

APP Aluminium Task Force Meeting
Sanya, Hainan, PR China
4 December 2008

**Sustainability Measurement &
Benchmarking**



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International Aluminium Institute





Perfluorocarbons (PFCs)



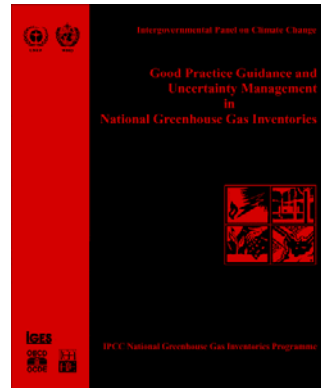
- Potent greenhouse gases (CF_4 & C_2F_6) with high global warming potential (GWP) & long atmospheric lifetimes
- IAI has a long time series of global emissions data (1990-2007)
 - Voluntary Objectives
 - 87% reduction in per tonne emissions globally since 1990
- Clearly defined and internationally recognised standards for PFC emissions calculation, measurement and reporting and standardised methodology for calculating non-reported emissions
 - PFC emissions are a function of the frequency and duration of “anode effects”
 - We collect anode effect data and calculate emissions based on these numbers



Interlocking Standards

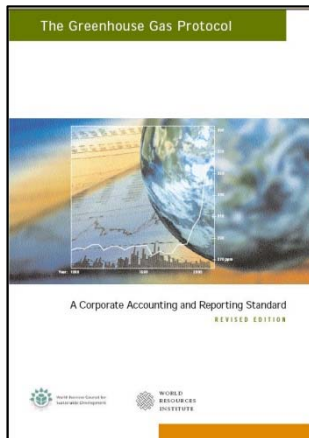


IPCC Good Practice Guidance



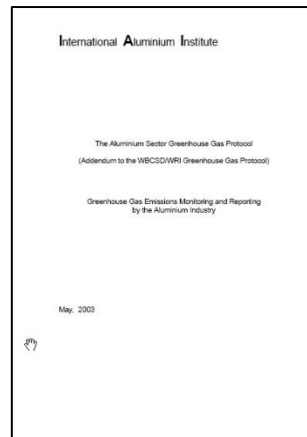
<http://www.ipcc-nggip.iges.or.jp>

WRI/WBCSD Corporate Good Practice Standards



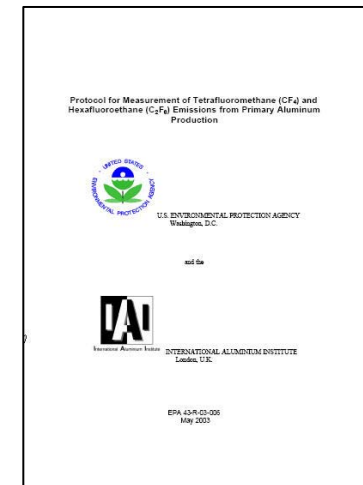
<http://www.ghgprotocol.org/>

IAI Industry GHG Protocol



<http://www.world-aluminium.org/cache/fl0000127.pdf>

USEPA/IAI PFC Measurement Protocol



<http://www.epa.gov/highgwp/aluminum-pfc/pdf/measureprotocol.pdf>



PFC Data Collected



METADATA

- Name & location of smelter
- Potline number
 - for those facilities that report by potline or with multiple technology classes

CALCULATION DATA

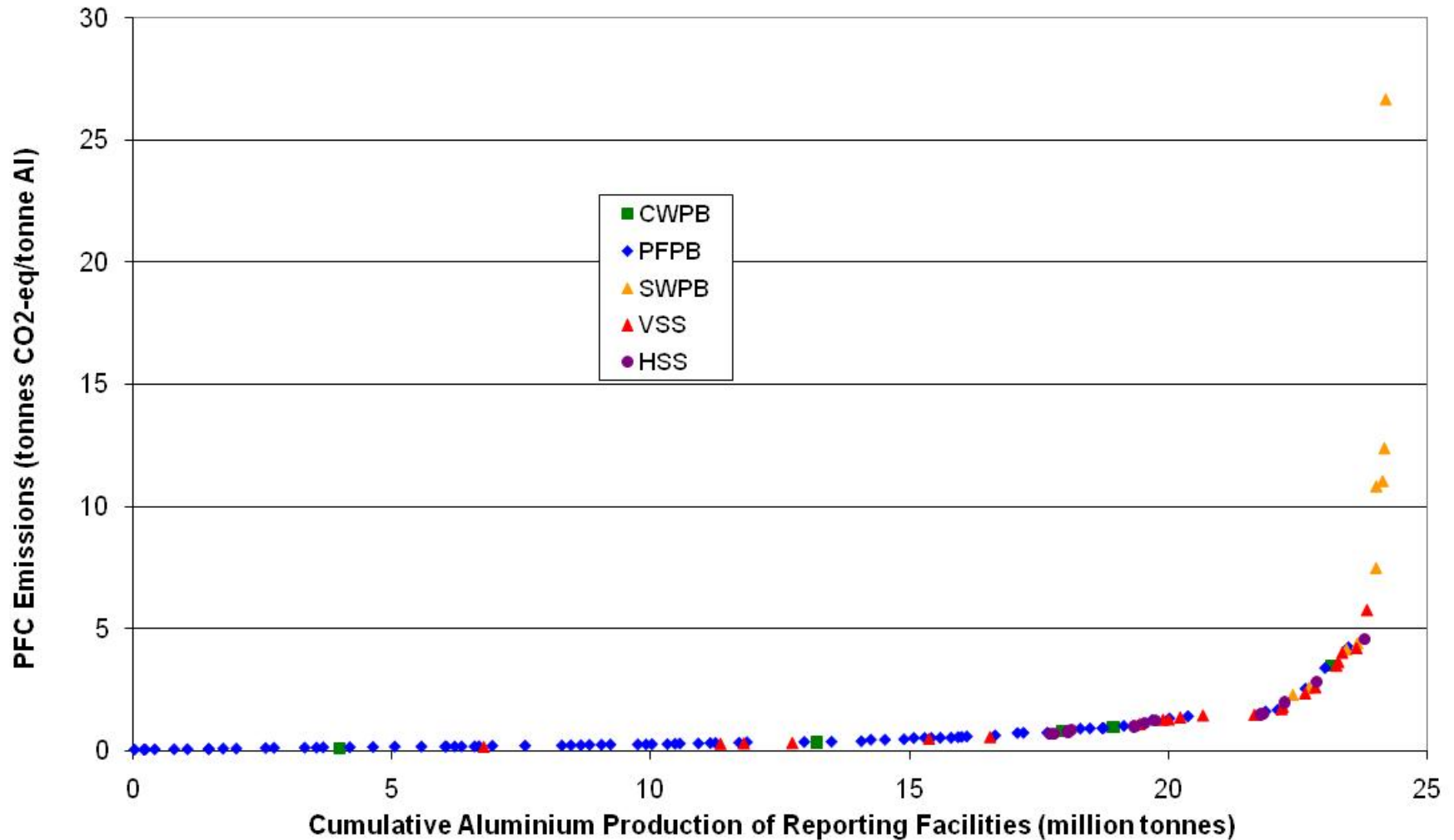
- Average number of anode effects per cell day (FREQUENCY)
- Average duration of anode effects (DURATION)
- Aluminium production for period over which anode effect data is collected
- Technology category (e.g. point fed prebake; horizontal stud Søderberg, etc)
 - defines the quantitative Tier 2 (technology specific) coefficient between anode effect data and CF₄ emissions
- Averaged Anode Effect (Algebraic or Positive) Overvoltage per cell day (for those facilities that use overvoltage – AP18 and AP3x class only)
- Calculated Tier 3 CF₄ emission coefficient and CF₄:C₂F₆ weight fraction for those facilities that have made PFC measurements, along with year of measurement.

