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The Strategic Impact of Changing Energy Markets on the Aluminium Industry

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CRU | THE INDEPENDENT AUTHORITY®

MINING | METALS | POWER | CABLES | FERTILIZERS | CHEMICALS

31 Mount Pleasant, **London** WC1X 0AD UK
Tel. +44 20 7903 2000 Fax +44 20 7278 0003

PO Box 1269, **Langley**, WA 98260 USA
Tel. +1 360 321 4707 Fax +1 360 3214709

Level2, Kalpataru Synergy, Opp. Grand Hyatt,
Santa Cruz (East), **Mumbai** 40005 INDIA

517, Tower B, Bright China Chan An Building,
7 Jianguomennei Avenue, **Beijing** 100005, China
Tel. +86 10 6510 2206 Fax: +86 10 6510 2207

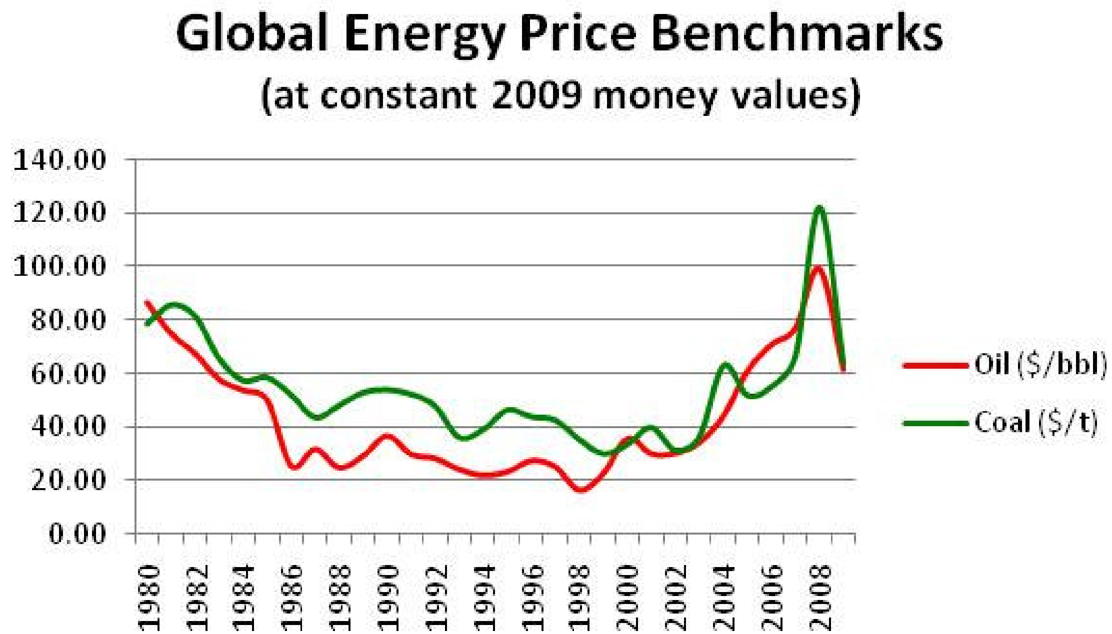
Augusto Leguía Norte Nº 100 of.506, Las Condes
Santiago, Chile Tel/Fax. +56 2 231 3900

www.crustrategies.com

This presentation will focus on the following topics:

- What is going on in global energy markets?
- What does this mean for alumina refineries?
- What is happening to the electricity sector?
- What does this mean for primary aluminium smelters?

The global energy markets have exhibited considerable volatility over the past 5 years



Note: Oil price is $/bbl Brent Crude; coal price is $/t South African export coal fob Richards Bay

- Prices fell sharply in real terms through 1998 for oil; through 2002 for coal
- Recent trends have been strongly upwards
- Sharp correction in the current cycle
- Is the change cyclical or structural?

