelter could secure in a competitive market.

[35] Although not central to the discussion of subsidies, it should also be noted that the SECV has apparently also agreed to take on some of the responsibilities associated with the Anglesea power station (owned by AWA - Australia (Alcoa 2001, p. 11)). For example, under the National Electricity Code the SECV 'is deemed to be the person that must register as the *Generator* in relation to the *generating systems* forming part of the Anglesea Power Station (see NECA 2001, Clause 9.4.2 (a) (4), (5) and (6)). As a consequence, the SECV rather than Alcoa is bound by the National Electricity Code.

**Figure 3 Victorian smelter electricity supply arrangements**




Source: See discussion above.

In sum, based on a range of information, we can make a robust conclusion that the two Victorian smelters pay between $13.50 and $15.50 per MWh for electricity, which is approximately $17.50/MWh below the price that would be negotiated in a competitive market. As former Treasurer Stockdale observed, this arrangement 'unfairly benefit[s] Alcoa at the expense of other business and household taxpayers in Victoria' (Stockdale 1995, p.2).

### QUEENSLAND

There is also sufficient information available to calculate the subsidy received by the Boyne Island smelter in Queensland. The smelter, majority-owned by Comalco, is supplied with electricity by the 1680 MW black coal Gladstone Power Station (GPS) which was purchased from the Queensland government by a Comalco-led consortium in March 1994. The net proceeds from the sale were $750 million (RBA 1997), equating to around $450/kW. The current replacement cost is around $2.5 billion (NRG 2001), suggesting that the sale price was very low.[36] Gillespie (1999) concurs, suggesting that '[t]he value derived from this sale was based on overall state development benefits rather than the value of the stand-alone power station.' The implication is that Comalco and its partners received a subsidy in the form of a cheap power station, which has enabled the smelter to enjoy cheap electricity. This can be tested, and the extent of any subsidy quantified, by comparing the sale price of GPS with the price of similar assets sold around the same time.

The Victorian Government privatised its electricity assets between December 1992 and April 1997, which covers the period in which the Queensland Government sold

[36] Other sources concur with this estimate of replacement cost. For example, at 1980 prices GPS was estimated to cost $759 million to build (Gallagher *et al.* 1981, p. 39). CPI was 43.96 at June 1980, compared with 133.8 at June 2001 (ABS 2001), indicating an indexed cost of $2.3 billion.

GPS. Over this period, the Victorian Government sold 6050 MW of coal-fired generation at an average price of $1,855/kW (see Appendix) (RBA 1997; Department of Treasury & Finance 1997, p. 117). In 1990 dollars, GPS was sold for just over $400/kW and the Victorian generators at around $1,550/kW.[37] This large difference seems particularly surprising considering that the Victorian generators were slightly older[38] and less reliable than GPS (Booth 2000, p. 96). However, factors such as replacement value, operating costs and market conditions explain some of the variation. Perhaps the most important factor is that the Victorian generators are powered by brown coal, which is cheaper than black coal resulting in lower operating costs.[39] Accordingly, to make a more accurate comparison between the sale of GPS and that of the Victorian generation assets it is necessary to adjust the sale price of GPS upwards by at most 60-70 per cent to account for the lower rate of return per kW of black coal generation.[40]

It is also widely recognised that those Victorian power stations sold in 1996 and 1997 were privatised around the peak of the market for utilities, and any price comparison needs to take this into account. In December 1992, when the market was more subdued, the Victorian Government sold 51 per cent of the brand new Loy Yang B power station for only $990/kW (in 1990 dollars) (RBA 1997). If a brand new power station sold for only $990/kW, presumably the average Victorian generator would have sold for even less (compared with the $1,550/kW actually received). However, the sale price of Loy Yang B was ‘substantially less than the…construction costs’ and the ‘book value of the power station had been devalued prior to its sale’ (Victorian Auditor-General’s Office 1997, Section 4.50), indicating that this share of Loy Yang B was sold for less than a fair market value. Taking these factors into consideration, it is reasonable to estimate that the average price for Victorian coal-fired generation assets sold between 1992 and 1997 was inflated by around 50 per cent. Using this estimate of market value, combined with the differences in operating and replacement costs of GPS and the Victorian generators, a market price for GPS would have been around $620/kW (in 1990 dollars)[41] or around $1,150 million at the time of sale. This compares with the actual sale price of $750 million, indicating that the Comalco-led consortium paid around $400 million less than GPS was worth.[42]

GPS can be thought of as two power stations of similar size: one selling electricity into the National Electricity Market and receiving market prices; and the other supplying the Boyne Island smelter.[43] Based on the above analysis, the former would

[37] See ABS 2001.
[38] Average age at time of sale was around 16 years, compared to 15 years for GPS (see Appendix).
[39] Average operating and fuel costs are estimated to be $15.1/MWh for refurbished Victorian brown coal compared with $22.6/MWh for refurbished NSW black coal generation (Naughten 2000, p. 5). However, GPS obtains black coal particularly cheaply from the Blackwater export coal mine (Booth 2000, p. 91) resulting in lower costs. On the other hand, the capital cost of new brown coal generation is 60-70 per cent higher than that for a black coal (Naughten 2000, p. 5).
[40] For example, at a low *long-run* pool price of $28/MWh, an average Victorian generator may be able to earn a return on capital of around $13/MWh compared with around $8/MWh at GPS (based on above footnote, i.e. operating and fuel costs for Victorian brown coal generation of $15/MWh and $20/MWh for GPS). Higher long-run pool prices will decrease the relative advantage of brown coal. This adjustment also accounts for the difference in replacement costs.
[41] That is $1550/kW divided by 1.5 to account for inflated Victorian generator prices and divided by 1.67 to account for the operating and capital cost differences.
[42] This is at the low end of other estimates (see testimony of Ian Lowe in JSCT 2000).
[43] Boyne Island consumes around 800 MW, compared to total generation capacity at GPS of 1680 MW.

have had a market price of around $600 million at the time of sale, on which it should be able to generate a reasonable return selling into the grid. Accordingly, the $400 million subsidy can be assigned entirely to the 800 MW of generation supplying the smelter (see Section 2.4). This capital cost subsidy of $500/kW can be converted to a $/MWh figure for comparison with earlier analysis. At the time of sale, the generation units at GPS were, on average, 15 years old and it is estimated that the power station would have had a further 25 years of operation. Accordingly, based on a 95 per cent capacity factor and an 8 per cent discount rate, a $500/kW subsidy decreases the return required on investment by $5.60/MWh. This represents an effective subsidy of around $37.5 million per annum[44] for electricity supplied by GPS to the Boyne Island smelter.

GENERAL

The analysis in Section 2.6, based on ISR, Industry Commission and ACIL analysis, indicated that the average electricity price paid by smelters in Australia was $21-23/MWh. This is consistent with the above estimates of the prices paid by the Victorian and Queensland smelters, the former being somewhat lower and the latter probably slightly higher. There is additional evidence that other smelters pay similar prices. For example, as discussed in Section 2.6, ING Barings (2000) estimated that the Bell Bay smelter was paying at most $23/MWh in 1997. The Industry Commission quotes representatives of the Tomago smelter indicating that they were receiving electricity at a price that was ‘in the market’ for a smelter of its size (IC 1998, p. 69). On the other hand, Capral (former owner of the Kurri Kurri smelter) believed it was paying more for electricity than its interstate counterparts (IC 1998, p. 69) and, having failed to secure cheap electricity, chose to sell its operations to VAW in June 2000 (ACTED 2001). Industry analysts have suggested that Victorian smelters pay $14 per MWh (Booth 2000, p. 43), Tomago around $22 per MWh and Kurri Kurri $27 per MWh.[45]

The three smelters examined in detail (Boyne Island, Portland and Point Henry) pay around $150 million per annum less for electricity than they would be charged in a competitive market. The other three smelters – Tomago, Kurri Kurri and Bell Bay pay prices estimated at around $22, $27 and $23 per MWh respectively. However, there is very little information available on the price that large high-voltage take-or-pay industrial customers should pay for power in a competitive market in NSW or Tasmania, making it difficult to determine the existence or extent of any subsidy received by these other smelters. However, some indication can be gained by assuming that smelters in NSW would pay a similar competitive price to that offered by Edison Mission Energy in Victoria.[46] To this can be added transmission costs, which are somewhat lower than those charged to Point Henry and significantly lower than Portland (see discussion of transmission distance on the following page).

Table 7 summarises the available information and combines it with some assumptions to provide a lower-end estimate of the electricity subsidies received by the smelting

[44] Based on 800 MW load operating at 95 per cent capacity.
[45] *Australian Financial Review*, 1 July 1999, p. 72.
[46] The higher fuel costs for NSW black coal-fired generators would tend to push up generation costs, although this is offset by lower capital costs (Naughten 2000, p. 5).

**Table 7 Low-end estimates of electricity subsidies to aluminium smelters**

| Smelter | Price | Demand | Consumption[¶] | Electricity expenditure | Generator price[*] | TUOS + other[#] | Subsidy | |
|---|---|---|---|---|---|---|---|---|
| | ($/MWh) | (MW) | (GWh) | ($m) | ($/MWh) | ($/MWh) | ($/MWh) | ($m) |
| Bell Bay | 23 | 256 | 2130 | 49 | 24 | 6 | 7 | 15 |
| Boyne Island | 21 | 800 | 6660 | 140 | 24 | 2 | 5.6 | 37 |
| Kurri Kurri | 27 | 300 | 2500 | 68 | 24 | 4 | 1 | 3 |
| Point Henry | | | | | | | | |
| - SECV | 13 | 200 | 1660 | 22 | 24 | 7 | 18.4 | 30 |
| - Anglesea | 26 | 160 | 1330 | 35 | 24 | 2 | 0 | 0 |
| Portland | | | | | | | | |
| - base contract | 15 | 520 | 4330 | 65 | 24 | 9 | 18.4 | 80 |
| - suppl. cont. | 33 | 64 a | 530 | 17 | 24 | 9 | 0 | 0 |
| Tomago | 22 | 690 | 5740 | 126 | 24 | 6 | 8 | 46 |
| **Total/average** | **21** | | **24880** | **520** | | | **8.5** | **210** |

a. The 'supplementary power arrangements provide for the supply of up to an additional 120 MW…with pass-through of all costs' (Victorian Auditor-General's Office 1999, Section 8.101, 8.103). However, only an additional 64 MW was needed to 'maximise [Portland's] production capacity' (Victorian Auditor-General's Office 1999, Section 8.98). Accordingly, 64 MW has been used. These agreements also require payment of a 'profit surcharge' determined according to the aluminium price (Victorian Auditor-General's Office 1999, Section 8.102).
¶ At 95 per cent capacity. The Point Henry and Portland subsidy amounts in Table 6 were calculated based on 100 per cent, and have been adjusted accordingly.
* That is, price that a generator would charge a continuous-load, high-voltage, take or pay customer in a competitive market. It has been assumed that the price charged by Edison Mission under what is effectively a long-term smelter contract with SECV can be applied in NSW, Queensland and Tasmania. If anything, this underestimates the generation costs in NSW and Queensland, and the marginal generation costs in Tasmania, and hence the subsidy.
# In Tasmania, continuous-load high-voltage kVA customers pay around $6/MWh in demand (i.e. network) charges (Aurora Energy 2001). Little information is available regarding contestable high-voltage (> 132 kV) customers in NSW. However, network charges of $4/MWh and $6/MWh have been estimated for Kurri Kurri and Tomago, respectively.
Note: this table has been constructed using the information in Section 2.6 and 2.7. That is, average electricity price, total consumption and total expenditure on electricity are consistent with ISR, ACIL, ABARE and IAI information. Price information for Point Henry and Portland has been derived above and price information for Tomago, Kurri Kurri and Bell Bay has been obtained from other sources discussed above. Price information for Boyne Island has been derived in accordance with average industry prices and scale of subsidy calculated above.

industry in Australia as a whole. On the basis of the Victorian subsidy identified by Treasurer Stockdale, and the estimates of prices for electricity paid by other smelters, the total subsidy to the aluminium smelters in Australia due to low- priced electricity is *at least* $210 million per annum. Taking into account the higher generation costs (and hence unsubsidised price) for black coal generation in New South Wales and Queensland,[47] a figure over $250 million is probably more accurate.

*The industry's arguments*

A number of reasons have been put forward to explain why the aluminium smelters pay lower prices than other business consumers for electricity (e.g. IC 1998, p. 69; ISR 2001, pp. 8-9; David Coutts in SECITA 2000, p. 161). Firstly, it is suggested that

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[47] And the likelihood that Bell Bay pays a price closer to $20/MWh (see discussion in Section 2.6).

smelters demand a continuous base load which is advantageous to the generators since it provides more certainty of demand. However, other large industrial customers (such as steel mills and other heavy manufacturing plants) will also generally demand a continuous base load, although not usually as large as an aluminium smelter.[48]

Secondly, it is argued that smelters are usually located close to power stations, thereby reducing transmission costs. However, the weighted average distance of smelters from their generators is well over 100 kilometres (an average heavily influenced by Portland's distance from the Latrobe Valley).[49] It is unlikely that other large industrial users are much further on average from their electricity suppliers. Moreover, the price estimates above already take into account the delivery costs, although in the case of the Portland smelter the Victorian Hamer Government heavily subsidised the construction of high-voltage transmission lines (Blake 1991).