QA/QC & QUALITATIVE INFORMATION

- Number of cells operating per day
- Feed type (e.g. side feed)
- Cell technology (e.g. AP30)
- Employment of automated AE prediction and termination procedures

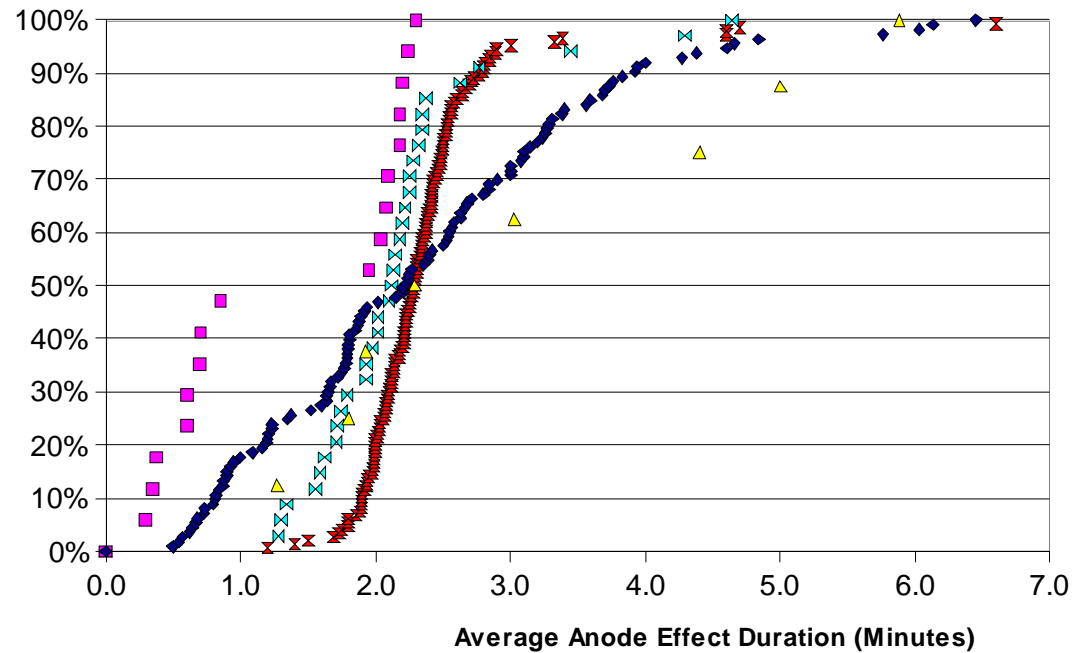
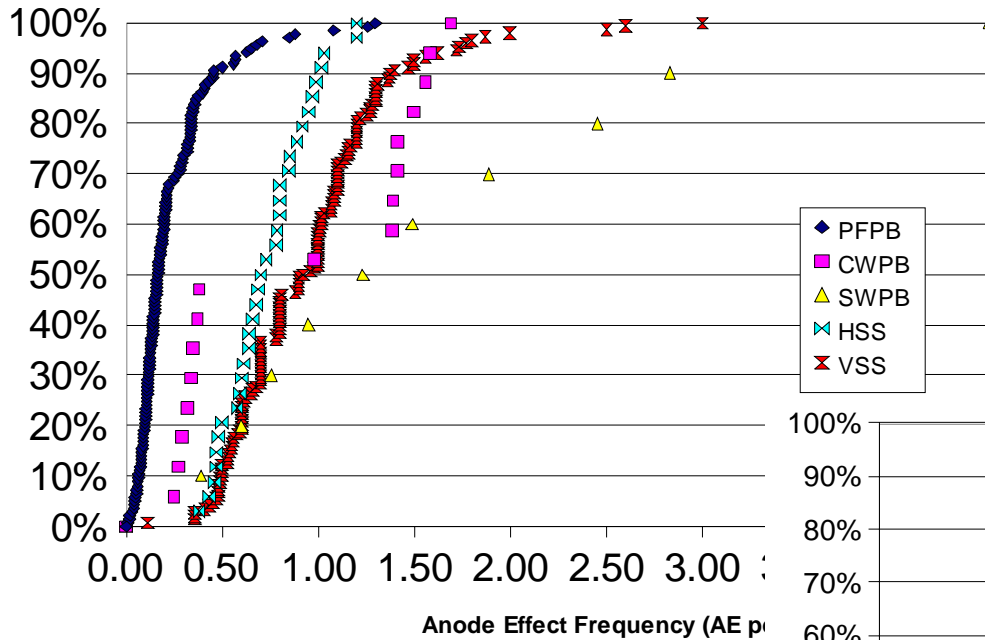


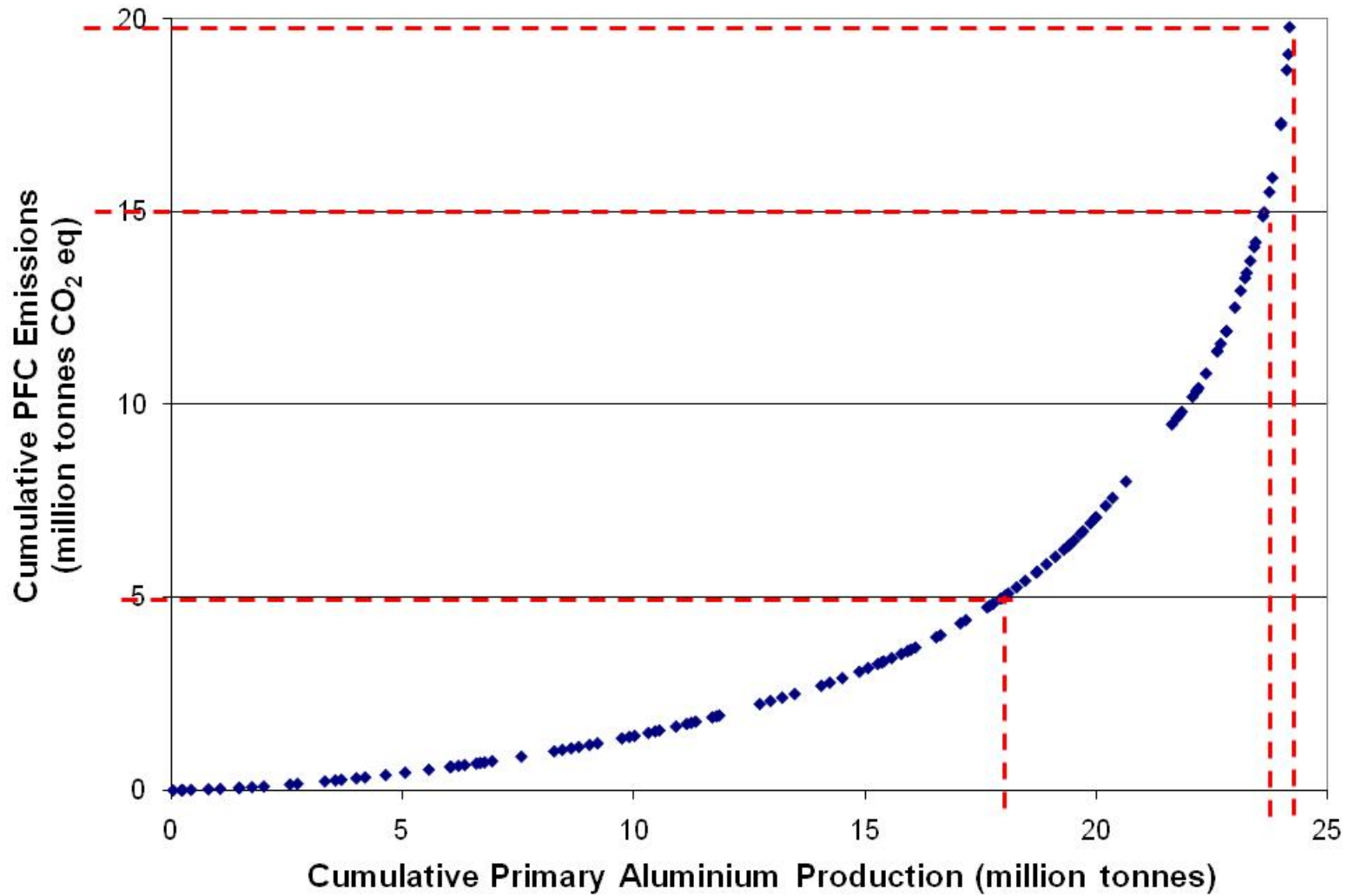
Benchmarking (emissions per tonne)