Source: IEA, EIA, IMF, McCloskey, CRU

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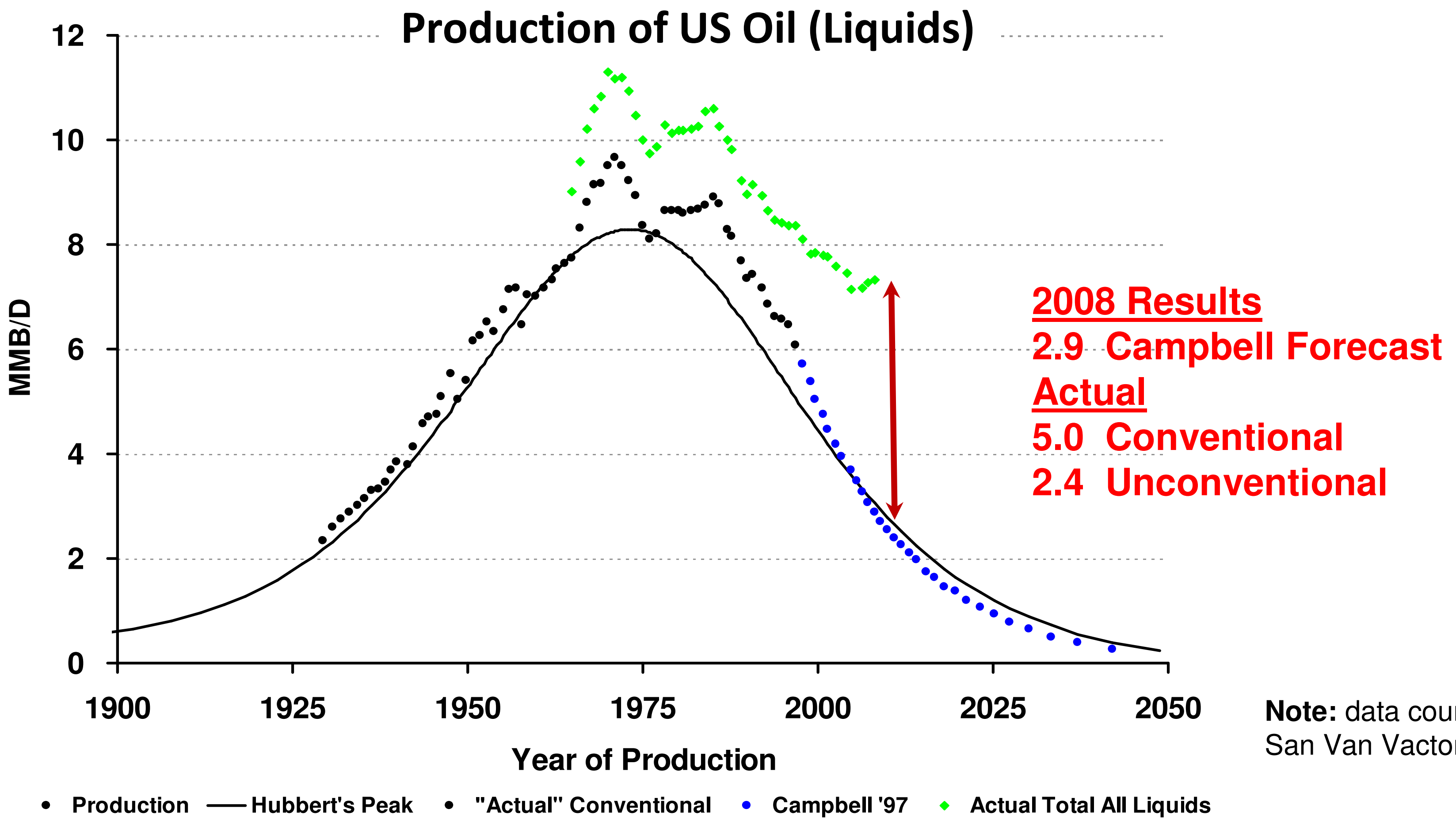