Thirdly, smelters draw a high voltage load, reducing transmission losses. Contrary to this, it might be noted that Treasurer Stockdale referred to the fact that other *high voltage* industrial customers in Victoria were paying up to three times the price paid by the smelters (Stockdale 1995, p. 2). This is probably close to the price smelters would be paying in the absence of subsidies.

Fourthly, electricity supply contracts generally contain 'take or pay' provisions, guaranteeing the smelters will pay for the electricity whether they use it or not, thereby contributing to certainty of demand for the generators.

The subsidy estimates presented earlier take into account the various arguments presented above. For example, the power hedge contract between the SECV and Edison Mission Energy for the supply of the Portland and Point Henry smelters is essentially a long-term contract for a continuous base load at high voltage. The contract 'effectively fixe[s] the price of energy, for a load equivalent to that supplied by the SECV to the aluminium producers from the year 2001 to 2016, at $23.95 per [MWh], indexed to movements in the [CPI]' (Victorian Auditor-General's Office 1998, Section 8.95). In other words, this contract provides Edison Mission Energy with the same benefits as a take or pay contract for the supply of the smelters. Accordingly, if Point Henry and Portland were paying a market price they would pay the same price paid by the SECV, not around $18/MWh less, as is the case.

[48] In the case of the Bell Bay smelter, it is precisely because it draws a continuous high load that Tasmania is potentially facing power shortages and Hydro Tasmania from time to time needs to operate the expensive Bell Bay oil-fired power station to meet demand. The absence of the smelter would reduce the average prices paid by other customers and delay the need for additional investment in either new capacity or interconnection with the NEM.

[49] For this calculation the following information has been used: Gladstone Power Station and the Boyne Island smelter are taken to be immediately adjacent; the Point Henry smelter is around 30 km from the Anglesea power station; the distance from the Tomago smelter to Macquarie Generation's Liddell and Bayswater power stations is at least 80 km, and the distance between VAW's Kurri Kurri smelter and the nearest power stations (Bayswater/Liddell) is at least 60 km; the Bell Bay smelter is very near the Bell Bay power station, but this is only operated when insufficient hydroelectric generation is available – the smelter is on average around 60 km from Poatina, Paloona, Devils Gate, Fisher, Trevallyn and Rowallan stations; the distance from Loy Yang B (Latrobe Valley) to the Portland smelter is estimated to be at least 400 km; and additional power for Point Henry (Anglesea is only 150 MW) needs to travel over 100 km, also from Loy Yang B.

Similarly, if the Gladstone Power Station had been sold at a market price it would need to charge market prices for electricity in order to be financially viable. However, the $400 million discount means that the owners of GPS (including Comalco) either do not have to charge a market rate to the Boyne Island smelter in order to receive an adequate return on their investment in the power station, or can generate excessive profits if they do charge the market price.[50] Accordingly, whatever the merits of the arguments for aluminium smelters receiving cheaper power, the estimate of the total electricity subsidy to the industry used in this paper incorporates these arguments.

A recent ISR (2001) paper[51] attempts to compile some ‘secondary’ evidence that supports the claims of industry that it does not receive significant subsidies. The main thrust of the argument presented by ISR is that Australian smelters are not subsidised because, although they pay a low electricity prices, smelters in other countries also pay low prices.[52] The justification they give for these prices being lower than those paid by other customers is that ‘economic fundamentals require discriminatory pricing matched to what the market will bear…in order to maximise efficiency’ (ISR 2001, p. 8). Section 3.5 discusses the existence of subsidies in other major aluminium-producing countries.

It is enlightening to look at the actions of the industry to assess whether it is paying economically efficient electricity prices as ISR suggests. If, for example, Alcoa believed that it is paying the price that would be achieved in an efficient market, then it would surely be willing to renegotiate or terminate its contract with the SECV and negotiate directly with generators (to which it could provide the benefits to which the industry regularly refers). However, when in 1995 the Victorian Government indicated that it would like to renegotiate the agreements Alcoa refused, even after the Government curtailed a portion of the electricity supply to the Portland smelter (Victorian Auditor-General’s Office 1998, Section 8.98).

Similarly, when the Aldoga smelter proponents approached the NSW Government to secure cheap electricity, Treasurer Michael Egan believed that providing electricity at the price requested by the smelter proponents would result in ‘everyone else pay[ing] more’ for electricity.[53] The Treasurer believed that the government-owned generators would receive a better price operating in the market, even though ISR would argue that in an efficient market the generators should receive lower prices.

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[50] It appears that through a complicated contractual arrangement, the owners of GPS may well receive more than the market price for their electricity, which appears to be purchased by a Queensland government corporation and is then sold to Boyne Island at loss (Enertrade 2001, pp. 1, 23).

[51] This ISR paper was prepared by a working group established by a steering committee made up of industry representatives (see Strategic Leaders Group list at http://www.isr.gov.au/agendas/Sectors/ LightMetals/ slg_list.html). The working group appears also to have been made up of AAC members and relies heavily on the AAC’s preferred consultants, principally ACIL Consulting.

[52] ISR, relying on ACIL (unreferenced or unpublished), suggest that in 1998 the median world electricity price paid by smelters was US$16.20/MWh and the average price US$19.30/MWh. The lowest price was US$5/MWh (which ISR states was not in Australia). In an earlier report ISR (2000, pp. 7, 18) suggest that in 1998 Australian smelters paid on average $20/MWh, or around US$12.50/MWh (based on an average exchange rate of US63cents/A$1 (US Federal Reserve 2001)). International prices are discussed in more detail in Section 3.5.

[53] *Australian Financial Review*, 8 February 2001, pp. 1,10

ISR also suggest that if Australian smelters enjoyed very low, subsidised electricity prices, then the smelters would be relatively inefficient in energy use. However, this reflects a misunderstanding of the nature of smelter power consumption and technology. According to ABARE 'age is a major determinant of the energy efficiency of smelters, with a difference of up to 30 per cent in efficiency between old and new smelters' (ABARE 1992, p. 5). Australian smelters are efficient mainly because they are relatively new and because they are large, allowing them to take advantage of economies of scale.[54] Further, even at subsidised prices electricity still makes up more than 20 per cent of industry operating costs, and therefore increasing energy efficiency is still an effective means of improving competitiveness.

Overall, the industry's arguments, where valid, have been incorporated into estimates of the subsidy to the smelting industry.

## 2.8 Politics and economics of smelter subsidies

The timing of approval, announcement and contract negotiation for smelters reflects the political nature of smelter development in Australia. The Industry Commission noted that the location of smelter developments depends to some extent on 'the willingness…of governments/electricity authorities to negotiate on electricity prices' (IC 1998, p. 16). There is enough evidence to make a strong case that smelter proponents routinely offer governments regional growth and employment in exchange for subsidised energy. Governments are then able to enjoy the short-term electoral benefits flowing from regional development and job creation. For example, the Greiner Government announced the approval of the expansion of the Tomago smelter in January 1991 (and signed a new power purchase agreement around the same time),[55] around four months before the NSW state election. Tomago is located on the edge of the Port Stephens electorate where it meets the electorates of Maitland, Wallsend and Newcastle. In the election the Liberal Party barely held the seat of Maitland (with a 1 per cent margin) (Green 1991). It may be co-incidental that a major employment-generating development on the edge of a marginal seat was secured just before a state election, but if it were more than coincidence then it would not be surprising that the Tomago consortium was able to extract favourable conditions from a Government desperate to secure re-election.

Similarly, in Queensland the sale of the Gladstone Power Station (GPS) by the Queensland Electricity Commission to a Comalco-led consortium in 1994 underpinned the construction of the third potline of the Boyne Island Smelter.[56] However, much of the negotiation over the sale of the power station occurred immediately prior to the 1992 election, at a time when the Goss Government was concerned about not having attracted major industrial projects to Queensland during its first term (Booth 2000, pp. 94-95). The Comalco-led consortium was in a position to exploit the Government's desire to demonstrate it was bringing new projects to Queensland. The Boyne Island smelter was also located in the state electorate of

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[54] For comparison, Australian smelters are on average 9, 16 and 25 years younger than South American, Western European and USA smelters (ACIL 2000, p. 22). Australian smelters are on average at least 50 per cent larger than North and South American, European or Asian smelters (ACIL 2000, p. 22).

[55] http://www.tomago.com.au/company/cohistory.html

[56] http://www.comalco.com.au/01_about/03_1990.htm#1994

Gladstone, eventually won by the ALP in 1992 with only a 4 per cent two-party-preferred majority (ECQ 1993). Because the actual sale did not take place until 1994 and the expansion did not commence until the following year, the Goss Government may have been hoping to continue to benefit from the project at the 1995 election.[57]

A similar situation prevailed in relation to the Aldoga smelter in Queensland and the Kurri Kurri smelter in NSW. In the case of what became Aldoga, Aust-Pac Aluminium initially proposed constructing a smelter in Lithgow, enabling Premier Bob Carr to announce the proposed smelter prior to the 1999 NSW state election.[58] However, according to NSW Treasurer Michael Egan, the initial request from the company on electricity prices 'was so far out of the ball park' that NSW was eventually forced to reject the proposal because 'you can only offer a subsidised price if everyone else pays more'.[59] Aust-Pac then moved on to Queensland as lead proponent in Aldoga Aluminium Smelter Pty Ltd. Premier Beattie was able to announce project approval less than three weeks prior to the 17 February 2001 election, amid reports of a $100 million incentive package and electricity prices of A$24-30/MWh (ACTED Consultants 2001).[60]

In the case of the Kurri Kurri smelter, in 1999 Capral reportedly told the NSW Government that its proposed expansion was at risk unless it could secure competitively-priced power,[61] which it failed to do. Some commentators believe Capral's failure to secure cheap power precipitated the sale of the smelter to VAW in June 2000 (ACTED Consultants 2001). VAW has indicated that future investment and expansion of the smelter would depend on the outlook for competitive energy supplies[62] and in July 2001 was still awaiting the outcome of power contract negotiations,[63] again indicating to the NSW Government that regional development is dependent on cheap electricity.

It should also be recognised that governments benefit outside the electorates where these developments occur. Governments are able to point to these projects as evidence that they are achieving benefits for the state as a whole. This is not to say that governments should avoiding supporting industry development or promoting projects in regional areas where a strong case can be made. What should be recognised is that certain approaches to industry support, for example the provision of cheap energy to the aluminium industry, will lead to perverse outcomes, in this case increased greenhouse gas emissions and environmental damage.

What do governments receive in return for subsidised electricity? In the case of Victoria, the Portland and Point Henry smelters employ around 1,600 people.[64] The

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[57] In the 1995 election the seat of Gladstone was won by independent Liz Cunningham with a majority of around 6 per cent (ECQ 1995). Cunningham soon brought down the Goss Government following the Mundingburra by-election.
[58] *Australian Financial Review*, 8 February 2001, pp. 1,10
[59] *Australian Financial Review*, 8 February 2001, pp. 1,10
[60] *Australian Financial Review* 8 February, pp. 1,10
[61] It has been suggested that Capral was attempting to secure a price of $22/MWh (ACTED Consultants 2001).
[62] *Reuters News Service*, 28 February 2001
[63] *Newcastle Herald*, 26 July 2001, p. 16
[64] In June 1998 the smelting industry employed around 5,500 people Australia-wide (ACIL 2001, p. 28). Victoria hosts capacity of 530,000 tonnes pa out of 1,752,000 tonnes pa Australia-wide. The

Victorian government (through the SECV) spends around $110 million dollars per annum providing subsidised electricity to the Victorian smelters, so each direct job is subsidised by around $70,000 per annum. This is paid mostly from smelter reduction levy revenue (i.e. other electricity customers). This is an extremely expensive way of supporting regional development. For the same amount of money, more jobs could be created by other projects.

It is also important to examine the opportunity cost of providing this subsidy to a particular industry. There is little independent analysis available on this issue, although a study on Tasmania concluded that the state would be better off economically without the Bell Bay smelter (CREA 1993). In the case of Victoria a simple example serves to illustrate the opportunities the state is forgoing by supporting Portland and Point Henry. As an alternative to supporting the aluminium smelting industry, the Victorian government could use the current $110 million per annum subsidy to promote other industries. Taking the renewable energy industry, the government could apply these funds to offset the premium of around 3.7 cents/kWh (Citipower 2001) charged by Victorian retailers on electricity from renewable sources (or Green Power). By eliminating the cost barrier to Green Power, the $110 million would allow the sale of an additional 3,000 GWh of electricity from renewables at no additional cost to customers, and would require around 1,000 MW of new generation capacity at the capacity factor achieved by wind generation.[65] This would create over 20,000 person-years employment in manufacturing and installation (AusWEA 2001, p. 54), or 1,000 permanent jobs assuming a 20-year wind turbine life, and would probably result in the development of a Victorian wind-turbine manufacturing industry. There would be additional employment in operations and maintenance of between 100 and 500 depending on the number of turbines and administrative structure.[66] Thus directing the $110 million to renewable energy could create 1,100-1,500 jobs directly, or almost as many as are employed in aluminium smelting in Victoria, and the maximum that would be lost if the subsidies were withdrawn and both the Portland and Point Henry smelters closed down completely. There would also be indirect economic benefits from supporting the renewable energy industry, and there is nothing to suggest that these would be any less than those generated by the aluminium smelting industry. In addition, this simple alternative would enable over 500,000 Victorian households to switch entirely to renewable electricity and reduce greenhouse gas emissions by more than 3 million tonnes per annum.[67] This example serves to illustrate the opportunity cost of supporting the smelting industry with subsidies of the scale identified in this paper.