Benchmarking AE data



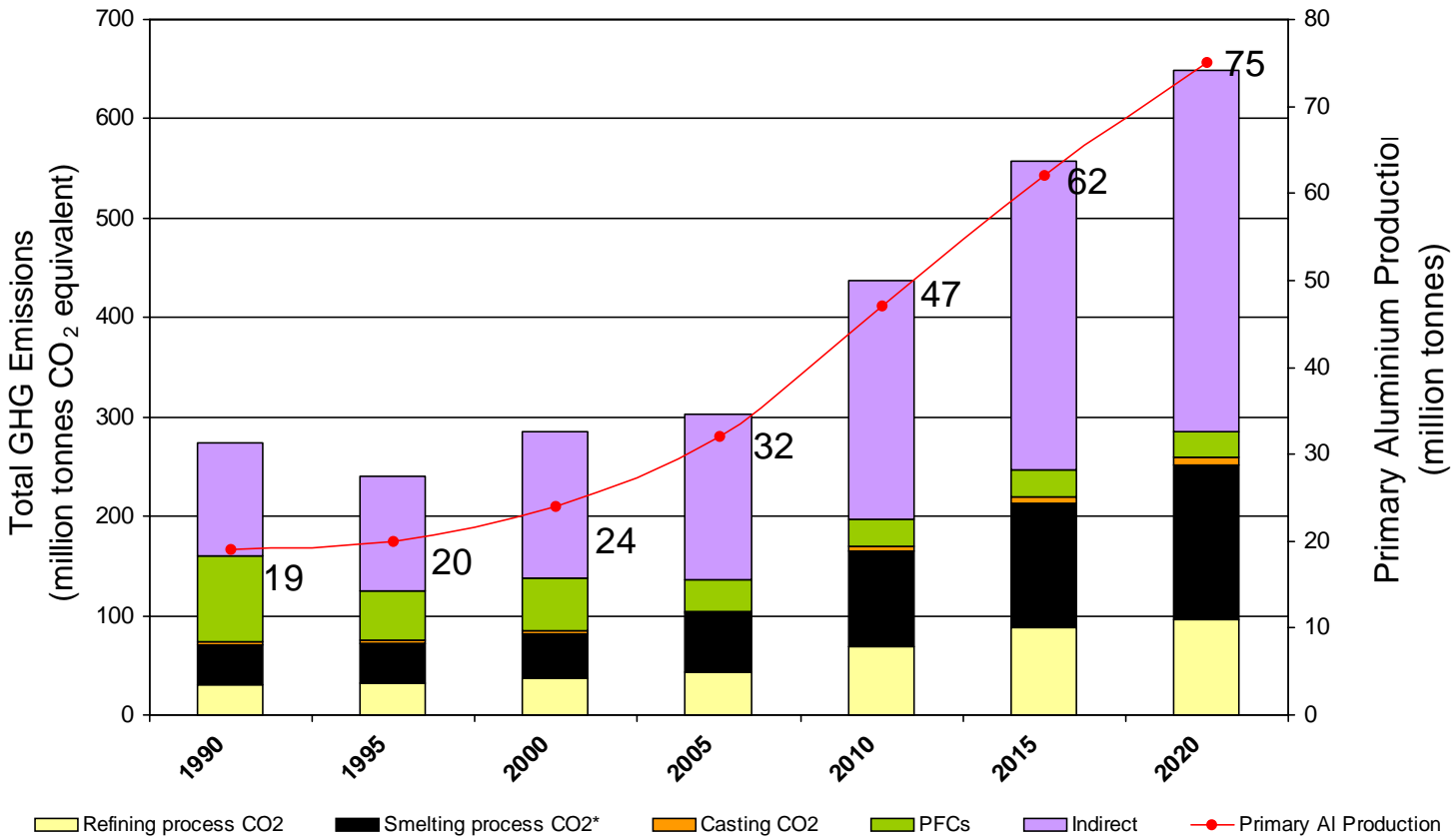




Smelter/Refinery Energy Usage



- Energy efficiency
- With power mix and fuel mix data, can calculate direct (fuel use) & indirect (electricity use) GHG emissions according to internationally standardised methodologies





Smelting Power Data Collected



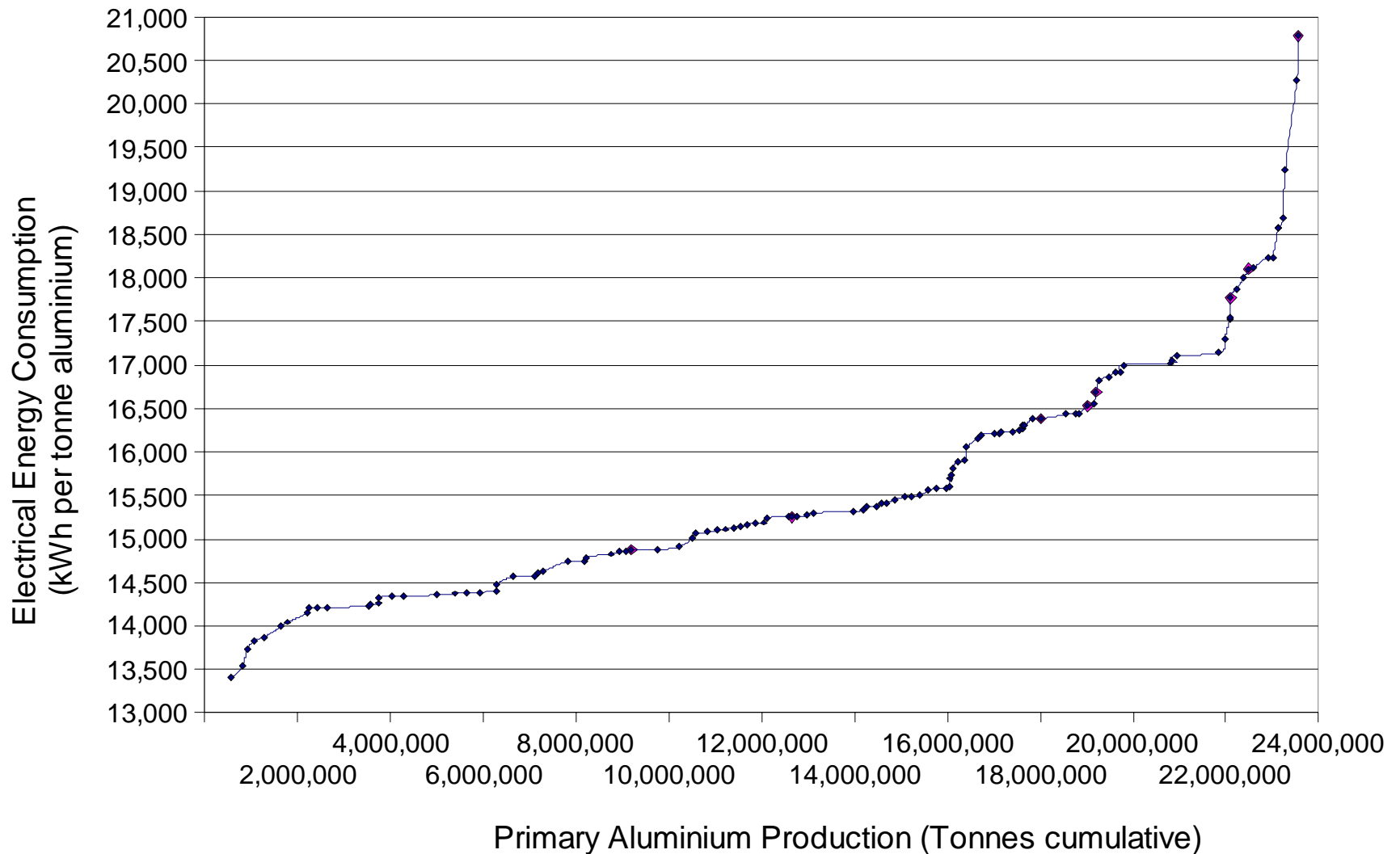
- a. Direct Current (DC) power used for electrolysis (GWh)
 - b. Total Alternating Current (AC) power use (GWh)
 - c. AC for smelting only - excluding auxiliary process power (GWh)
 - d. Auxiliary process AC power (GWh)
-
- Quality check on the data: $(b = c + d)$ & $(a \approx c)$

 - Aluminium production (tonnes)

 - OUTPUT
 - DC electrical energy efficiency (kWh per tonne)
 - Total AC electrical energy efficiency (kWh per tonne)



Benchmarking Smelter Electrical (Total AC) Energy Consumption (All Technologies)



4. Electrical Energy Used for Smelting

Table 1 – Relating to this Smelter and Cell Technology

(Exclude electrical energy used in anode production and casting. Include electrical energy lost in AC/DC rectification, and the electrical energy used by associated auxiliaries e.g. pollution control equipment, compressed air generation, heating and lighting. See Reporting Guidelines 2 and 3.)