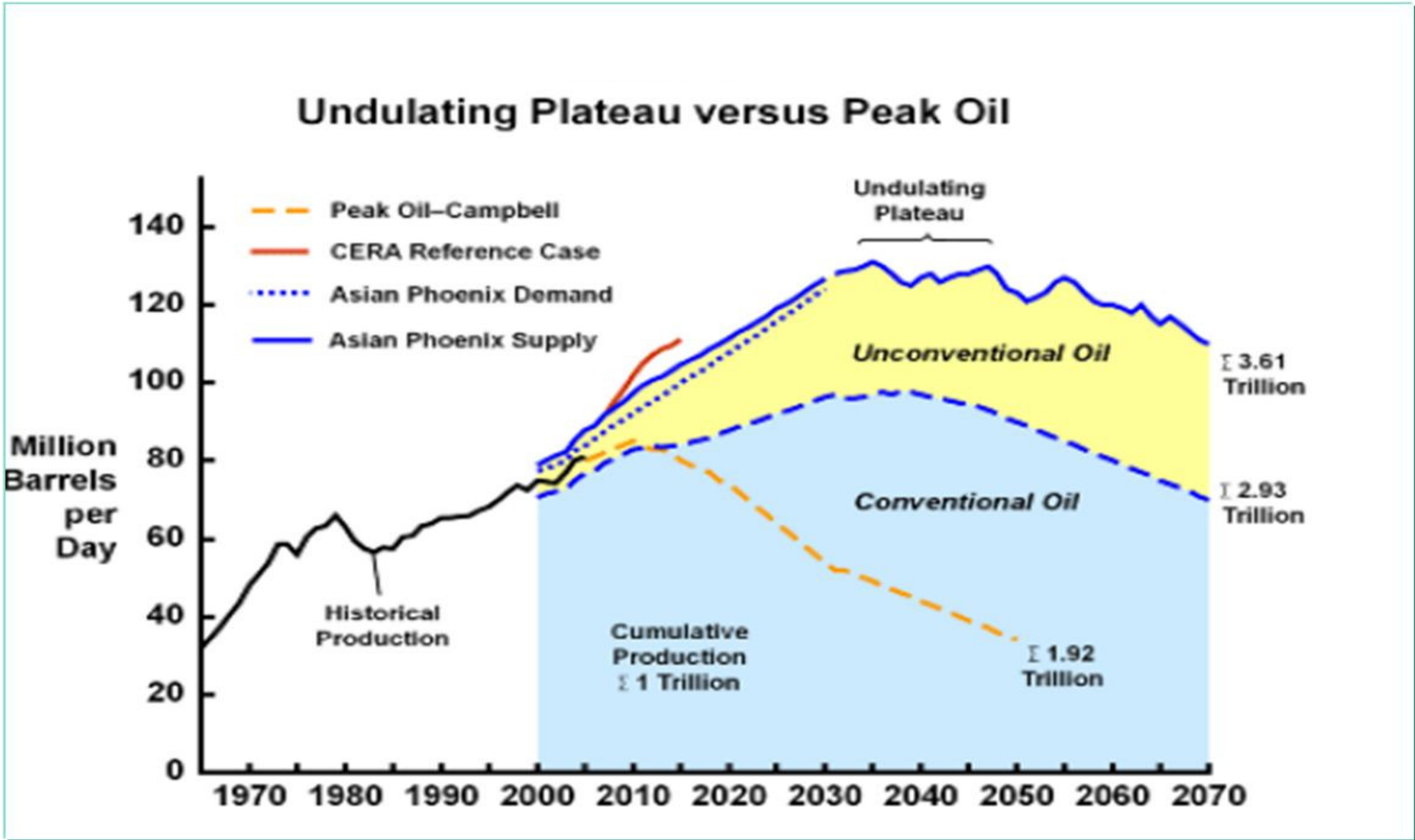
"Peak oil" concerns are based on Hubbert's curve as extended by analysts like C. Campbell (1997)