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estimate of 1,600 jobs assumes that no large changes in total employment have occurred since June 1998, and this is reasonable since the only expansion was of potlines 1 and 2 at Tomago and this was completed in 1998.

[65] The example used here assumes an average capacity factor of 34 per cent. Although some wind projects could well achieve capacity factors of over 40 per cent (AusWEA 2001, p. 4), it is likely that there are a limited number of sites of this quality and a lower number is more accurate. For example, a global average of 25-30 per cent is suggested elsewhere by AusWEA (2001, p. 48). In addition, the estimate of 3,000 GWh is probably an underestimate because it assumes there are no economies of scale that reduce the additional cost of sourcing renewable electricity.

[66] Estimates vary widely, ranging from 2-6 jobs per 100 turbines (NWCC 1997) to 0.05 to 0.5 jobs per MW (ACIL 2001). Some examples include 40 full-time jobs for a 240 MW facility in Iowa and 3 jobs for a 25 MW facility in Minnesota (NWCC 1997; AWEA 2000).

[67] The 1,800,026 Victorian residential customers consumed 10,631 GWh in the year ended 30 June 1999 (ESAA 2000), averaging 5,900 kWh pa. Accordingly, the 3,000 GWh would enable over

*Economic impact*

The analysis above seems to contradict the claims of the aluminium smelting industry that their ‘industry has developed without government protection’ (Burgess 2000). The direct financial subsidy provided to the aluminium smelting industry by taxpayers and other electricity consumers amounts to a large proportion of total industry costs. If electricity costs comprise just over one-fifth of total operating costs (ACIL 2000, p. 20), and smelters pay around 60 per cent (probably at most) of the market price for electricity supplied to large industrial customers then the subsidy accounts for around 8 per cent of total industry costs. This suggests that a large proportion of the profits of the industry are provided by subsidies paid for by taxpayers and other electricity consumers. Furthermore, most of these profits do not accrue in Australia but are repatriated to foreign parent companies (see Section 2.3).

## 2.9 Summary and conclusions

In sum, the aluminium smelting industry in Australia employs 5,500 people, exports $3.9 billion worth of primary aluminium,[68] contributed $840 million to gross domestic product in 1997-98 and was responsible for additional greenhouse gas emissions of around 27 Mt $CO_2$-equivalent in 1998-99 (or 5.9 per cent of total emissions).[69] The large contribution to emissions is mainly due to the industry’s greenhouse gas intensity compared to that of other industrial sector activities – every dollar of economic output generated by the aluminium smelting industry results in the emission of around five times more greenhouse gas than agriculture and around 22 times more than other manufacturing activities.

Through the provision of cheap electricity, the industry receives a subsidy estimated to be at least $210 million each year, and probably in excess of $250 million. Each job directly generated by the industry is costing governments close to $40,000 per annum. The industry is not currently charged for its greenhouse gas pollution, but at a conservative price of $10/tonne $CO_2$-equivalent the industry is receiving an additional annual environmental subsidy of close to $270 million, or around $50,000 per employee.

The industry relies on supplies of cheap electricity to operate competitively. Government support, through cheap power and other arrangements, has resulted in the emission of large amounts of greenhouse gas pollution. The decision by governments to support this industry, often for political reasons, has had a large financial and environmental cost.

More than three-quarters of the industry is foreign owned, with a similar proportion of profits directed offshore. Much of this profit can be attributed directly to electricity subsidies, paid for by Australian taxpayers and electricity consumers.

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500,000 Victorian households to switch entirely to renewable energy. The estimate of reduced emissions could well be higher if brown coal generation is displaced.

[68] This recent figure is inflated because of the historically low value of the Australian dollar.

[69] Excluding land-use change.

# 3. The world industry

## 3.1 Location and scale

Aluminium smelters are spread across the world, with at least 157 smelters operating in 47 countries (AME 2001). Around 43 per cent of smelters are located in the five largest producing countries – USA, China, Russia and Canada and Australia. Table 8 summarises the location of smelting capacity. The broad regional distribution of capacity is presented in Figure 4.[70]

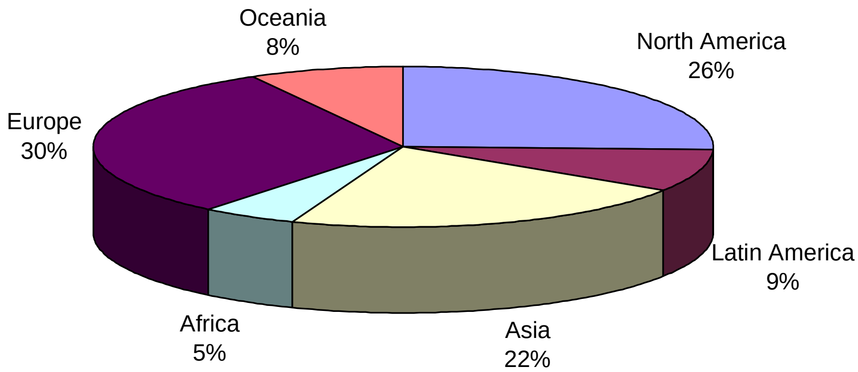
**Table 8 Worldwide smelting capacity (thousand tonnes per annum)**

| | 1999 | 2000 (estimate) |
|---|---|---|
| USA | 4,270 | 4,270 |
| Russia | 3,190 | 3,200 |
| China | 2,640 | 2,640 |
| Canada | 2,300 | 2,300 |
| Australia | 1,770 | 1,770 |
| Brazil | 1,220 | 1,260 |
| Norway | 1,000 | 1,020 |
| South Africa | 676 | 676 |
| Venezuela | 640 | 640 |
| France | 430 | 430 |
| Other | 7,240 | 7,480 |
| Total | 25,400 | 25,700 |

Source: USGS 2001, p. 19

Total production in 1999 was around 23.6 million tonnes (Plunkert 2001, Table 12). Table 9 presents 1999 production and the distribution of smelters. Countries can be divided into two categories according to whether their aluminium smelting industry is geared towards supplying domestic requirements, or generating export income. Into the latter group fall Australia, Bahrain, Brazil, Canada, New Zealand, Norway, South Africa, the UAE and Venezuela. Russia too falls into this category, although its industry was probably originally established to supply domestic needs prior to the country's economic collapse. It is also unlikely that the smelters in Trinidad and Mozambique are for the supply of domestic demand for aluminium.

**Figure 4 Regional location of aluminium smelting capacity, 2000**




Source: IAI 2001;USGS 2001, p. 19; Plunkert 2001, Table 12

[70] IAI figures are based on survey returns from primary aluminium smelters. This has resulted in an underestimate of capacity in Asia (IPAI capacity figures suggest 2.3 Mt capacity in 2000, whereas

**Table 9 Location of smelters and production, 1999**

| Country | Number of smelters | Production (,000 tonnes) |
|---|---|---|
| Argentina | 1 | 205 |
| Australia | 6 | 1718 |
| Azerbaijan | 1 | * |
| Bahrain | 1 | 503 |
| Bosnia Herzegovina | 1 | 70 |
| Brazil | 7 | 1250 |
| Cameroon | 1 | 92 |
| Canada | 12 | 2390 |
| China | 20 | 2530 |
| Croatia | 1 | 35 |
| Egypt | 1 | 193 |
| France | 4 | 455 |
| Germany | 6 | 634 |
| Ghana | 1 | 104 |
| Greece | 1 | 160 |
| Hungary | 1 | 35 |
| Iceland | 3 | 220 |
| India | 7 | 550 |
| Indonesia | 1 | 100 |
| Iran | 3 | 137 |
| Italy | 3 | 187 |
| Japan | 1 | 11 |
| Mexico | 1 | 67 |
| Mozambique | 1 | * |
| Netherlands | 2 | 287 |
| New Zealand | 1 | 327 |
| Nigeria | 1 | 16 |
| Norway | 7 | 1020 |
| Poland | 1 | 55 |
| Romania | 1 | 174 |
| Russia | 13 | 3146 |
| Slovak Republic | 1 | 109 |
| Slovenia | 1 | 50 |
| South Africa | 2 | 679 |
| Spain | 3 | 364 |
| Suriname | 1 | 10 |
| Sweden | 1 | 99 |
| Switzerland | 1 | 34 |
| Tajikistan | 1 | 229 |
| Trinidad | 1 | * |
| Turkey | 1 | 62 |
| Ukraine | 2 | 112 |
| United Arab Emirates | 1 | 440 |
| United Kingdom | 4 | 272 |
| USA | 23 | 3779 |
| Venezuela | 2 | 570 |
| Yugoslavia | 1 | 73 |
| **World** | **157** | **23553** |

* Smelter not operating in 1999

Source: Plunkert 2001, Table 12; AME 2001

### 3.2 Australian operators' international assets

As discussed earlier, the Australian aluminium industry is dominated by international companies, including Alcoa (USA), Rio Tinto (UK), Pechiney (France) and VAW (Germany). These corporations own significant aluminium smelting assets throughout the world. Alcoa, the largest aluminium producer in the world, owns smelting capacity of 4.2 million tonnes per annum in Australia, Brazil, Canada, Germany, Ghana, Italy, Norway, Spain, Suriname and the USA (Alcoa 2001).[71] Rio Tinto, which through Comalco owns the Bell Bay smelter and a little over half the Boyne Island smelter in Australia, also has aluminium operations in New Zealand (Tiwai Point smelter) and Anglesey in Wales.[72] Pechiney, the majority owner of the Tomago smelter, has smelting operations in Canada, Cameroon, France, Greece, the Netherlands and Australia and is the fourth-largest aluminium producer in the world, with capacity of 1.145 million tonnes (AME 2001; Pechiney 2001). VAW, the owner of the Kurri Kurri smelter and part of Tomago, controls aluminium production capacity worldwide of around 600,000 tonnes in Australia, Canada and Germany (USGS 1999; SGF 2001).

Members of the consortium involved in the Boyne Island smelter (Sumitomo Light Metals, Mitsubishi, Yoshida Kogyo,

USGS estimates production of over 4.5 Mt, Plunkert 2001, Table 12). China alone is estimated to have capacity of 2.6 million tonnes (USGS 2001, p. 19)

[71] Also, see http://www.alcoa.com/site/invest/annual_reports/ar_trends_ingot.asp

[72] http://www.riotinto.com/about/KeyData.asp

Sumitomo Chemical, Kobe) and an owner of the Portland smelter (Marubeni) are also involved in the smelter projects in Canada, Venezuela, Mozambique, New Zealand and the USA. These companies work together consistently[73] and to such an extent that they can almost be viewed as one company.

### 3.3 Other international operators

The international aluminium smelting industry is dominated by a handful of companies. Between them, the five largest companies own 42 per cent of world smelting capacity of 25.7 Mt per annum (USGS 2001, pp 9), and control a much larger proportion.

Setting aside the Chinese government's smelter holdings, the five largest companies are Alcoa (4.2 Mt), Russky Aluminy (RusAl) (2.45 Mt), Alcan (2.25 Mt), Pechiney (1.145 Mt) and BHP-Billiton (1 Mt). However, the industry can be divided into multinational corporations – those companies with smelting operations in more than one country – and domestic companies. The latter have far less influence over the international market in primary aluminium. Countries that are dominated by domestic firms as opposed to the multinationals include China, countries of the former Soviet Union and some Eastern European countries.

China is estimated to have around 20 major smelters, with capacity close to 2.6 million tonnes per annum (AME 2001; USGS 2001, pp 9). Most are owned by central and regional governments, although a number have been vested in Chinalco (or Chalco), which is soon to list on the New York and Hong Kong stock exchanges (DIC 2001).[74]

Russia is the second-largest producer. Major players include Russian Aluminium Corporation (also called Russky Aluminy or RusAl) which owns almost 2.45 million tonnes of production capacity.[75] The other major Russian aluminium group is SUAL (Siberian-Urals Aluminium), which operates four smelters and has a share of a fifth, with a total capacity of around 600,000 tonnes. This company is owned by Access-Renova investment group, which appears to have no other aluminium assets (Pirani 2001). A third group, dominated by the British investment group Aimet controls capacity of around 190,000 tonnes in Russia.