Energy Source	Electrical Energy Used for Primary Aluminium Smelting (GWh)			Total (d) = (a) + (b) + (c)
	Self generated (a)	Purchased		
		From National or Regional Grid (b)	From Other Sources (c)	
Hydro				
Coal				
Oil				
Natural Gas				
Nuclear				
Total				

Power Mix

5. Self-Generated Electrical Energy

(Only complete this Section if appropriate)

a. Table 2 – Total Electrical Energy Self-Generated (See Reporting Guideline 4)

Energy Source	Electrical Energy Self-Generated (GWh)			Total (g) = (a) + (e) + (f)
	Used in Operating the Smelter		Used for Other Purposes (f)	
	As Reported in Table 1 for Smelting (a) From Table 1	Other Smelter Operations (e)		
Hydro				
Coal				
Oil				
Natural Gas				

Note that “Other Smelter Operations” include anode production and casting

b. Table 3 – Quantities of Fuel Used (See Reporting Guidelines 5 and 6)

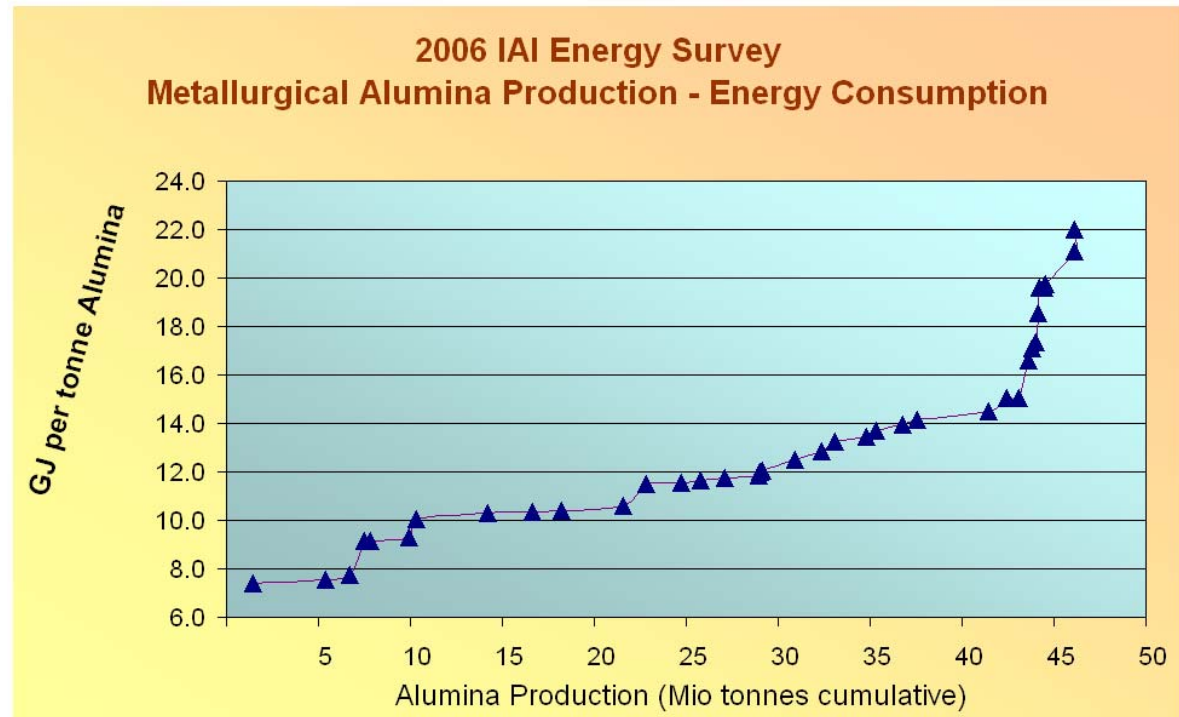
Energy Source (Fuel)	Total Electrical Energy Self-Generated (GWh) (g) From Table 2	Quantity of Fuel Consumed In Generating Electrical Energy (h)	Calorific Value Of Fuel (j)	Fuel Energy Consumed In Generating Electrical Energy (k) = (h) x (j) x 10 ⁻⁹ TJ
Coal		kg	kJ/kg	TJ
Oil		kg	kJ/kg	TJ
Natural Gas		m ³	kJ/m ³	TJ



Refining Energy Data Collected



- Metallurgical alumina production (tonnes)
- Primary energy use (Joules)
- OUTPUT:
 - Energy efficiency (GJ/tonne)