Note: data courtesy of San Van Vactor

The science is far from settled: there is a huge range of opinion



Source: CERA's 2006 refutation of peak oil (Jackson)

"Peak Oil" is more a philosophy than a science

Facts Embraced

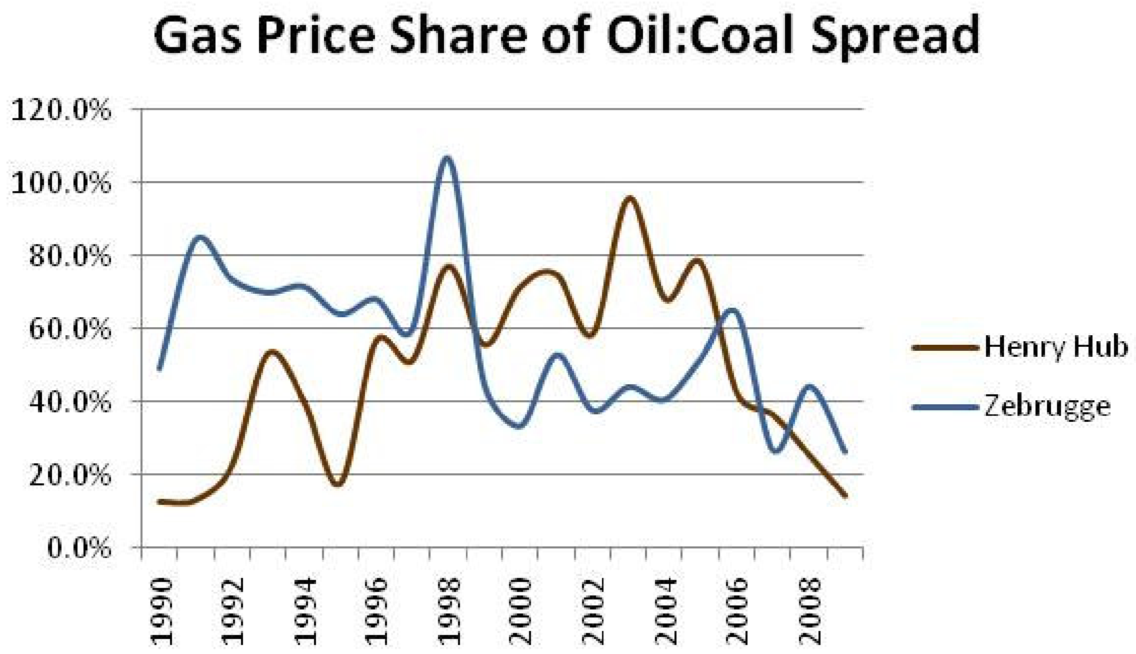
- Hydrocarbon resources are finite
- Individual fields are developed, peak and then decline
- Non-OPEC discoveries have not kept up with the growth of oil consumption
- Alternatives are more expensive and may have adverse environmental implications

Facts Overlooked

- Resources of less conventional hydrocarbons are extremely large in the absolute
- There is a long track record of consistent technological innovation in terms of energy production
- Past price increases have stimulated substitution and conservation

The stone age came to an end, but not because we ran out of stones!

The gas market is developing a dynamic of its own in both North America and Europe



Note: The figures represent the proportion of the oil premium over coal that is captured in the gas price at the pricing benchmark in each region