China and Russia account for around 6 million tonnes, or around 23 per cent, of world capacity. Production in Yugoslavia, Slovenia, Ukraine, Tajikistan, Poland, Romania, Croatia, Bosnia Herzegovina and Azerbaijan (totalling close to 1.5 Mt) is also largely uninfluenced by the major multinationals that dominate the industry in the rest of the world. This leaves around 18.2 Mt controlled by a combination of multinationals, domestic firms and governments. The operations of the five largest multinational corporations are discussed below.

[73] See Alouette (http://www.sgfqc.com/en/champ/metaux/metaux.asp), Mozal (http://www.billiton.com/newsite/ html/investor/aboutus/Mozal.htm), Tiwai Point (http://www.comalco.com.au/05_operations/ 07_tiwai.htm), Intalco and Eastalco (http://www.ame.com.au/smelters/al/Intalco.htm, Alcoa 2001, p. 8) and Venalum (http://www.ame.com.au/smelters/al/Venalum.htm).
[74] http://www.financeasia.com/articles/A899F0F3-C72C-11D5-81D40090277E174B.cfm, http://www.tibet-web.com/english/news/02241118.htm
[75] http://www.sovereign-publications.com/Russian per cent20Alu.pdf and AME 2001

*Multinational aluminium smelting companies*

As mentioned earlier, Alcoa is the largest aluminium smelter, with capacity of over 4 million tonnes or 23 per cent of world production (outside the 7.5 Mt in the former Soviet Union, China and Eastern Europe, see above). Alcoa has a primary aluminium monopoly in Italy (3 smelters), Spain (3) and Suriname (1), and also owns around 44 per cent of production in the USA and 33 per cent of production in Canada (along with smelters in Norway, Ghana, Germany and Australia) (Alcoa 2001; USGS 1999). Brackets are used in the following descriptions to indicate percentage of a country's production controlled by that particular company, where control exceeds 40 per cent.

**Table 10 Concentration of ownership of smelting capacity for selected countries, 2001**

| **Country** | **Capacity 2001 (tonnes)** | **Owned by:** | | |
|---|---|---|---|---|
| | | **Top 2 Alcoa Alcan** | **Top 5 Top 2 plus Pechiney BHP-Billiton Norsk Hydro** | **Top 10 Top 5 plus Rio Tinto, VAW, Kaiser, Century, Japanese group (Kobe, Sumitomo, Mitsubishi etc.)** |
| **Major producers** | | | | |
| USA | 4,323,000 | 49 % | 49 % | 70 % |
| Canada | 2,583,000 | 87 % | 91 % | 94 % |
| Australia | 1,752,000 | 13 % | 26 % | 78 % |
| Brazil | 1,262,000 | 30 % | 47 % | 61 % |
| Norway | 1,034,000 | 16 % | 90 % | 90 % |
| Germany | 726,000 | 6 % | 6 % | 61 % |
| South Africa | 671,000 | 0 % | 100 % | 100 % |
| Venezuela | 640,000 | 2 % | 2 % | 16 % |
| France | 440,000 | 0 % | 100 % | 100 % |
| *Sum of major producers* | 13,431,000 | 39 % | 57 % | 76 % |
| **Other producers** | | | | |
| Cameroon | 90,000 | 0 % | 58 % | 58 % |
| Ghana | 200,000 | 10 % | 10 % | 100 % |
| Greece | 155,000 | 0 % | 60 % | 60 % |
| Iceland | 228,000 | 74 % | 74 % | 74 % |
| Italy | 187,000 | 100 % | 100 % | 100 % |
| Mozambique | 250,000 | 0 % | 47 % | 72 % |
| Netherlands | 300,000 | 0 % | 57 % | 57 % |
| New Zealand | 313,000 | 0 % | 0 % | 100 % |
| Spain | 365,000 | 100 % | 100 % | 100 % |
| Suriname | 30,000 | 100 % | 100 % | 100 % |
| Switzerland | 36,000 | 100 % | 100 % | 100 % |
| United Kingdom | 335,000 | 60 % | 60 % | 100 % |
| *Sum of other producers* | 2,489,000 | 40 % | 58 % | 86 % |
| **Total** | **15,920,000** | **39 %** | **57 %** | **77 %** |

Source: Alcan 2001; Alcoa 2001; Plunkert 2000; Several countries in USGS 1999; Norsk 2000; Pechiney Netherlands 2000; Billiton 2000; Altech 2001; AME 2001; Kaiser 2001; Century 2001; SGF 2001; CAV 2001

Alcan is the second largest aluminium smelter, with capacity of around 2.25 million tonnes and operations in Brazil, Canada (54 per cent), Iceland, Norway, Switzerland, the UK (60 per cent) and the USA (Alcan 2001). Pechiney is third among the multinationals, controlling 1.145 million tonnes of production, with smelters in Australia, Cameroon (58 per cent), Canada, France (close to 100 per cent), Greece (60 per cent), the Netherlands (57 per cent) (Pechiney 2001; Pechiney Netherlands 2001; Altech 2001). BHP-Billiton owns production capacity of around one million tonnes and owns South Africa's smelting industry (100 per cent), has a strong influence over Mozambique's only smelter (47 per cent) and also has interests in two smelters in Brazil (Billiton 2000).[76] Norsk Hydro owns close to 780,000 tonnes of smelting capacity, including in Norway (74 per cent), Iceland and the Slovak Republic (Norsk 2000).

These five companies account for around 9.5 Mt of capacity, or 52 per cent of capacity outside China, the former Soviet Union and Eastern Europe. Table 10 summarises corporate ownership around the world (excluding China, countries of the former Soviet Union and Eastern Europe).

Table 11 presents the top two multinational producers within a country and the percentage of that country's production owned by those companies. As can be seen, ownership is highly concentrated.

**Table 11 Concentration of ownership in major producer countries, 2001**

| Country | Owned by top 2 in that country | Top 2 companies |
|---|---|---|
| USA | 55 % | Alcoa and Century |
| Canada | 87 % | Alcan and Alcoa |
| Australia | 41 % | Comalco/Rio Tinto and Japanese group (Sumitomo, Kobe, Marubeni, Mitsubishi) |
| Brazil | 38 % | Alcoa and BHP-Billiton |
| Norway | 84 % | Norsk and Alcoa |
| Germany | 68 % | VAW and Corus |
| South Africa | 100 % | BHP-Billiton |
| Venezuela | 16 % | Japanese group (Sumitomo, Kobe, Marubeni, Mitsubishi) and Alcoa |
| France | 100 % | Pechiney |

Source: Alcan 2001; Alcoa 2001; Plunkert 2000; Plunkert 2001; Several countries in USGS 1999; Norsk 2000; Pechiney Netherlands 2000; Billiton 2000; Altech 2001; AME 2001; Kaiser 2001; Century 2001; SGF 2001; CAV 2001

[76] Recent reports suggest that BHP-Billiton may acquire the remaining 54.5 per cent in the Valesul smelter in Brazil from the domestic Companhia Vale Rio do Doce (CVRD), further boosting its size (*Australian Financial Review*, 10 October 2001).

## 3.4 Energy use and greenhouse gas emissions: present and future

*Energy use*

Smelting aluminium is an energy-intensive activity requiring large amounts of electricity to reduce aluminium oxide to aluminium metal. Table 12 reproduces the IAI's estimates of the average amount of electricity consumed in smelting each tonne of aluminium in different regions of the world. The industry in Oceania is the most efficient user of electricity, principally because the smelters are larger and newer (see discussion at the end of Section 2.7).

Unlike the Australian aluminium smelting industry where coal predominates as the source of electrical energy, the international industry uses a diverse mix of power sources. As can be seen from Table 13, in 1998 worldwide the industry obtained around 54 per cent of its electricity from hydroelectric generation, 30.5 per cent from coal-fired generation, 8.1 per cent from natural gas generation, 6.4 per cent from nuclear and 1 per cent from oil-fired generation (IAI 2000a). Since over 60 per cent of the energy needs of the industry are obtained from sources that do not generate greenhouse gas emissions, the international industry is less greenhouse-intensive than the Australian industry.

In Table 13, figures for Oceania have been broken down into Australia and New Zealand (assuming that the average energy consumption in each is similar).[77] Australia could be broken down into mainland and Tasmania, with the former 100 per cent coal-fired generation and the latter 100 per cent hydroelectric.

**Table 12 Electrical power consumed per tonne of aluminium produced and production, 1999**

| Region | Average power consumption (MWh) | Production (1999)* (thousand tonnes) |
|---|---|---|
| Europe | 15.193 | 7,245 |
| North America | 15.371 | 6,169 |
| Asia | 15.323 | 4,454 |
| Latin America | 15.340 | 2,092 |
| Oceania | 14.852 | 2,018 |
| Africa | 15.024 | 1,096 |
| World | 15.241# | 23,074 |

* From Plunkert 2000, Table 12
\# Differs from IAI estimate (IAI 2000a) because USGS (Plunkert 2000) production figures have been used.
Note: When compiling this table it was assumed that the average consumption for those smelters that did not respond to the IAI's surveys was the same as that of other smelters in the same region.

Source: IAI 2000a; Plunkert 2000, Table 12

[77] This assumption can be varied within a reasonable range of likely energy intensities without significantly affecting the figures presented in Table 13.

**Table 13 Smelting electricity fuel source, 1998 (per cent)**

| | Africa | North America | Latin America | Asia | Europe | Oceania | Of which | | Worldwide average |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Australia | New Zealand | |
| Hydro | 39.1 | 72.9 | 91.0 | 9.8 | 47.6 | 23.6 | 8.2 | 100.0 | 54.1 |
| Coal | 59.8 | 25.4 | 0.0 | 35.7 | 20.0 | 76.4 | 91.8 | 0.0 | 30.5 |
| Oil | 0.0 | 0.0 | 1.9 | 0.4 | 2.4 | 0.0 | 0.0 | 0.0 | 0.9 |
| Gas | 1.1 | 0.0 | 6.7 | 54.1 | 6.1 | 0.0 | 0.0 | 0.0 | 8.1 |
| Nuclear | 0.0 | 1.6 | 0.4 | 0.0 | 24.0 | 0.0 | 0.0 | 0.0 | 6.4 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Source: IAI 2000a

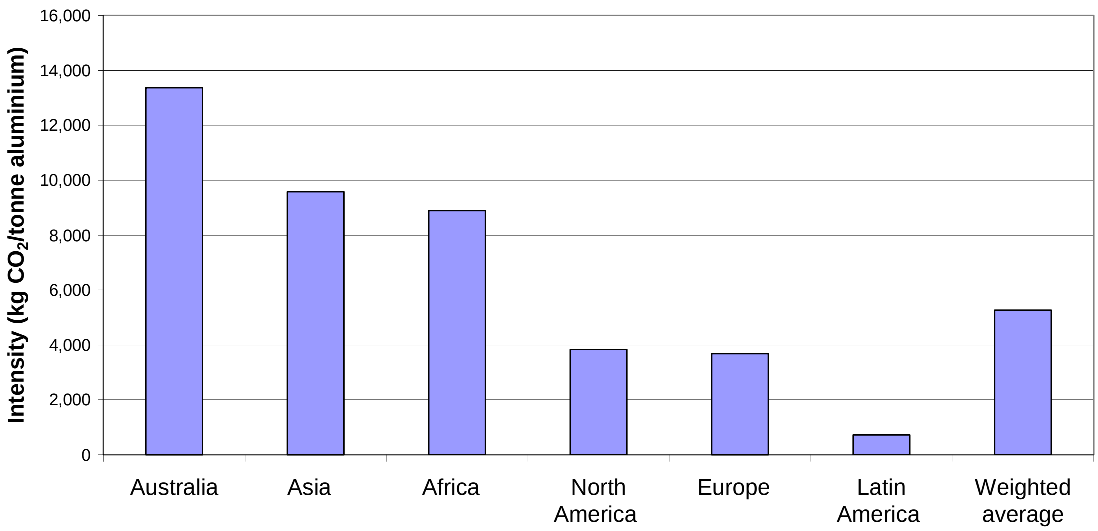
Table 13 also shows that hydro is the main sources of electricity for smelting in the Americas and makes a significant contribution in Europe and Africa. Nuclear power is a significant source in Europe only, whereas natural gas is the main source in Asia but makes a small contribution elsewhere. Oceania is the most coal-intensive region, owing to the dependence of the mainland Australian industry on this fuel source.

Research from the IAI indicates that new smelting capacity is likely to continue to obtain electricity from similar sources. In their survey of the industry the IAI stated that they had:

> identified projects totalling 4 million metric tonnes over the next 6 to 8 years, of which at least 55 per cent will be hydro powered, a maximum of 30 per cent coal fired and 15 per cent gas. Much of the gas powered plants use flare gas, which otherwise would have been burnt off anyway. Overall the expanded capacity will not alter the existing proportion of hydropower [55 per cent] in the energy mix (http://www.world-aluminium.org/environment/electric.html).

The average power consumption and source mix information have been combined with greenhouse gas emission factors (IPCC 1997, p. 1.6) to produce estimates of the greenhouse gas intensity of aluminium smelting in different regions. These are presented in Figure 5.