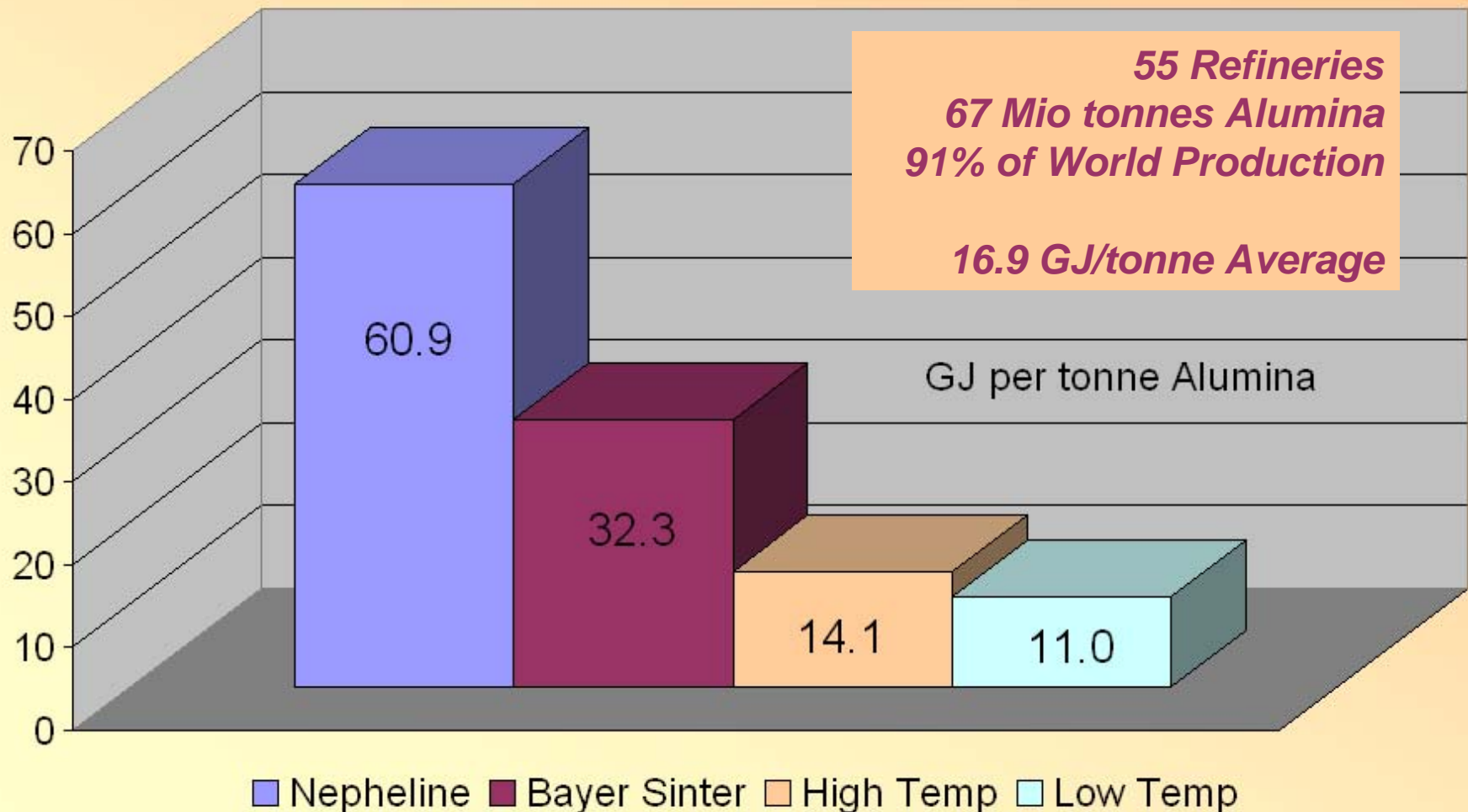




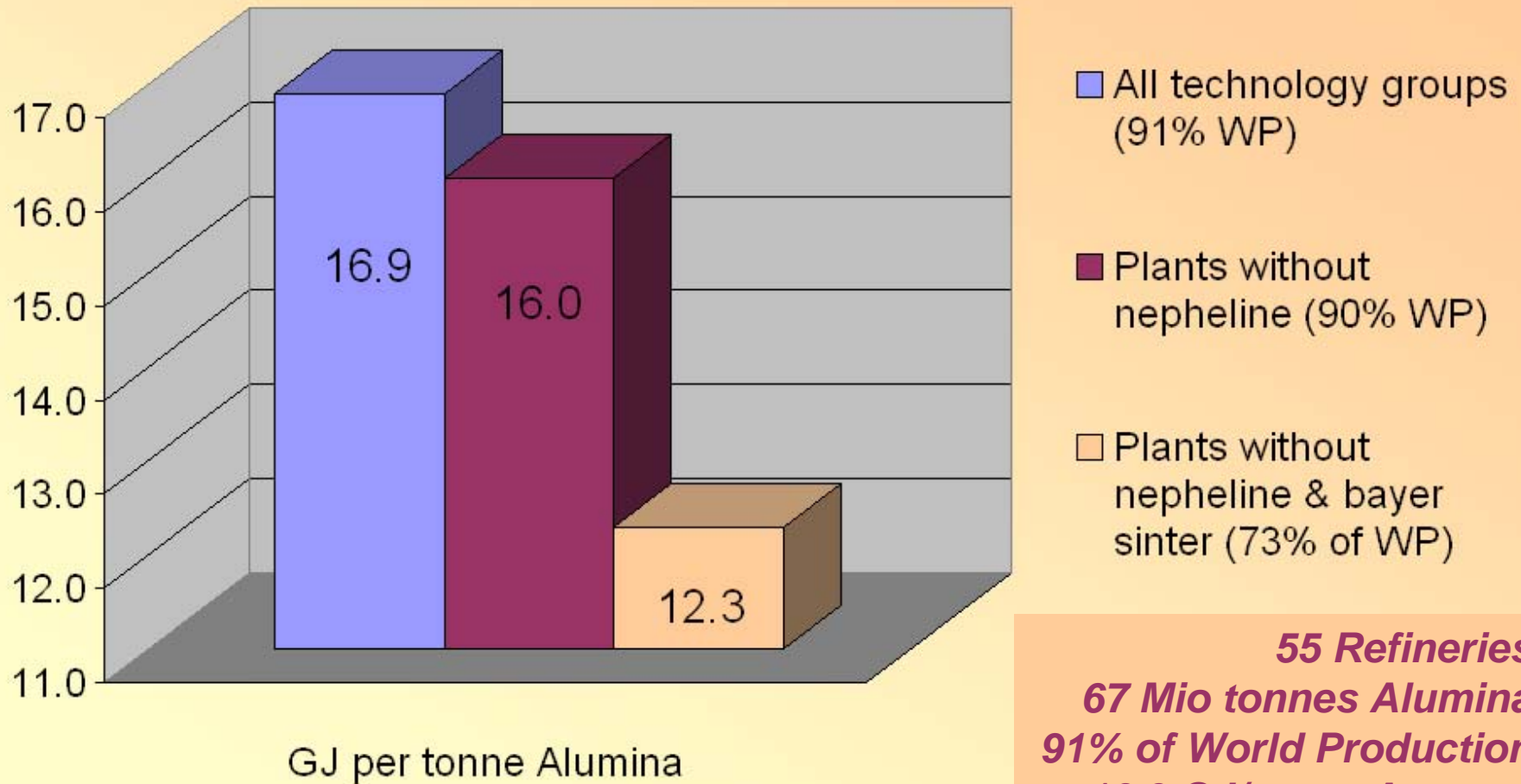
Global Energy Consumption for Refineries



Energy Consumption per Technology Group for 2006



Energy Consumption 2006: % of World Production (WP)



4. Energy Used for Hydrate Production (Do NOT include energy used to produce Chemical Alumina)

a. Table 1 – Energy from Fuel used for Direct Heating and to produce Self-Generated Electricity

Energy Source (Fuel)	Quantity of fuel Consumed (a)	Calorific Value of Fuel (b)	Fuel Energy Consumed (c) = (a) x (b) x 10 ⁻⁹
Coal	kg	kJ/kg	TJ
Heavy oil	kg	kJ/kg	TJ
Diesel oil	kg	kJ/kg	TJ
Gas	m ³	kJ/m ³	TJ
Other (e.g. purchased steam)		kJ/unit	TJ

Please specify "Other" fuel type and units of quantity. If "Other" fuel type is purchased steam, then please state the fuel (for example, coal) used to produce the steam.

b. Table 2 – Energy from Purchased Electricity

Energy Source (Fuel)	Electrical Energy Consumed (d)	Conversion Factor (e)	Fuel Energy Consumed in Generating Electrical Energy Consumed (f) = (d) x (e) x 10 ⁻⁹
Hydro	kWh	3600 kJ/kWh	TJ
Coal	kWh	kJ/kWh	
Oil	kWh	kJ/kWh	
Natural Gas	kWh	kJ/kWh	
Nuclear	kWh	3600 kJ/kWh	

5. Energy Used for Calcination (Do NOT include drying energy used to produce Chemical Alumina)

a. Table 3 – Energy from Fuel used for Direct Heating and to produce Self-Generated Electricity

Energy Source (Fuel)	Quantity of fuel Consumed (a)	Calorific Value of Fuel (b)	Fuel Energy Consumed (c) = (a) x (b) x 10 ⁻⁹
Coal	kg	kJ/kg	TJ
Heavy oil	kg	kJ/kg	TJ
Diesel oil	kg	kJ/kg	TJ
Gas	m ³	kJ/m ³	TJ
Other		kJ/unit	TJ

Please specify "Other" fuel type and units of quantity

b. Table 4 – Energy from Purchased Electricity

Energy Source (Fuel)	Electrical Energy Consumed (d)	Conversion Factor (e)	Fuel Energy Consumed in Generating Electrical Energy Consumed (f) = (d) x (e) x 10 ⁻⁹
Hydro	kWh	3600 kJ/kWh	TJ
Coal	kWh	kJ/kWh	TJ
Oil	kWh	kJ/kWh	TJ
Natural Gas	kWh	kJ/kWh	TJ
Nuclear	kWh	3600 kJ/kWh	TJ

Power/Fuel Mix

6. Surplus Energy Exported from Site

(Only complete this Section if appropriate)

Table 5 – As Electricity or Steam

Energy Source (Fuel)	Quantity of fuel Consumed (a)	Calorific Value of Fuel (b)	Fuel Energy Consumed (c) = (a) x (b) x 10 ⁻⁹
Coal	kg	kJ/kg	TJ
Heavy oil	kg	kJ/kg	TJ
Diesel oil	kg	kJ/kg	TJ
Gas	m ³	kJ/m ³	TJ
Other		kJ/unit	TJ