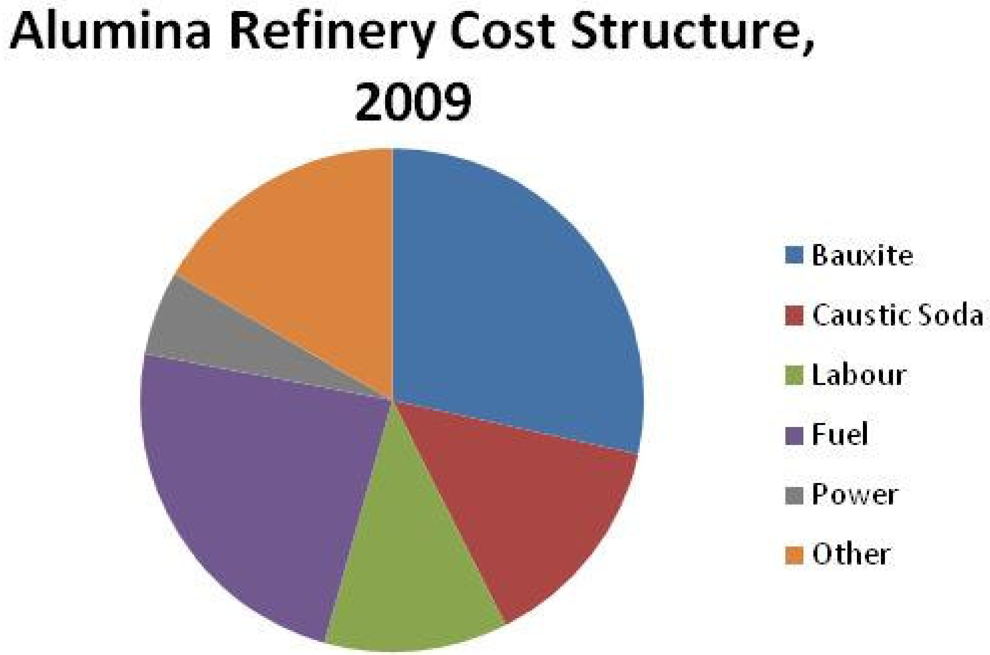
- Gas companies have been trying for an oil equivalent price
- Gas competes with coal in power stations
- Gas transport costs are high and the global market is relatively inefficient
- US shale gas developments have surprised everyone

Source: IEA, EIA, Nexant, CRU

For the record, here are CRU's current strategic planning assumptions for energy consumers

- Oil prices will reflect marginal unconventional sources such as the Alberta tar sands – say $70-80/bbl rising at a real rate of increase of 0.5%
- Coal prices will reflect total costs at new mines – say $65-75/t declining at a real rate of 0.25% per annum
- Gas prices will fluctuate between these limits depending on local market balances and competitive conditions
    - highest portion of bargaining zone/spread captured in Asia, lowest portion in North America; Europe in between
    - will be based on costs of production (i.e. lower than coal) only in areas of massive structural surplus, such as the Middle East
    - gradual globalization of gas markets through improved transport capacity and lower costs will slowly serve to eliminate islands of stranded gas; although shale gas developments have the potential to recreate gas islands, e.g. M.E., Australia