**Figure 5 Electricity-related greenhouse gas intensities of aluminium smelting, 1998**



Clearly, the most greenhouse gas intensive region in this analysis is Australia, with around 13.6 tonnes of $CO_2$ from electricity consumption per tonne of aluminium, followed by Asia, Africa, North America, Europe and Latin America. Smelting in Australia is around 40 per cent more greenhouse intensive than the average for Asia, the next highest region and more than 2.5 times the worldwide weighted average.[78]

The new smelter developments that the IAI expects to be powered by flare gas are located almost entirely in the Middle East (included in Asia in Figure 5). Arguably, electricity obtained from flare-gas is a net zero emissions source of electricity and this should be a preferred site, on environmental grounds, for future growth in worldwide the smelting industry.

The information in this section is summarised in Figure 6. Among other things, this diagram shows that Oceania's seven smelters produce about the same amount of greenhouse gas emissions from electricity as North America's 35 smelters, which produce almost three times as much aluminium.

*Greenhouse gas emissions from carbon anode oxidation and perfluorocarbon releases*

Although electricity consumption is a major source of greenhouse gas emissions from aluminium smelting, the direct emission of carbon dioxide from anode oxidation and of perfluorocarbons (PFCs) is also significant, and makes up a majority of emissions in regions where electricity generation is not based on fossil fuels, such as Latin America.

In modern and refurbished smelters, emissions of perfluorocarbons (PFCs) and other exhausts are substantially lower compared to older smelters. As a result of refurbishments, the commissioning of new smelters and operational changes, significant reductions in PFC emissions have occurred in a number of countries in recent years. An international survey by the IAI suggests that a 47 per cent per unit reduction was achieved between 1990 and 1997.[79] This same survey indicated that current levels of PFC intensity are similar in smelters in developed and developing countries, with developing countries (0.29 kg $CF_4$/tonne) slightly outperforming developed countries (0.31 kg $CF_4$/tonne).[80]

Carbon anode oxidation, on the other hand, is related to the reduction-oxidation reaction necessary to produce aluminium metal and is therefore closely related to the quantity of the metal produced.[81]

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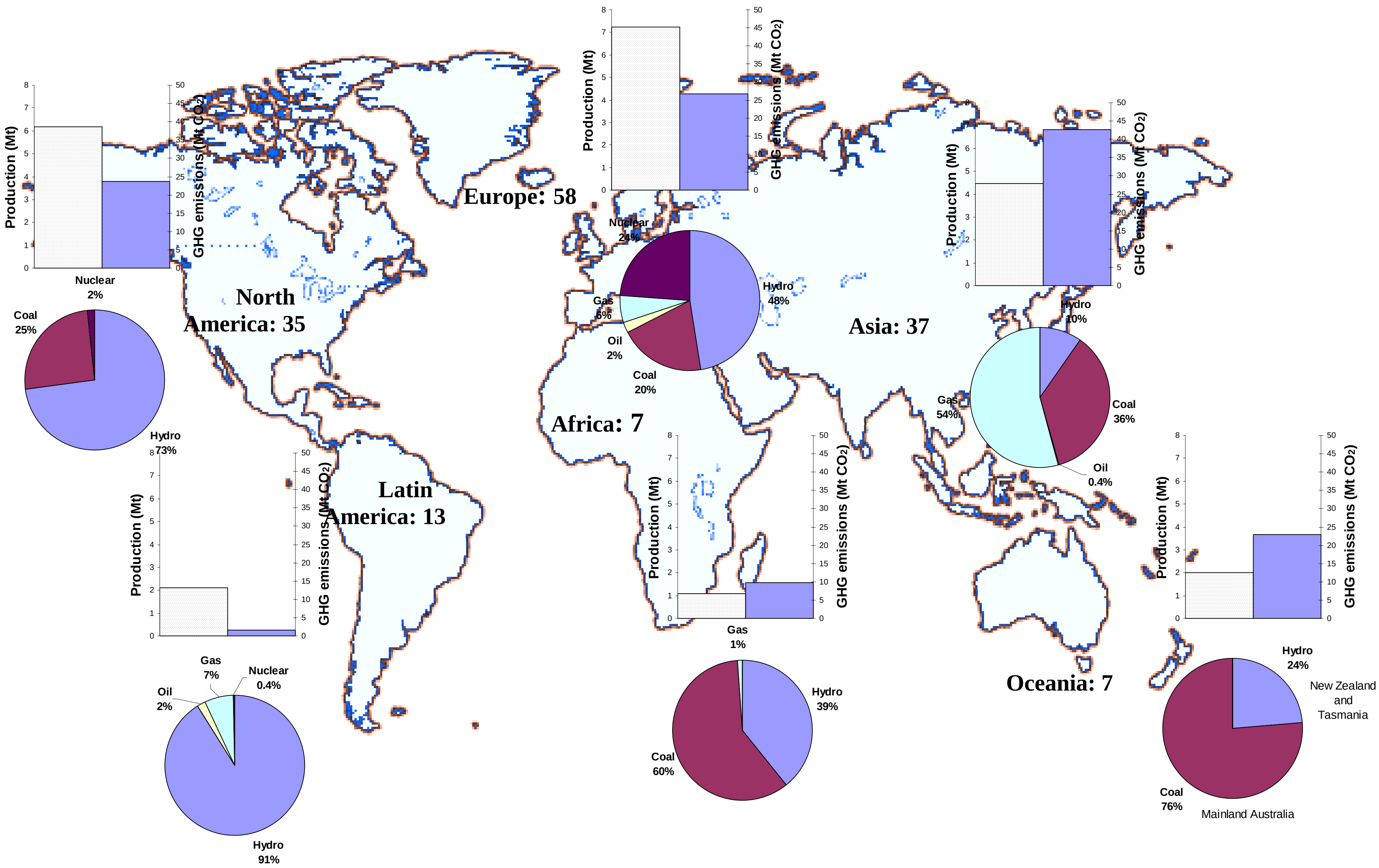
[78] These estimates of greenhouse gas emissions are based only on the generation of the electricity, and do not include emissions arising from the collection of fuel for that electricity generation. For example, estimates of gas-fired generation exclude emissions associated with flaring and venting of natural gas during the production and delivery phase. Similarly, fugitive methane emissions that occur with the mining of some coals are excluded from estimates of greenhouse gas emissions from coal-fired electricity. In the case of hydroelectric generation, emissions of methane resulting from the rotting of vegetation in reservoirs are similarly excluded.

[79] See http://www.world-aluminium.org/environment/climate/climate_change1.html

[80] The IAI compared countries in listed in Annex 1 to the United Nations Framework Convention on Climate Change (developed) with those countries not listed in Annex 1 (developing).

[81] Inert anode technology has the potential to change this significantly, although it is not yet in widespread use.

**Figure 6 Regional aluminium production, associated electricity-related greenhouse gas emissions and smelting electricity sources, 1999**



It is reasonable to assume that any new smelter or smelter refurbishment will install modern technology that minimises PFC emissions and therefore smelter location will have little or no impact on these emissions. On the other hand, electricity fuel mix and greenhouse emissions are highly dependent on location. Accordingly, if expansion of the aluminium smelting industry is focussed on minimising greenhouse gas emissions, development will be concentrated in areas with access to hydroelectric, nuclear and gas-fired generation. This is consistent with the IAI's findings on future development.

In the case of Australia, the information in Figure 5 shows that a decision by the industry to direct expansion, or to relocate, offshore will generally have a positive impact on the environment. Based on the worldwide average emissions-intensity of aluminium smelting, each 100,000 tonnes of capacity that Australia forgoes will reduce global greenhouse gas emissions by 0.8 million tonnes per annum.

### 3.5 Electricity prices and market power

Electricity is a key input into the aluminium smelting process and accounts for a large proportion of industry costs. Accordingly, smelters throughout the world seek to obtain electricity as cheaply as possible. As discussed in Sections 2.6 and 2.7, the electricity prices paid by Australian smelters are a well-kept secret, and this situation is replicated throughout the world. However, there is sufficient evidence to confirm that the industry has secured electricity at below market prices throughout the Western World.[82] As a result of these arrangements, it is likely that world aluminium prices are lower than they would otherwise be, encouraging overuse and reducing incentives for recycling.

As shown in Section 3.3, the industry is highly concentrated, enabling smelting companies to exercise excessive market power when negotiating power contracts. Further, the major smelting companies have close ties with one another, and often co-operate in joint ventures. This has led some commentators to suggest that a degree of collusion exists within the industry, with companies co-ordinating their claims and negotiating power. The Venezuelan courts, for example, forced Alcoa and Alcan to withdraw from the proposed privatisation of Corporación Aluminios de Venezuela, after warning that they would become a world monopoly if they acquired the firm.[83] Analysts generally agree that there are relatively few expansion opportunities available to Alcoa that would not raise concerns amongst North American and European competition regulators.[84]

The industry in Australia has been discussed in detail in Section 2. The electricity subsidies received by smelters in some other countries, and the negotiating tactics employed by smelting companies worldwide are discussed below. It should be noted that there are regional differences that preclude a simple comparison of electricity

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[82] This term is used broadly to denote all countries except China, the former Soviet Union and Eastern European countries.
[83] *Inter Press Service*, 17 March 1998, http://www.oneworld.org/ips2/mar98/21.44_085.html. Interestingly, Alcan was created through the forced break-up of Alcoa in 1928. The view of the Venezuelan courts is that this break-up is no longer effective as a means of limiting market power.
[84] *Australian Financial Review*, 16 October 2001, http://afr.com/premium/marketwrap/equities/2001/10/16/FFX9LFD4USC.html

prices paid in one country with those in another. A high price is not necessarily unsubsidised, nor a low price necessarily subsidised. For example, a subsidised price in the Pacific Northwest of the USA (see below) is close to the wholesale market price in Australia. These regional differences have been taken into account in the following discussion.[85]

*New Zealand*

In New Zealand, the Comalco/Sumitomo smelter, located at Tiwai Point on the southern tip of the South Island, is reported to be receiving subsidised electricity. In 1987, the CEO of the corporatised Electricorp stated that '[u]nder the existing agreements…all other electricity consumers will be subsidising the smelter. Comalco is benefiting by $1-1.5 million per week as a result of the present agreements'.[86] At the time this estimate was made, the smelter had electricity contracts for 485 MW (Comalco NZ 1998). Accordingly, the annual subsidy was in the order of NZ$50-75 million, implying a per MWh subsidy of NZ$12-18. Moreover, there were allegations that Comalco attempted to exercise political influence over decisions regarding the smelter and its power supply arrangements in the early 1970s by issuing cheap shares to influential New Zealanders including politicians, judges and newspaper executives.[87]

Comalco also threatened to direct investment away from New Zealand. During power negotiations the company suggested that it had to decide between a number of projects – constructing a fourth potline at Tiwai Point, expanding operations in Australia or building an entirely new smelter in Chile.[88] In the end it chose both to expand the Tiwai Point smelter and upgrade the Boyne Island smelter in Australia (in addition to purchasing the Gladstone Power Station). It is reasonable to assume that, consistent with past behaviour, Comalco used the same negotiating tactics with the Queensland Government.[89]

*Canada*

The Alouette, Becancour, Baie Comeau and Lauralco smelters in Canada are supplied electricity by Hydro-Quebec, a government-owned utility. The Alouette (owned by VAW, Corus, Marubeni, Kobe, Austria Metall and the Quebec government) and Baie Comeau (Alcoa) smelters were reported to be paying CAN$22.70 per MWh in 1998

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[85] As discussed in Section 2.7, ISR suggested that in 1998 the median electricity price paid by smelters around the world was US$16.20/MWh, the average was US$19.30/MWh and the lowest was US$5/MWh (ISR 2001, p. 8). This information alone provides no indication of the existence or extent of subsidies.

[86] *Multinational Monitor* 1992, http://www.essential.org/monitor/hyper/issues/1992/06/mm0692_07.html

[87] *Multinational Monitor* 1992, see previous footnote.

[88] *Multinational Monitor* 1992, see previous footnote.

[89] This negotiating tactic is not inconsistent with Comalco's recent approach to deciding on an appropriate site for expanding its alumina operations. Commentators suggest that by threatening to establish a refinery in Malaysia instead of in Australia, Comalco (Rio Tinto) was able to obtain an 'assistance package' from Federal and Queensland Governments worth about $300 million (*Australian Financial Review*, 10 October 2001, Go-ahead ends Gladstone refinery doubt, http://www.afr.newsalert.com/bin/story?StoryId=Co8phWfebrKzyuunbr0Xlu0m&FQ).

(or US$15.20 per MWh).[90] The contracts between Hydro-Quebec and the smelters set the maximum electricity costs at 18.5 per cent of total production costs, however other provisions meant that the smelters were paying around US$3.60/MWh less than this in 1998. These Canadian smelters were paying around 35 per cent less than other industrial customers, equivalent to a subsidy of around CAN$60,000 per employee in the case of Alouette.[91] Similar contracts, between Hydro-Quebec and Norsk Hydro (for the supply of a magnesium smelter), were deemed by the United States Department of Commerce to confer a subsidy. The Department took steps towards implementing trade restrictions before the contracts were hastily rewritten (WTO 1993).