Please specify "Other" fuel type and units of quantity



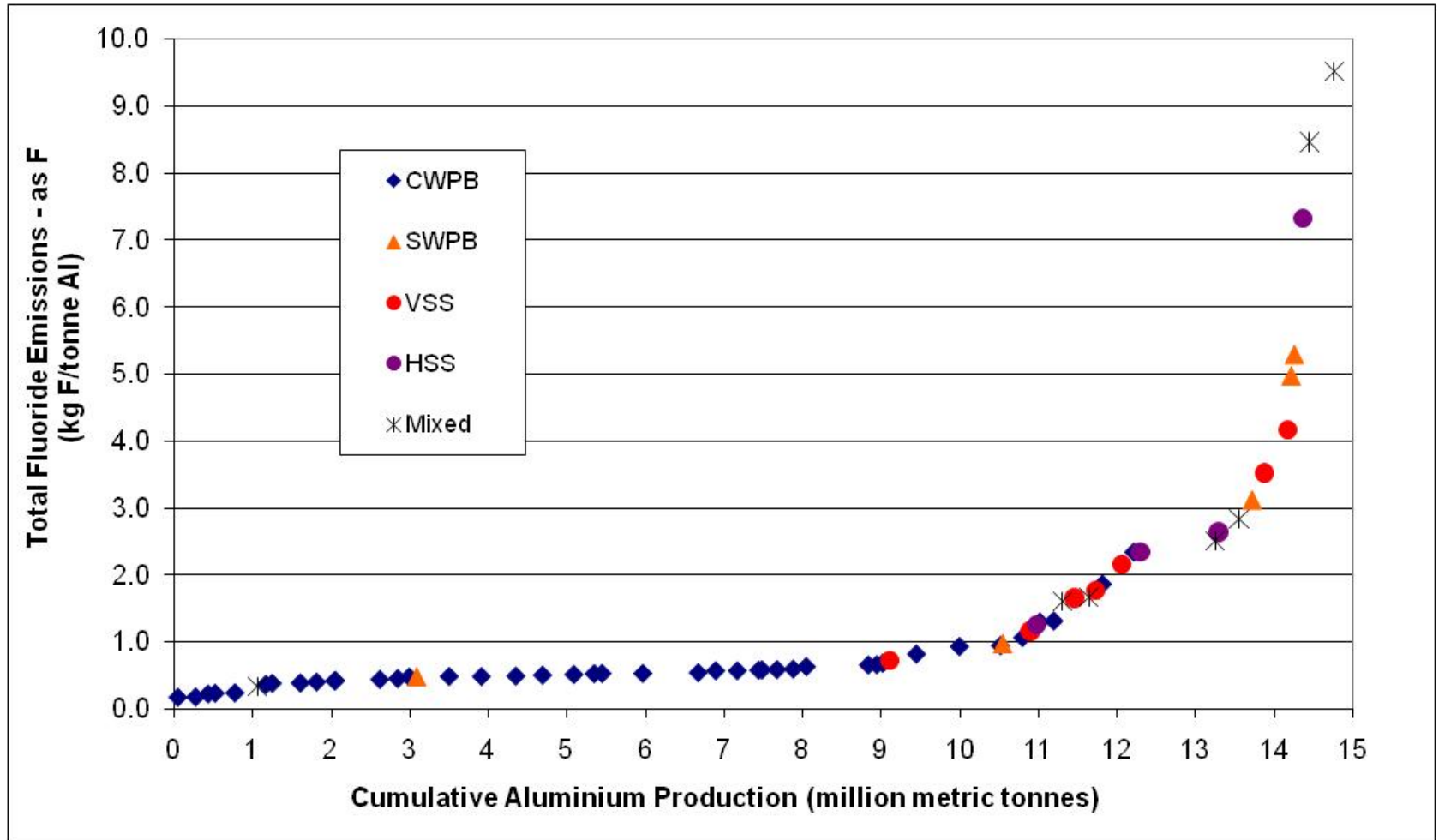
Fluorides



- Local environmental impacts
- Data collected (smelters only – electrolysis & anode production):
 - Total gaseous fluoride emissions (tonnes)
 - Total particulate fluoride emissions (tonnes)
 - Aluminium production (tonnes)
- Output:
 - Fluoride emissions (kg total fluoride) per tonne of aluminium produced

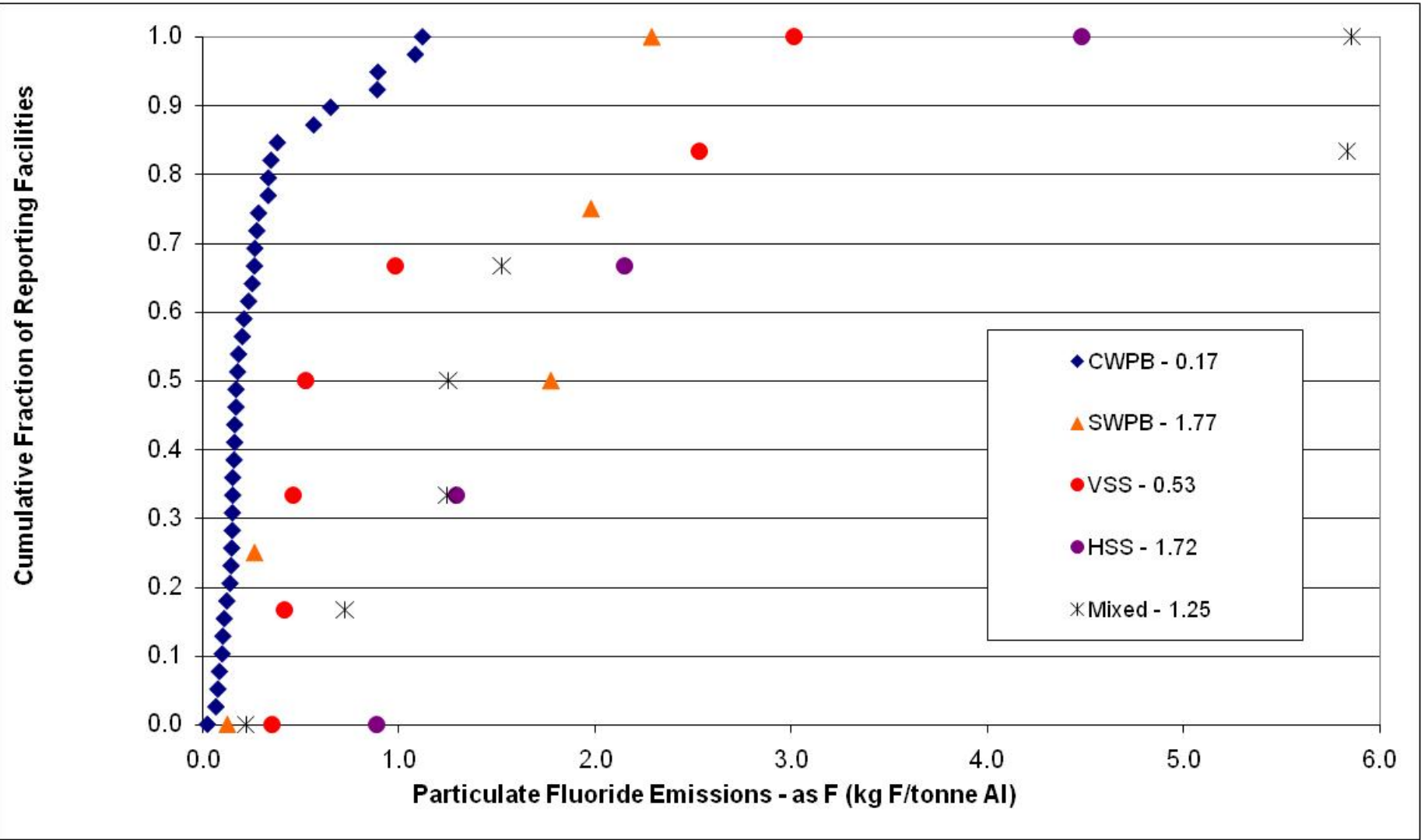


Total Fluoride Benchmarking





Particulate Fluoride Benchmarking





Spent Pot Lining (SPL)



- Largest smelting waste stream
- Potential to be used as a feedstock for other industries
- a. Spent Pot Lining (SPL) generated from operations (tonnes)
- b. SPL recycled externally (tonnes)
- c. SPL deposited with treatment (tonnes)
- d. SPL deposited without treatment (tonnes)
- e. SPL stored (tonnes)
- Quality check on the data: $(a = b + c + d + e)$
- OUTPUT:
 - Percentage of SPL generated recycled per annum
 - Percentage of deposited SPL treated before deposition



Bauxite Residue Management



Active Residue Management – Metric 1

- Volume of stored bauxite residue produced in a calendar year per 1000 tonnes of alumina produced in that same year.
 - Measure will be influenced by improvements to consolidation/density in the deposit, extraction efficiency, bauxite quality, use of residue

Historical Residue Management - Metric 2

- Land area (footprint) utilised to store the bauxite residue since refinery operation commenced per 1000 tonnes of alumina produced over the same period
 - Land area does not include ponds constructed for the sole purpose of storing water and will not contain residue at the time of refinery closure
 - Measure will be influenced primarily by moves to store more residue within a given footprint

Residue Storage Area (RSA) Rehabilitation – Metric 3

- Surface area and percentage of total RSA's that has been converted to productive and sustainable land use.
 - This will include areas that have been closed, re-vegetated and managed in a sustainable manner as per existing best practice.



Recycling Rates



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	A	B	C	D	F	BD	BE	BF	BG	BH	BI	BJ	BK
1	REGIONAL AND WORLDWIDE RECYCLE RATES												
2													
3	USA												
4	ESTIMATED COLLECTION (RECYCLING) RATE OF OLD SCRAP -- USA												
5	Year				1950	2000	2001	2002	2003	2004	2005	2006	2007
6	Bldg & Const				20%	80%	80%	80%	80%	80%	80%	80%	80%
7	Transportation - Auto & Lt Truck				40%	85%	85%	85%	85%	85%	85%	85%	85%
8	Transportation - Aerospace				20%	75%	75%	75%	75%	75%	75%	75%	75%
9	Trans - Truck/Bus/Trailer/Rail/Marine				20%	70%	70%	70%	70%	70%	70%	70%	70%
10	Packaging - Cans				10%	62%	55%	53%	50%	52%	52%	52%	52%
11	Packaging - Other (Foil)				0%	5%	5%	5%	5%	5%	5%	5%	5%
12	Machinery & Equipment				20%	40%	40%	40%	40%	40%	40%	40%	40%
13	Electrical - Cable				10%	80%	80%	80%	80%	80%	80%	80%	80%
14	Electrical - Other				10%	10%	10%	10%	10%	10%	10%	10%	10%
15	Consumer Durables				15%	15%	15%	15%	15%	15%	15%	15%	15%
16	Other (ex Destructive Uses)				15%	15%	15%	15%	15%	15%	15%	15%	15%
17	Destructive Uses				0%	0%	0%	0%	0%	0%	0%	0%	0%
18	(Not currently used)				0%	0%	0%	0%	0%	0%	0%	0%	0%
19													
20	WESTERN EUROPE												
21	ESTIMATED COLLECTION (RECYCLING) RATE OF OLD SCRAP -- WESTERN EUROPE												
22	Year				1950	2000	2001	2002	2003	2004	2005	2006	2007
23	Bldg & Const				20%	90%	90%	90%	90%	95%	95%	95%	95%
24	Transportation - Auto & Lt Truck				20%	90%	90%	90%	90%	90%	90%	90%	90%
25	Transportation - Aerospace				20%	90%	90%	90%	90%	90%	90%	90%	90%
26	Trans - Truck/Bus/Trailer/Rail/Marine				20%	90%	90%	90%	90%	90%	90%	90%	90%
27	Packaging - Cans				0%	44%	45%	46%	48%	48%	50%	52%	58%
28	Packaging - Other (Foil)				0%	20%	20%	20%	20%	20%	20%	20%	20%