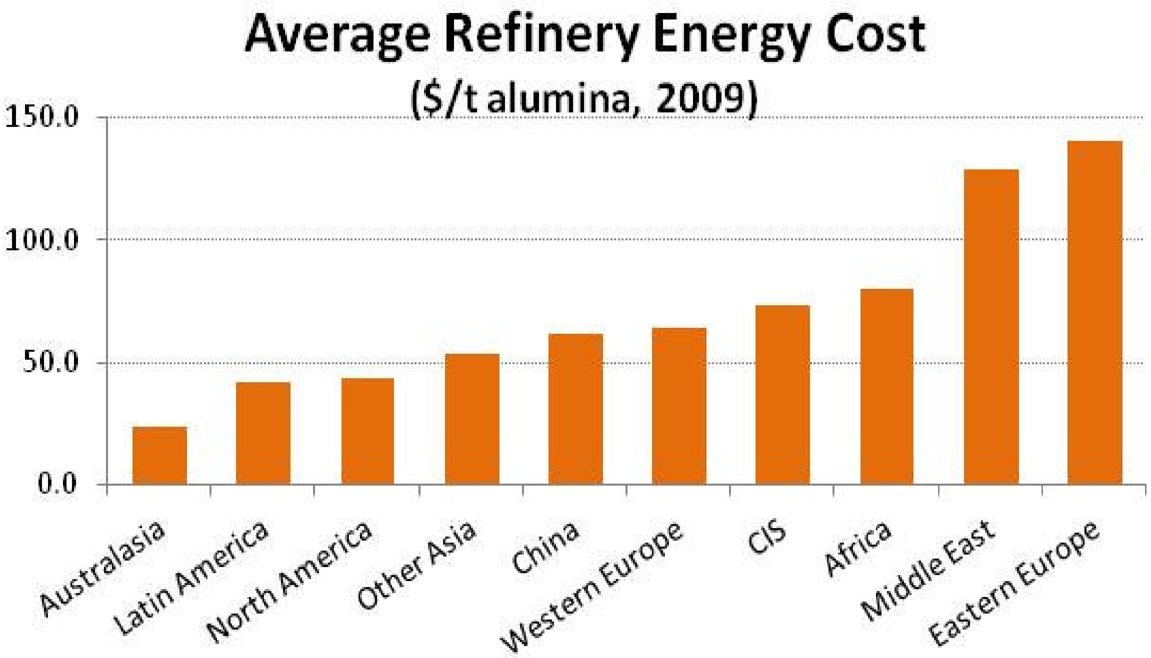
Fuel cost is nearly as critical as bauxite cost to an alumina refinery



- Integrated refineries have much lower bauxite costs than non-integrated ones
- Infrastructure and taxes/royalties drive bauxite costs
- Fuel cost leverage is based on refinery location relative to gas (or sometimes coal)

Source: CRU Alumina Refining Cost Service

Fuel costs vary considerably around the world



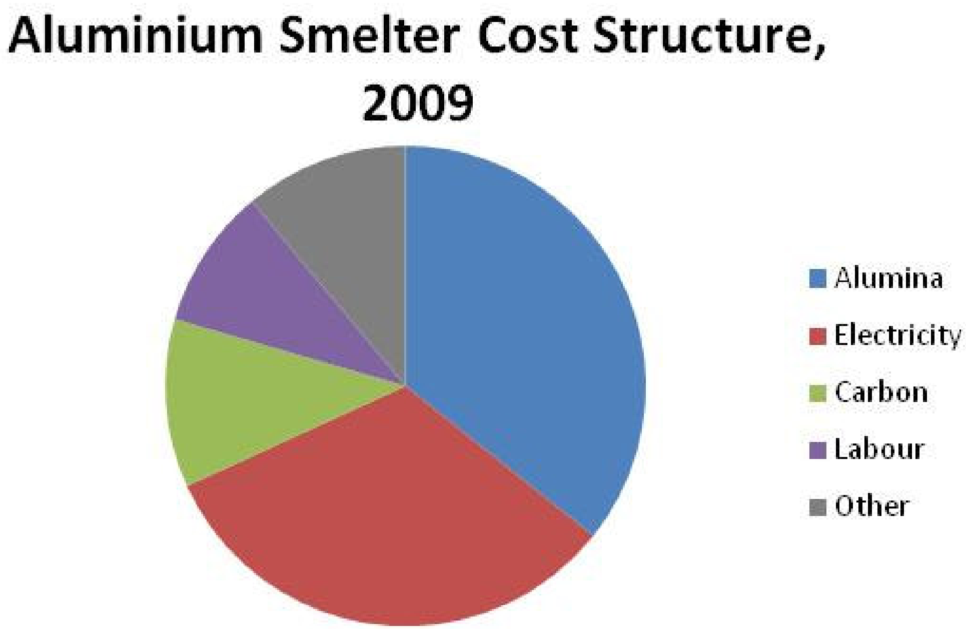
- Australia has cheap gas and coal and efficient plants
- China and Russia have cheap fuel but have energy-intensive refining technologies
- Africa and Eastern Europe have high fuel prices
- The Middle East plants are not in the oil-rich states

Source: CRU Alumina Refining Cost Service

How can alumina refineries manage their fuel costs?