Quebec's former Premier, Lucien Bouchard is reported to have said that by 1998 Hydro-Quebec had already lost about CAN$2 billion supplying the four aluminium smelters.[92] Clauses in the contract mean that from 2002 the electricity price will be partly pegged to the average electricity cost paid by smelters around the world – a requirement that will further ensure that the electricity price is entirely unrelated to Hydro-Quebec's actual costs of supplying power.

*United States of America*

In the Pacific Northwest of the USA, the Bonneville Power Administration (BPA), an agency of the US Department of Energy, provides power to a number of aluminium smelters (38 per cent of USA smelting capacity is concentrated in Washington, Oregon and Montana). The ten smelters in this region have a total capacity of 1.6 million tonnes and demand around 3000 MW of power (USGS 1999; Altech 2001; Kaiser Aluminium 2001; Alcoa 2001; Convergence Research 1996).

Compared with industrial customers supplied by other distributors in the region, aluminium smelters paid between US$2 billion and US$5.9 billion less for an equivalent amount of power over the period 1980-1994 (Convergence Research 1996). In 1994 the amount by which smelters were underpaying their share of full system costs as per the Northwest Power Planning Act was around US$16 per MWh (Convergence Research 1996). A number of groups have conservatively estimated that the annual subsidy for the period 1996-2001 was over US$200 million (FoE 1996, Convergence Research 1995), or around US$8/MWh averaged across the entire 3000 MW. ABARE noted that a few aluminium smelters in the USA received 'electricity at prices as low as –US0.5c/kWh, implying there are cross-subsidies' (ABARE 1992, p. 28). In addition, the aluminium smelters have avoided paying state utility taxes because BPA is a Federal body. Other industrial customers in the same region (but supplied by other distributors) are required to pay these taxes.

These subsidy estimates were made prior to the electricity shortages in California in 2000-01, which caused wholesale electricity prices to peak as high as US$500/MWh

[90] *The Gazette* (Montreal), 14 December 1998, Hydro gets chance to alter deals: Second secret contract adds $460 million to shortfall, p. A1
[91] *The Gazette* (Montreal), 21 December 1998, Smelter gets cheap electricity: Sweetheart Alouette deal is costing Hydro dearly, p. A1
[92] *The Gazette* (Montreal), 14 December 1998, Hydro gets chance to alter deals: Second secret contract adds $460 million to shortfall, p. A1

(compared with US$22.60/MWh paid by aluminium smelters).[93] Under these conditions, many smelters found producing aluminium to be less profitable than selling their contracted power into the market at much higher rates.[94]

BPA's numerous attempts to reduce the scale of the subsidies enjoyed by the aluminium smelters have been met by threats and political interference. In what is a reoccurring tactic, in the late 1970s all the smelting companies operating in the Pacific Northwest threatened to leave the region unless their electricity rates were tied to the world price of aluminium (Convergence Research 1996). That is, they demanded that the utility accept some of the commercial risk associated with operating an aluminium smelter.

*South Africa*

In South Africa, the industry is reported to by paying as little as US$3/MWh (Bond 1999, p. 12).[95] A senior government official describes the policy of providing electricity to smelters as follows: "if we increase the price of electricity to users like [BHP-Billiton's] Alusaf, their products will become uncompetitive and that will affect our balance of payments" (Bond 1999, p. 12). In other words, the industry would not be able to compete on the world market without receiving a subsidy from the government-owned utility, Eskom. Interestingly, a former key financial officer at Eskom 'approved arrangements that led to sales of electricity to [one of BHP-Billtion's] smelter[s] at an extremely low price' and subsequently took up a chief executive position at Billiton (Bond 1999, p. 14).[96]

*Brazil*

Multinational aluminium corporations have successfully extracted favourable arrangements from developed countries where electricity deregulation is progressing and governments are held somewhat accountable. It is likely that the smelters are able to negotiate even larger subsidies in developing countries where governments are often desperate to earn foreign exchange and promote development.[97] In many cases, these governments experience higher levels of corruption and are less accountable, potentially benefiting the aluminium industry further.

In the case of Brazil, Alcoa readily admits that it obtains electricity for its Alumar smelter (owned jointly with BHP-Billiton) from a government-owned utility (Eletronorte) 'at a small discount from the applicable industrial tariff' (Alcoa 2001, p. 11). The Alumar smelter obtains its power from the Tucurui hydroelectric dam[98]

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[93] *Australian Financial Review*, 11 April 2001, p. 26

[94] For example, see *Australian Financial Review*, 13 January 2001, *Christian Science Monitor*, 9 February 2001, http://www.csmonitor.com/durable/2001/02/09/p2s2.htm,

[95] It is not clear whether this is the rate for the energy alone, or includes all costs associated with electricity supply, such as transmission. Regardless, it is extremely low but comparable to the price paid by the Victorian smelters.

[96] See also http://www.billiton.com/newsite/html/investor/keypeople/ExecutiveDir.htm.

[97] For example, in the case of smelters supplied with hydroelectric power 'the enormous costs of dam construction, particularly in developing countries, tends to be met by governments, aid agencies and taxpayers, rather than by the actual consumers of electricity' (ABARE 1992, pp. 28-29).

[98] Arguably one of the biggest environmental and social disasters in dam-building history. For an evaluation of the project see the case study produced by the World Commission on Dams (2000).

and, as with many other smelters around the world, the electricity price is linked to the price of aluminium on the world market, reflecting an expectation held by the aluminium smelting industry that others should bear its commercial risks. These arrangements have resulted in Alumar paying around US$13/MWh in recent years, with prices so low in 1997 that the State-owned utility Eletronorte subsidised Alumar to the tune of US$200 million.[99] The contract under which Alcoa and BHP-Billiton obtain this subsidy expires in 2004, and it appears that the corporations have recognised that there will be significant resistance to them obtaining subsidised power in the future. Accordingly, they are involved in consortia that are seeking to develop a number hydroelectric power stations in the Amazon Basin, including the Serra Quebrada and Santa Isabel dams (IRN 2001, p. 12).

*General comments*

An ING Barings study of a dozen smelters throughout the world provides estimates of the cost of electricity for a number of different operations (see ING Barings 1997 in ING Barings 2000). The results are reproduced in Table 14. According to this study, smelters obtaining the cheapest electricity are located in Bahrain, France, Cameroon, Australia and Canada, whereas higher prices are paid in the Eastern European countries. Although this information alone provides no indication of whether smelters receive subsidised electricity, it does demonstrate that smelters located in those markets to which the multinational aluminium companies have had access receive cheaper power than those smelters that have historically operated in countries where

**Table 14 Electricity costs for selected smelters**

| Smelter | Country | Electricity costs (US$/tonne) | Electricity prices (US$/MWh)* | Current Owner |
|---|---|---|---|---|
| Alro Slatina | Romania | 647 | 40-46 | Govt, private (privatisation imminent) |
| Inota | Hungary | 580 | 36-41 | Magyar |
| Konin | Poland | 482 | 30-34 | Impexmetal, workers, govt |
| Mostar | Bosnia | 541 | 34-39 | Govt |
| Bogoslovsk | Russia | 452 | 28-32 | SUAL |
| Edea | Cameroon | 239 | 15-17 | Pechiney, govt |
| Alba | Bahrain | 172 | 11-12 | Govt, others |
| Bell Bay | Australia | 258 | 16-18 | Comalco |
| Dunkerque | France | 175 | 11-13 | Pechiney |
| Hamburg | Germany | 404 | 25-29 | Alcoa, VAW, AMAG |
| Alouette | Canada | 265 | 17-19 | VAW, Corus, Marubeni, Kobe, AMAG, govt. |
| Columbia Falls | USA | 387 | 24-28 | Glencore |

* Based on 14-16 MWh/tonne.
Source: ING Barings 1997 in ING Barings 2000; AME 2001; Plunkert 2000; Plunkert 2001; USGS 1999; SGF 2001

[99] *Die Wochenzeitung* (Swiss), No. 21, 5 May 2000, pp. 15-19

those multinationals have had no influence. However, it is possible that this is coincident with other factors, such as lower efficiency (technological and economic) and poor access to cheap raw materials for power production in Eastern European countries. It should also be noted that these prices in Eastern Europe are exceptionally high, particularly when one considers that the US dollar prices of many goods and services in Eastern European countries are significantly lower than the US dollar prices of equivalent goods and services in Western developed countries.

### 3.6 Summary and conclusions

The global aluminium smelting industry is dominated by a handful of companies. Only in those economies that have been largely closed to foreign investment do the major aluminium multinationals have little influence. The five largest players, Alcoa, Alcan, Pechiney, BHP-Billiton and Norsk Hydro, control 52 per cent of capacity outside China and former communist-bloc countries. Close to three-quarters of this capacity is controlled by the top 10 companies. In major aluminium-producing countries, Alcoa and Alcan own an average of around 40 per cent of production.

On a regional basis, most smelters use a similar amount of electrical energy per unit of aluminium metal produced. Accordingly, electricity prices have an important influence on profitability. There is evidence that multinational smelting companies attempt to exercise undue power during negotiations with governments eager to promote industrial development in their country or region. A common negotiating tactic used by smelters is to threaten to relocate elsewhere or to withhold investment from a particular area if governments do not guarantee them cheap power.

However, unlike the Australian industry, the global industry generally obtains electricity from a variety of sources, with hydro predominating and coal contributing only 30 per cent. As a consequence, Australian production is relatively greenhouse-intensive, with intensity exceeding the regional averages for Asia, Africa, North America, Europe and Latin America. Aluminium produced in Australia is around 2.5-times more greenhouse gas intensive than the world average. Moreover, new aluminium smelting capacity is expected to be, on average, far less greenhouse intensive than Australian production.

Accordingly, if greenhouse gas abatement policies in Australia were to lead to the relocation of the smelting industry to other parts of the world this would have a net benefit in terms of global greenhouse gas emissions. Each 125,000 tonnes of capacity that relocates from Australia would reduce annual global greenhouse gas emissions by one million tonnes.

# 4. The Australian smelting industry in a post-Kyoto world

The aluminium smelting industry has frequently threatened to redirect investment away from Australia if governments introduce greenhouse gas abatement policies that increase the cost of energy.[100] The industry argues that because developing countries are not covered by the targets in the Kyoto Protocol their governments will not need to introduce greenhouse gas abatement policies that increase energy costs and, as a result, the smelting industry will head to those countries. Accordingly, the industry argues, introducing greenhouse gas abatement policies that affect the price of energy in Australia will not lead to reduction in global greenhouse gas emissions and will merely shift the location of emissions – so called 'carbon leakage'. The Australian industry has also sought to point out that because Australia is slightly more efficient in using electricity and has reduced direct emissions from smelting then it should be a preferred location, on environmental grounds, for smelter operation.

However, we have seen that electricity-related emissions attributable to smelters in Australia are two and a half times the world average per tonne of aluminium produced. In future expansion, the International Aluminium Institute expects the majority of smelters will obtain electricity from sources with zero emissions. The IAI also reports that the direct emission of greenhouse gases during smelting have decreased to a similar level in both industrialised and developing countries. Accordingly, relocation of the industry from Australia will benefit the global environment, reducing net emissions by around 15 million tonnes per annum if the entire industry were to relocate to those regions of the world where future expansion is expected.

Furthermore, the industry's claims about the likelihood of relocation should also be tested. As noted by ACIL (2000, p. 21), cheap power is only one of the factors affecting the competitiveness of the smelting industry in Australia. Other factors include:

- abundant raw materials close at hand;
- alumina at world's best quality and price;
- highly reliable alumina supplies;
- relatively low transport costs;
- a high level of technology enabling world's best practice in smelter operation;
- well developed infrastructure;
- economic and political stability;
- the capacity to recycle scrap aluminium; and
- tolerance of a high level of foreign ownership.[101]

This is confirmed by research conducted for the Federal Government by Dr Lee Schipper, who noted that location of the mineral resource, transport and technical

[100] The AAC routinely groups aluminium and alumina together when discussing the threat to the industry of greenhouse policies, even when it is widely recognised that since 'Australia maintains a very cost competitive position in alumina production and has a significant proportion of the world market share, it is unlikely to be disadvantaged by an increase in the general level of alumina price that may result from greenhouse policies' (ABARE 1992, p. 32).

[101] This last point was made by Johnston *et al*. 1996, pp. 110-113

expertise are more important determinants of the location of large industrial projects than energy costs.[102] If cheap energy was the only factor making Australia's aluminium smelting industry low-cost and low-risk, then increases in the price of power would encourage multinationals to invest elsewhere. Fortunately, Australia has many other advantages.