Ready Circular: BG159



Semis Shipments



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BK219 =BK181+BK200

	A	B	C	D	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK
1	REGIONAL AND WORLDWIDE PRODUCT NET SHIPMENTS															
2	000 MT															
3	USA and Canada															
4	ALUMINIUM INDUSTRY PRODUCT NET SHIPMENTS, 000 Metric Tons -- USA															
5	Year				1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
6	Bldg & Const				1,215	1,325	1,325	1,392	1,468	1,453	1495	1563	1,561	1,678	1,676	1,644
7	Transportation - Auto & Lt Truck				1,516	1,636	1,832	1,982	2,222	2,345	2210	2362	2439	2,672	2,731	2,375
8	Transportation - Aerospace				85	86	87	88	89	90	116	124	128	140	155	136
9	Trans - Truck/Bus/Trailer/Rail/Marin				1,006	917	1,071	1,178	1,289	1,176	864	923	953	1,045	1,056	1,419
10	Packaging - Cans				1,982	1,845	1,885	1,936	1,966	1,919	1833	1841	1,827	1,911	1,922	1,840
11	Packaging - Other (Foil)				325	330	335	337	350	345	417	417	414	396	400	479
12	Machinery & Equipment				570	569	626	629	661	678	641	616	620	730	755	760
13	Electrical - Cable				438	437	463	462	497	513	460	483	467	513	364	386
14	Electrical - Other				219	219	232	231	249	257	226	194	188	209	388	386
15	Consumer Durables				621	654	693	725	760	770	681	722	719	730	709	746
16	Other (ex Destructive Uses)				23	29	30	0	0	0	88	1	1	70	281	739
17	Destructive Uses				256	258	275	273	293	293	279	390	385	416	142	142
18	(Not currently used)															
19																0%
20	Domestic Total				8,256	8,305	8,854	9,233	9,844	9,839	9,311	9,636	9,702	10,511	10,579	11,052
21																0
22	EUROPE (EU 25 + EFTA)															
23	ALUMINIUM INDUSTRY PRODUCT NET SHIPMENTS, 000 Metric Tons -- WESTERN EU															
24	Year				1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
25	Bldg & Const				1,680	1,722	1,763	1,804	1,858	1,914	2,168	2,235	2,272	2,550	2,770	3,018
26	Transportation - Auto & Lt Truck				1,539	1,577	1,615	1,652	1,702	1,753	1,994	2,048	2,082	1,890	2,022	1,974
27	Transportation - Aerospace				100	100	100	100	100	100	100	100	102	100	102	101
28	Trans - Truck/Bus/Trailer/Rail/Marin				729	749	769	790	816	844	973	1,003	1,019	1,405	1,407	1,643
29	Packaging - Cans				382	391	401	410	422	435	662	710	722	859	867	943
30	Packaging - Other (Foil)				611	626	641	656	676	696	811	812	825	883	918	995
31	Machinery & Equipment				573	587	601	615	633	652	612	612	622	1,049	1,143	771
32	Electrical - Cable				382	391	401	410	422	435	425	425	432	300	440	446
33	Electrical - Other				191	196	200	205	211	217	260	260	264	300	300	771
34	Consumer Durables				382	391	401	410	422	435	420	420	427	485	555	569
35	Other (ex Destructive Uses)				721	739	756	774	797	821			0		276	155

Ready Circular: BE77

NUM

Recycling:

High rates in key markets in 2007



Building – up to 98%

The sector used 13 million tonnes in 2007

Beverage cans –

2003: 62%

2006: 64%

2007: 66%



The sector used 4.5 million tonnes in 2007

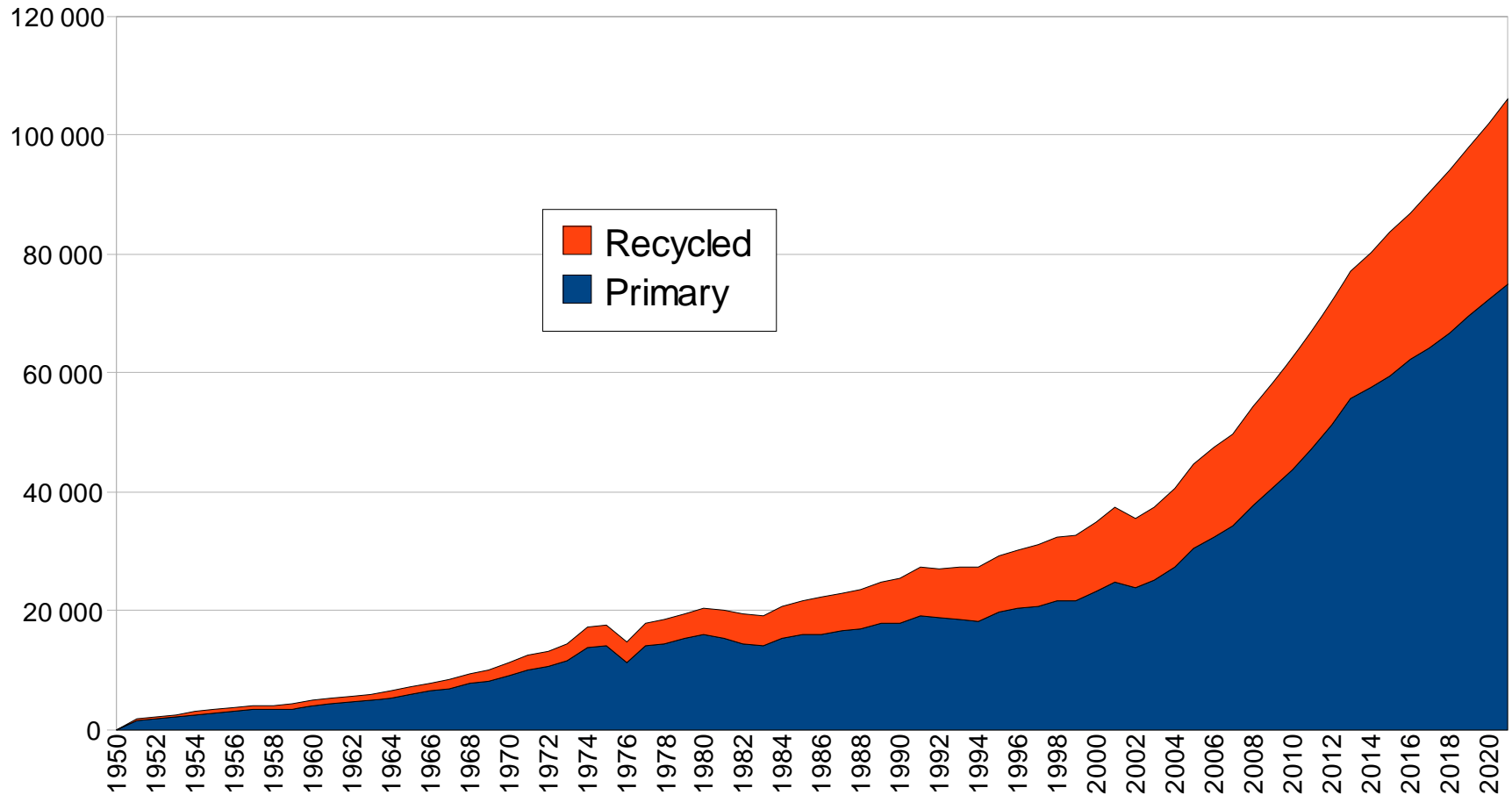


Automotive – up to 95%

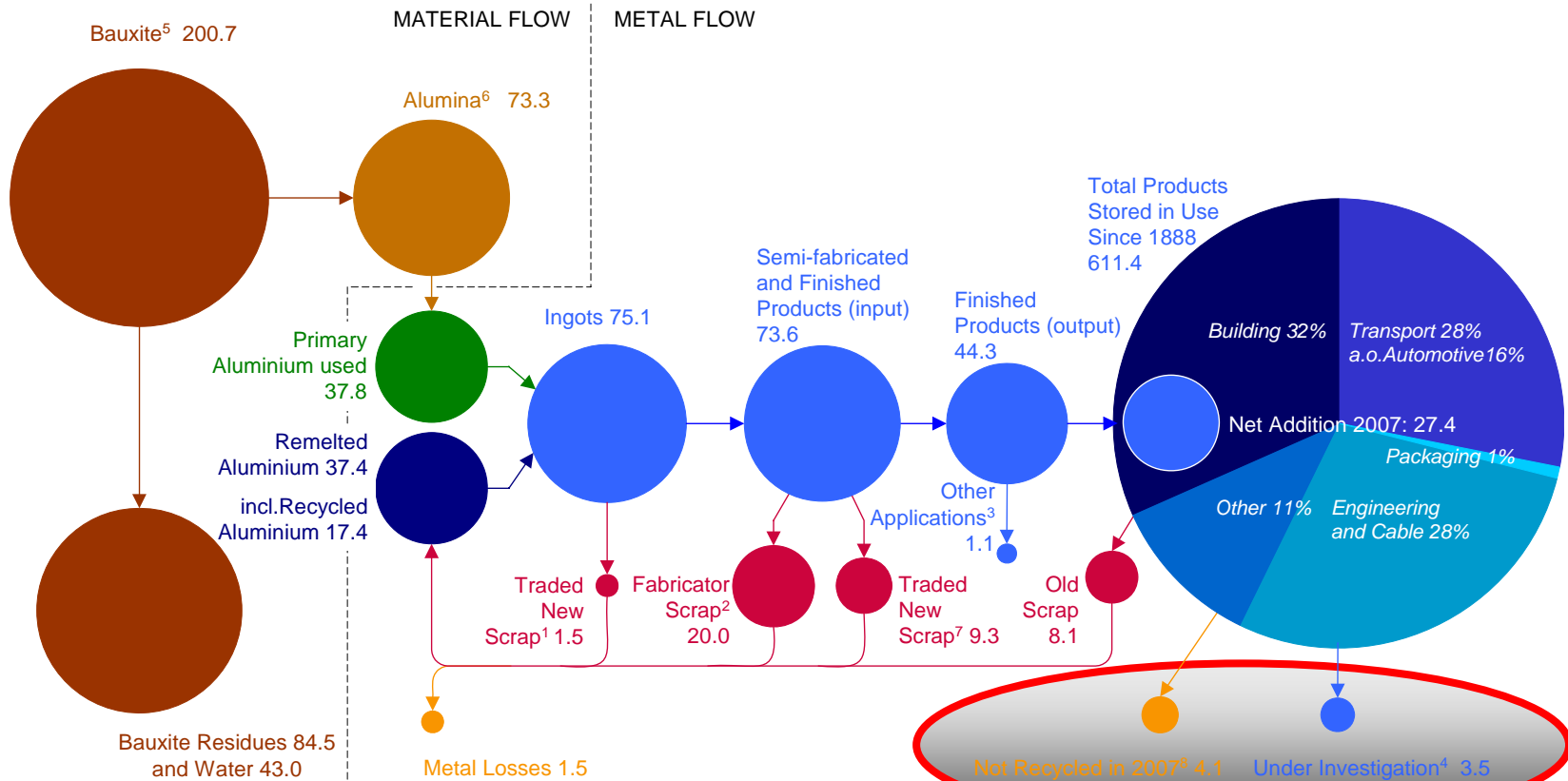
The sector used 14.5 million tonnes in 2007



Growing demand for aluminium products will continue to be met from both primary and recycled metal sources



Aluminium Mass Flow (DRAFT 2007)

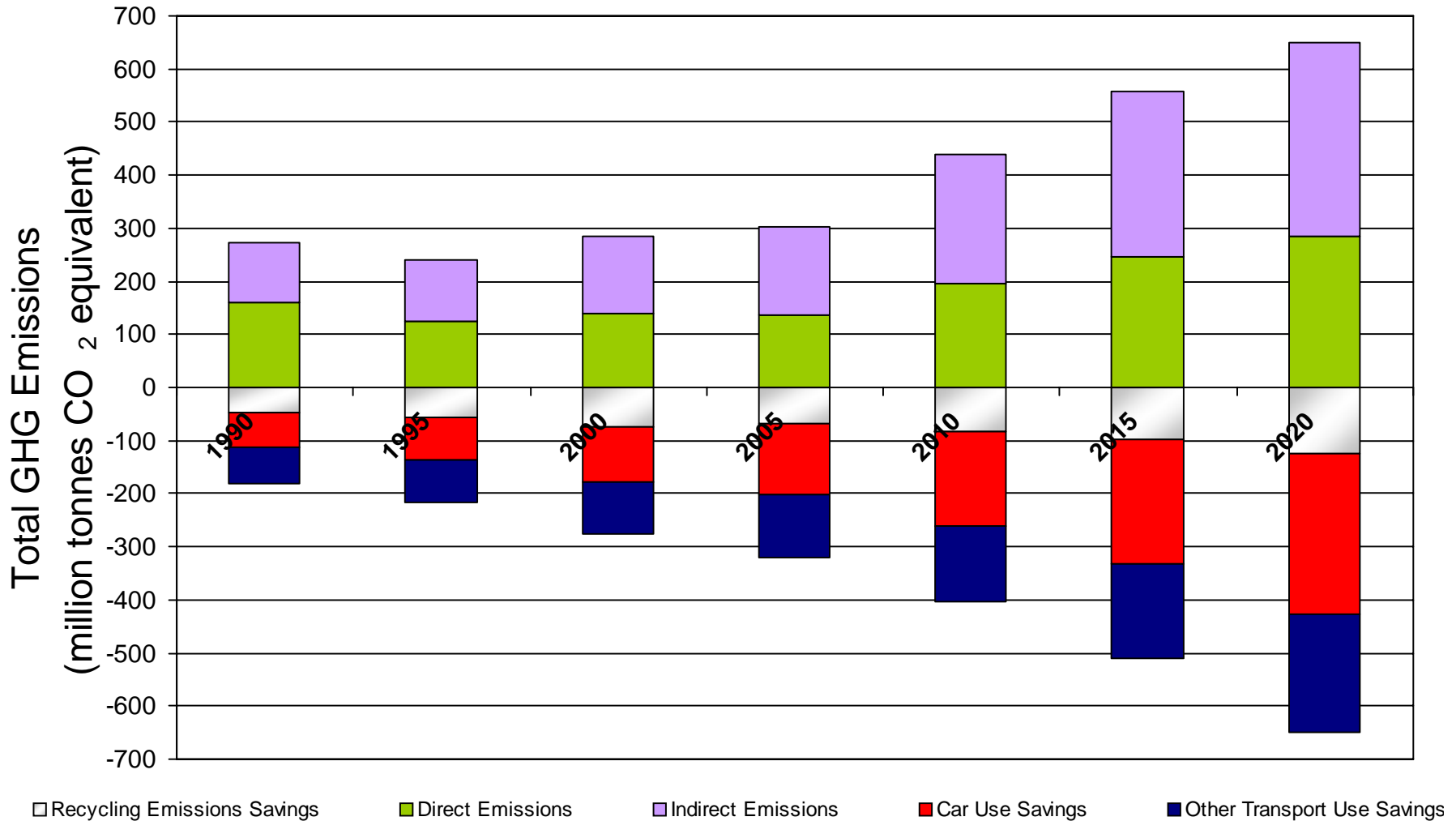


Values in millions of metric tonnes. Values might not add up due to rounding. Production stocks not shown

1 Aluminium in skimmings; 2 Scrap generated by foundries, rolling mills and extruders. Most is internal scrap and not taken into account in statistics; 3 Such as powder, paste and deoxidation aluminium (metal property is lost) 4 Area of current research to identify final aluminium destination (reuse, recycling or landfilling); 5 Calculated based on IAI LCI report - update 2005. Includes, depending on the ore, between 30% and 50% alumina; 6 Calculated. Includes on a global average 52% aluminium; 7 Scrap generated during the production of finished products from semis; 8 Landfilled, dissipated into other recycling streams, incinerated, incinerated with energy recovery.



Modelled Use Phase and Recycling GHG Emissions Savings





Surveys (January-March 2009)



- Anode Effect Survey
 - PFC emissions
 - Smelters

- Energy Survey
 - Smelters
 - Refineries

- Sustainable Development Indicators (SDI) Survey
 - Smelters
 - Fluoride emissions
 - SPL disposal
 - (*water use*)
 - Refineries
 - Residue management
 - (*water use*)

- Market data
 - Industry Associations (AA, AAC, AAI, CAA, CNIA, JAA, KNMA)
 - Recycling rates
 - Shipments to transport

Merci

謝謝

बहुत धन्यवाद

ありがとうございます

당신을 감사하십시오

Thank you



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