Project lifetime is another important issue that is often overlooked in the discussion of carbon leakage. The Bell Bay smelter was constructed 46 years ago, the Point Henry smelter 38 years ago and the Kurri Kurri smelter 32 years ago. The average age of smelters in the USA is 47 years, in Western Europe 38 years and South America 31 years (ACIL 2000, p. 22). What this serves to illustrate is that an investment in a smelter is a long-term (40 years-plus) proposition. The United Nations Framework Convention on Climate Change acknowledges that developing countries will be expected to follow the lead of industrialised countries and take on greenhouse gas emission targets in the future. In all likelihood this will be 10-15 years after developed country emission restrictions are implemented. Accordingly, it appears unlikely that corporate executives will decide to relocate aluminium smelters to developing countries because in many cases the benefits of cheaper energy obtained over 10-15 years will not offset the disadvantages for the remaining 25-30 years of operation of higher transport costs, greater political risk, poor infrastructure, less expertise, poorer-quality alumina and inadequate technology.

Clearly, it is unlikely that the Australian industry will relocate or redirect investment to developing countries in response to greenhouse gas abatement policies because Australia has many commercial advantages (other than cheap energy) not possessed by these countries. If the industry is to relocate or redirect investment, it will most likely be to those countries endowed with similar advantages, many of which appear in Annex B of the Kyoto Protocol and therefore have abatement targets.

The overall contribution of the aluminium industry to abatement efforts should also be examined. In general, a greenhouse gas abatement regime, international or domestic, should be designed to ensure that abatement occurs where it is cheapest. Economic modelling of emissions trading schemes, which are one means to concentrate abatement where it is most cost-effective, predict that much of this abatement will be concentrated in the aluminium sector (for example, see Jakeman *et al.* 2001; Allen Consulting 2000).[103] In other words, these models suggest that the greatest emission reduction can be achieved for the least economic pain by concentrating reductions in aluminium smelting. Accordingly, if the industry were quarantined from energy price increases and other requirements to reduce emissions, a larger economic sacrifice would need to be made to meet abatement targets and this would fall more heavily on other sectors. Many of these other sectors contribute far more to employment and GDP relative to their contribution to greenhouse gas emissions.

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[102] *Australian Energy News*, DPIE, September 1997. Note, in the case of the aluminium industry location of the mineral resource (bauxite) is somewhat less important than for some other minerals.
[103] These models have a number of well-documented flaws (Hamilton *et al.* 2001) that tend to inflate estimates of the economic cost of abatement policies. However, apart from a few fundamental omissions, they can generally identify those sectors in which large emission reductions are available for relatively little economic cost.

To summarise, the industry is unlikely to relocate from Australia to developing countries because Australia has many advantages other than cheap energy. However, the industry may choose to site operations in other industrialised countries that offer a low-emission electricity supply. Regardless, the global environment would benefit from the aluminium smelting industry relocating from Australia because greenhouse gas emissions per tonne of aluminium are substantially higher in Australia compared to the rest of the world. As we have seen in Section 2, the Australian economy may also benefit from the removal of subsidies to the industry. Thus, in the case of the aluminium smelting industry, greenhouse abatement policies that increase the cost of energy in Australia will result in improved global environmental outcome and may improve economic performance by promoting better allocation of resources.

*Afterthought – World Trade Organization and Smelter Subsidies*

The aluminium smelting industry in Australia claims that it is not subsidised. For example, the head of Alcoa's Victorian operations has stated that the aluminium industry 'has developed without government protection,'[104] and the former head of the Australian Aluminium Council has stated that 'the industry is not subsidised, as is sometimes wrongly claimed by some commentators'.[105] ISR says that if Australian smelters are receiving subsidised power then it leads to the 'unlikely conclusion that up to 50 per cent of the world's supply of aluminium is subsidised' (ISR 2001, p. 9).[106] However, as demonstrated in Section 3.5, this conclusion is not unlikely at all and is entirely consistent with evidence available around the world. The fact that only five companies control more than 50 per cent of the supply of aluminium outside China and former communist-bloc countries makes it even more likely that they are able to exercise significant power in negotiations with governments over electricity pricing. By employing the well-used tactic of threatening to take their export earnings and their jobs elsewhere, the industry has secured subsidised electricity throughout the world.

Many of the subsidies provided to the aluminium smelting industry may very well be 'actionable' under the World Trade Organization (WTO) Agreement on Subsidies and Countervailing Measures ("the Agreement").[107] According to the Agreement, a subsidy is deemed to exist if:

> (a)(1) there is a financial contribution by a government or any public body…, where (iii) a government provides goods and services other than general infrastructure…or…(a)(2) there is any form of income of price support, [which operates directly or indirectly to increase exports of any product from…its territory][108]…and (b) a benefit is thereby conferred (Article 1.1).

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[104] Peter Burgess, address to the Committee for the Economic Development of Australia, 15 November 2000, http://www.alcoa.com.au/news/speeches/PeterBurgessCEDAspeech.html)
[105] David Coutts in SECITA 2000, p.161
[106] The logic behind this statement by ISR seems to be that because Australian industrial electricity prices are 'among the lowest…in the world' it could be expected that Australian smelters pay electricity prices 'well within [sic] the median' worldwide price and therefore if Australian smelters are subsidised then 'up to [half] the world's supply of aluminium is subsidised' (ISR 2001, pp. 8-9). This arguement is not strong.
[107] See WTO 1994
[108] See Article XVI in GATT 1994 and GATT 1947

This definition of a subsidy appears to apply to the benefit received by many smelters from government-subsidised electricity.

To be subject to the Agreement, the subsidy must also be 'specific to an enterprise or industry or group of enterprises or industries' (Paragraph 2.1). However, '(a) where the granting authority…explicitly limits access to a subsidy to certain enterprises, such a subsidy shall be [deemed to be] specific.' In many cases it is only the aluminium smelting industry, or an individual smelter, that receives the subsidised electricity, suggesting that arrangements are sufficiently specific for the Agreement to apply.

The Agreement also sets out whether or not a subsidy is 'actionable'. For this to be the case, the subsidy must cause 'adverse effects to the interests of other Members [of the agreement], i.e.: (a) injury to the domestic industry of another Member…(c) serious prejudice to the interests of another Member.' (Article 5). Serious prejudice, for example, is 'deemed to exist in the case of: (a) the total ad valorem subsidization of a product exceeding 5 per cent' (Paragraph 6.1 (a)). Based on a simple calculation, the subsidy to the aluminium smelters would need to be lower than about US$4.50/MWh to avoid triggering Paragraph 6.1 (a), based on a product value of US$1350 per tonne of aluminium.[109] This compares with the estimate for Australia (in Section 2.7) of an average subsidy of A$8.50/MWh, rising to A$17.50/MWh for Portland and Point Henry. Serious prejudice may arise under a number of other situations that may also be applicable to aluminium smelters (see Article 6).

Where a subsidy is actionable, a Member to the Agreement may seek to have the effects of the subsidy remedied through a number of procedures (Article 7 and Part V). There is at least one precedent for trade-related action against the provision of subsidised power. The United States took trade action against Canada over subsidies provided to Norsk Hydro's magnesium smelting operations in Canada. '[A] favourable hydro electricity contract negotiated between the producer, Norsk-Hydro, and the provincially-owned utility, Hydro-Quebec' was deemed by the United States Department of Commerce to confer a subsidy (WTO 1993). This forced a renegotiation of the power contracts.

Accordingly, if the industry in Australia believes its own claims that it does not receive subsidised electricity, it would be in its best interests to encourage the Australian Government to take action in the WTO against those countries that do subsidise their smelters, including New Zealand, the USA and Brazil.[110] This should be the first step in protecting the competitiveness of the industry in Australia, irrespective of the impact of greenhouse gas abatement policies.

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[109] '[I]n determining whether the overall rate of subsidisation exceeds 5 per cent of the value of the product, the value of the product shall be calculated as the total value of the recipient firm's sales in the most recent 12-month period, for which sales data is [sic] available, preceding the period in which the subsidy is granted' (Annex IV, Paragraph 2). For this calculation it has been assumed that the total value of sales would not have been different in the absence of the subsidy (even though output and sales may have been lower without the subsidy).

[110] ABARE readily notes that there is evidence of subsidisation in the USA (ABARE 1992, p. 28). On the other hand, if another country believes Australia subsidises its smelters, as the analysis in this paper strongly indicates, then they would have strong grounds to claim that these subsidies where hurting their own industry and take trade action to force Australia to remedy the situation.

# References


AAC 2000a, Aluminium investment could shift to 'non-Kyoto' countries, Press Release, 20 November

AAC 2000b, 1999 Greenhouse Challenge Public Statement, Australian Aluminium Council, http://www.aluminium.org.au/Downloads/Policy/1999_GH_Chall_Pub_statement.pdf

AAC 2001a, EU approach threatens cost hikes of 30 per cent, Press Release, 18 July

AAC 2001b, Australian Aluminium Statistical Summary, Australian Aluminium Council, http://www.aluminium.org.au/Stats.html

ABARE 1992, Greenhouse policies and the Australian aluminium industry, Australian Bureau of Agricultural and Resource Economics, Report prepared for the Aluminium Development Council, ABARE project 5227.102.

ABS 1998, International merchandise trade, Australian Bureau of Statistics 5422.0.

ABS 1999a, Labour force, Australian Bureau of Statistics 6203.0

ABS 1999b, International merchandise trade, Australian Bureau of Statistics 5422.0

ABS 2000, National income, expenditure and product: Australian national accounts, Australian Bureau of Statistics 5206.0

ABS 2001, Consumer price index, Australian Bureau of Statistics 6401.0

ACIL 2000, Aluminium and the Australian Economy, A report to the Australian Aluminium Council, ACIL Consulting, May

ACIL 2001, Employment Indicators for Australia's Renewable Energy Industries: Synopsis, ACIL Consulting, http://www.seda.nsw.gov.au/pdf/employmentindicators.pdf

ACTED Consultants 2001, Alumina, aluminium chemicals & zeolites, http://www.chemlink.com.au/alumina.htm

AGO 2001a, National greenhouse gas inventory 1999, National Greenhouse Gas Inventory Committee, Australian Greenhouse Office, April 2001.

AGO 2001b, National greenhouse gas inventory: analysis of trends and greenhouse indicators 1990-99, National Greenhouse Gas Inventory Committee, Australian Greenhouse Office, April 2001.

AIGN 1998, Australian Industry Greenhouse Network Submission on Efficiency Standards and Renewable Energy Issues Papers, July

AIGN 2000, A Submission to the House of Representatives Joint Standing Committee on Treaties: Inquiry into the Kyoto Protocol, Australian Industry Greenhouse Network, September

Alcan 2001, Primary Metal in Alcan Facts 2001, http://www.alcan.com/corporate/alcancom.nsf/graphics/documents/$file/AFE04-07.pdf

Alcoa 2001, Annual Report, US Securities Exchange Commission Form 10-K, 2000

Allen Consulting 2000, Meeting the Kyoto Target: Impact on Regional Australia, Report for the Minerals Council of Australia, Melbourne, November

Altech 2001, http://www.altech.is/smelters.htm

AME 2001, Aluminium smelters, AME Mineral Economics, http://www.ame.com.au/smelters/al/smelters.htm

Aurora Energy 2001, Electricity rates, http://www.auroraenergy.com.au/default.asp?pageID=193&Level1=5&Level2 =147&Level3=193

AusWEA 2001, Wind force 10: A blueprint to achieve 10% of the world's electricity from wind power by 2020 – the Australian contribution, Australian Wind Energy Association and Greenpeace

AWEA 2000, Wind Energy and Economic Development: Building sustainable jobs and communities, Wind Energy Fact Sheet, American Wind Energy Association, http://www.awea.org/pubs/factsheets/EconDev.PDF

Billiton 2000, http://www.billiton.com/newsite/html/investor/aboutus/Alumunuium.htm

Blake, T. 1991, Towards a sustainable Victoria? An evaluation of the conservation and environment policy performance of the Cain Government, Cain Government: Policies and Performance Seminar, University of Melbourne, February

Bond, P. 1999, Economic growth, ecological modernization or environmental justice? Conflicting discourses in South Africa today, presented at Political Economy, the Environment and Economic Crisis conference, Union of Radical Political Economics, Bantam, Connecticut, August, http://qsilver.queensu.ca/~mspadmin/pages/Project_Publications/Papers/Economic.pdf

Booth, R.R. 2000, Warring tribes: the story of power development in Australia, The Bardak Group, Perth

Burgess, P. 2000, The Australia Aluminium Industry – Prospects & Challenges, Executive Director, AWA Victorian Operations, http://www.alcoa.com.au/news/speeches/PeterBurgessCEDAspeech.html, 15 November

Bush, S., Dickson, A., Harman, J. and Anderson, J. 1999, Australian energy: market developments and projections to 2014–15, ABARE Research Report 994, Canberra.

CAV 2001, CVG Venalum: The Company, Corporación Aluminios de Venezuela, http://www.aluminio.com.ve/english/venalum_en.htm

Century 2001, Century Aluminum in brief, http://www.centuryaluminum.com/content.htm

Citipower 2001, Electricity Prices for Residential Customers, http://www.citipower.com.au/resprices.pdf

Comalco NZ 1998, Annual Review 1997, Comalco New Zealand Ltd, http://www.comalco.com.au/01_about/12_comnz_rev97.pdf

Convergence Research 1995, Bonneville Power Administration – Giving it all away, http://www.converger.com/bpa/BPAAFDC.htm

Convergence Research 1996, On the Brink: Nuclear Debt, Subsidies, and the Future of Bonneville Power Administration, Prepared for American Rivers, Trout Unlimited, Oregon Natural Resources Defense Council, September, http://www.converger.com/bpabrink/bpabrinklyz.htm

CREA 1993. The Tasmanian Economy in 2009-10 Under Two Electricity Consumption Scenarios, Centre for Regional Economic Analysis, University of Tasmania, Report Commissioned by the HEC, 26 January.

Department of Treasury & Finance (Victoria) 1997, Victoria's Electricity Supply Industry: Towards 2000, Energy Projects Division, June, http://www.energy.dtf.vic.gov.au/domino/web_notes/energy/dtf_epd_www.nsf/WebPages/Stage+Four+Publication

DIC 2001, State-Run Integrated Aluminium Giant Launched, Press Release 24/02/2001, China Economic Information Network, Department of International Co-operation, State Information Center, http://ce.cei.gov.cn/enew/new_f1/fi00fbc4.htm

Eastern Aluminium 1999, Annual Report 1998, Eastern Aluminium Ltd.

ECQ 1993, Queensland election 1992: Statistical returns, Electoral Commision Queensland, Brisbane, March

ECQ 1995, Queensland election 1995: Statistical returns, Electoral Commision Queensland, Brisbane, 13 October

EME 1997, Current Report, US Securities Exchange Commission Form 8-K/A, Edison Mission Energy, March 31 (filed 23 May)

EME 2001, Annual Report, US Securities Exchange Commission Form 10-K, 2000, Edison Mission Energy

Enertrade 2001, Enertrade Annual Report 2000-01, Queensland Power Trading Corporation, http://www.enertrade.com.au/report2000/ENE.AnnualReport.pdf

ESAA 2000, http://www.esaa.com.au/head/portal/informationservices/data

FoE 1996, River of Red Ink, Economics for the Earth, Friends of the Earth – NW Office, http://www.foe.org/foenw/e4e/redink2.html

Gallagher, D.R., McColl, G.D., Copeland, M.C. and McDonald, T.K. 1981, The national economic benefits of the Gladstone Aluminium Smelter, Contract Study for Comalco Limited, April

GATT 1947, General Agreement on Tariffs and Trade 1947, World Trade Organisation, http://www.wto.org/english/docs_e/legal_e/gatt47.pdf

GATT 1994, General Agreement on Tariffs and Trade 1994, World Trade Organisation, http://www.wto.org/english/docs_e/legal_e/06-gatt.pdf

Gillespie, A. 1999, Public/Private Partnerships for Power Development in Australia, ATSE Delegation to South Africa, 1-2 November 1999, Australian Academy for Technological Sciences and Engineering, http://www.atse.org.au/publications/irc-reports/paper-south_africa_november_1999p4.htm

Green, A. 1991, 1991 New South Wales Legislative Assembly Election: Estimate two-candidate preferred results by polling place, NSW Parliamentary Library Background Paper No. 1994/6

Hamilton, C., Pears. A., and Pollard. P. 2001, Regional Employment and Greenhouse Policies, Discussion Paper no. 41, The Australia Institute, October

IAI 2000a, Electrical Power Used in Primary Aluminium Production - Form ES002, International Aluminium Institute, http://www.world-aluminium.org/iai/stats/es002.html, 20 December

IAI 2000b, Annual Primary Aluminium Production, International Aluminium Institute, http://www.world-aluminium.org/iai/stats/primary.html, March

IAI 2001, Primary Aluminium Annual Production Capacity - Form 250, International Aluminium Institute, http://www.world-aluminium.org/iai/stats/250.html, 20 February

Industry Commission (IC) 1998, Micro reform – impacts on firms: aluminium case study, Research Paper, Ausinfo, Canberra, March 1998.

ING Barings 2000, Romanian Aluminium Sector, ING Barings Romanian Research, January, http://www.ingbarings.ro/Research/Analyses/romalum.pdf

IPCC 1997, Revised 1996 IPCC guidelines for national greenhouse gas inventories: workbook, Volume 2, Intergovernmental Panel on Climate Change, United Nations Framework Convention on Climate Change

IPCC 2001, Third assessment report, Intergovernmental Panel on Climate Change, United Nations Environment Programme/World Meteorological Organisation

IRN 2001, World Rivers Review, Vol. 16, No. 5, International Rivers Network, October

ISR 2000, Energy efficiency best practice in the Australian aluminium industry: Sector study, Energy Efficiency Best Practice Program, Department of Industry, Science and Resources, May

ISR 2001, Light metals action agenda, working paper no. 1: Aluminium, Department of Industry, Science and Resources, August

Jackson, J., McIver, R., McConnell, C. and Brue, S. 1999, Economics, Irwin/McGraw Hill

Jakeman, G., Heyhoe, E., Pant, H., Woffenden, K. and Fisher, B.S. 2001, The Kyoto Protocol: Economic impacts under the terms of the Bonn agreement, ABARE Conference Paper 2001.28

Johnston, S., Gostelow, P., Jones, E. and Fourikis, R. 1996, Engineering and Society: An Australian Perspective, Addison Wesley Longman Australia

JSCT 2000, Inquiry into the Kyoto Protocol, *Hansard* 18 October 2000, Joint Standing Committee on Treaties

Kaiser Aluminium 2001, Primary Aluminium Products: Operations, http://www.kaiseral.com/kaiser/kaiseral.nsf/5750142c51bc1952862569b2007f762b/2373d632eae52a16062569b3001f0755!OpenDocument

LME 2001, LME Cash Settlement and Reference Prices: All Contracts, London Metal Exchange, http://www.lme.co.uk/data_prices/historical_data.asp

Naughten 2000, Economic assessment of combined-cycle gas turbines in Australia: some effects of microeconomic reform and technological change, Australian Bureau of Agricultural and Resource Economics, Conference Paper 2000.15

NECA 2001, National Electricity Code, National Electricity Code Administrator, http://www.neca.com.au

Norsk 2000, Hydro Aluminium Metal Products: Key figures, http://www.hamp.hydro.com/hits/osl02471.nsf/AllById/12EF7BF99A5796E5412568FF003F1F82

NRG 2001, Key Assets: Gladstone Power Station, http://www.nrgasiapacific.com.au/KeyAssets/keyassets.htm

NWCC 1997, The Effect of Wind Energy Development On State and Local Economies, Wind Energy Series no. 5, National Wind Coordinating Committee, January, http://www.nationalwind.org/pubs/wes/wes05.htm

Pechiney 2001, Businesses: Primary Aluminium, http://www.pechiney.com/pechiney/webpechiney.nsf/ToDocNiv2DGWebWo/SomAluPrim?OpenDocument&LANG=VINT$

Pechiney 2000, Pechiney and AMP Life Limited exchange irrevocable offers for Pechiney to acquire AMP Life's 15.5 per cent direct stake in the Tomago aluminum smelter, Press Release, http://www.pechiney.com/pechiney/webpechiney.nsf/ComPFinAllV5VINT/412566E1002CD6524125696D0025AA52

Pechiney Netherlands 2001, Pechiney Nederland NV, http://www.pechineynederland.com/gb/pechiney.html

Pirani, S. 2001, Running ahead of itself – again: Russian corporates try to push back financing limits, *Trade Finance*, January

Plunkert, P. 2000, Aluminium in *Minerals Yearbook 1999*, United States Geological Survey Minerals Information, http://minerals.usgs.gov/minerals/pubs/commodity/aluminum/050499.pdf

Plunkert, P. 2001, Aluminium in *Minerals Yearbook 2000*, United States Geological Survey Minerals Information, http://minerals.usgs.gov/minerals/pubs/commodity/aluminum/050400.pdf

RBA 1997, Privatisations in Australia, Reserve Bank Bulletin, December 1997, http://www.rba.gov.au/PublicationsAndResearch/Bulletin/bu_dec97/bu_1297_2.pdf

Rio Tinto 2001, Rio Tinto 2000 Annual Report and Financial Accounts

SECITA 2000, The Heat Is On: Australia’s Greenhouse Future, Report of the Senate Environment, Communications, Information Technology and Arts References Committee, November

SECV 2001, Annual Report 2000-01, State Electricity Commission of Victoria

SECV 2000, Annual Report 1999-00, State Electricity Commission of Victoria

SGF 2001, Metals and minerals, Societe Generale de Financement du Quebec, http://www.sgfqc.com/en/champ/metaux/metaux.asp

SKM 2001, Initial advice statement, Boyne Island aluminium smelter: Extension of reduction lines, Sinclair Knight Merz, November, http://www.comalco.com.au/eis/02_documents.htm#

State of Victoria 1984, The Portland aluminium smelter: Victorian government statement, Economic Strategy for Victoria Statement no. 3, 1 August

Stockdale, A. 1995, State withdraws from negotiations with Alcoa, Press Release 18 July 1995.

US BLS 2002, Consumer Price Index, Bureau of Labor Statistics, US Department of Labor, 16 January, ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt

US Federal Reserve 2001, H.10 Historical Data: Foreign Exchange Rates, http://www.federalreserve.gov/releases/H10/hist/dat96_al.txt

USGS 1999, Minerals Yearbook 1998 (Volume III. -- Area Reports: International), United States Geological Survey, http://minerals.usgs.gov/minerals/pubs/ country/

USGS 2001, Mineral Commodity Summaries, United States Geological Survey, January

VENCORP 2000, Electricity Transmission Use of System Prices 2000/01, July http://www.vencorp.com.au/docs/corporate/TUOS1.pdf

Victorian Auditor-General's Office 1997, Report of the Auditor-General on the Victorian Government's Finances, 1996-97, http://www.audit.vic.gov.au/ sfo97/sfo9704.htm

Victorian Auditor-General's Office 1998, Report of the Auditor-General on the Victorian Government's Finances, 1997-98, http://www.audit.vic.gov.au/ sfo98/afs9808.htm

Victorian Auditor-General's Office 1999, Report of the Auditor-General on the Victorian Government's Finances, 1998-99, http://www.audit.vic.gov.au/ sfo99/afs9907.htm

Victorian Auditor-General's Office 2000, Report of the Auditor-General on the Victorian Government's Finances, 1999-00, http://www.audit.vic.gov.au/ afs2000/afs0007.htm

WA DME 2000, Alumina price, Western Australia Department of Mines and Energy, http://www.dme.wa.gov.au/statistics/resourcefocus9900/wordandexcel/alumin a9900.xls

World Commission on Dams 2000, Brazil Case Study: Tucuruí Dam and Amazon/Tocantins River Basin, November, http://www.dams.org/studies/br/

WTO 1993, United States – Measures affecting the export of pure and alloy magnesium from Canada, *Report by the Panel (SCM/174)*, Dispute Settlement, Adopted panel reports within the framework of GATT 1947, World Trade Organization (WTO), http://www.wto.org/english/tratop_e/dispu_e/ 92magnes.wpf

WTO 1994, Agreement on Subsidies and Countervailing Measures, The Final Act Embodying the Results of the Uruguay Round of Multilateral Trade Negotiations, World Trade Organisation, http://www.wto.org/english/docs_e/legal_e/final_e.htm#subsidies

# Appendix

## Comparison of the sale of Gladstone Power Station and the privatisation of Victorian generation assets

| Power Station | Capacity (MW) | Type | Sale proceeds ($m) | Date | CPI¶ | Sale proceeds (1990$m) | $/kW | 1990$/kW | Average age at time of sale (years) |
|---|---|---|---|---|---|---|---|---|---|
| Gladstone Power Station, Qld | 1680 | Black coal – PW | 750 | Mar-94 | 110.4 | 679 | 446 | 404 (674)# | 15 |
| Yallourn | 1450 | Brown coal – TF | 2428 | May-96 | 119.8 | 2027 | 1674 | 1398 | 19 |
| Loy Yang B | 510 | Brown coal – TF | 544 | Dec-92 | 107.9 | 504 | 1067 | 989 | -2* |
| Loy Yang B | 490 | Brown coal – TF | 1150§ | Apr-97 | 120.2 | 957 | 2347 | 1953 | 3 |
| Loy Yang A | 2000 | Brown coal – TF | 4746 | Apr-97 | 120.2 | 3948 | 2373 | 1974 | 11 |
| Hazelwood | 1600 | Brown coal – TF | 2357 | Aug-96 | 120.1 | 1963 | 1473 | 1227 | 29 |
| Victorian Total | 6050 | | 11225 | | | 9399 | 1855 | 1553 | 16 |

* under construction at time of sale
\# adjusted to account for higher capital cost of brown coal fired generation
¶ 1990 = 100
§ Cash sale proceeds were only $84 million, but the purchaser also released the Victorian state government from significant liabilities (Victorian Auditor-General's Office 1997, Section 4.64).
PW: pulverised wall
TF: tangentially-fired

Source: RBA 1997; Department of Treasury & Finance 1997, p. 13; ABS 2001; Victorian Auditor-General's Office 1997, Section 4.64

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