- For 25 years, most new refineries have been integrated - hence location has been driven by bauxite availability and infrastructure constraints
    - Australia (gas, coal), Brazil (gas) and India (coal) all have reasonable energy economics so this has not been an issue
- The upsurge in Chinese refining capacity has partly reflected a capital cost advantage
    - most local bauxite quality is poor, resulting in high energy use, but energy prices have been kept relatively low; future competitiveness and sustainability issues?
- The traded bauxite market has started to grow, particularly in the Indian and Pacific ocean basins, to serve China
- Rising energy costs may introduce a third factor into the location selection decision
    - will Ma'aden be the start of a larger Middle East alumina refining expansion?

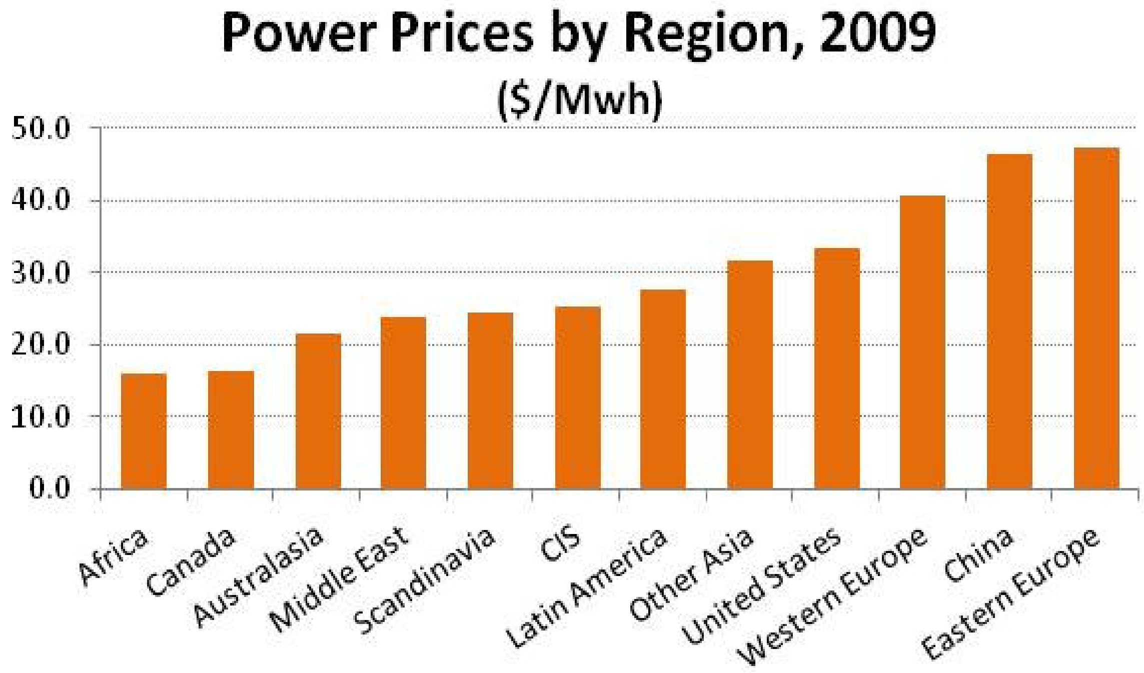
Aside from alumina, electricity is the single largest cost in smelting and the driver of location decisions



- Alumina and carbon are commodities where everyone pays more or less the same price
- Labour and other costs vary widely, but are very small in relation to the total cost structure
- Power costs show the largest variations across smelters
- Aluminium has been described as “congealed electricity”

Source: CRU Aluminium Smelting Cost Service

High power cost regions have prices 3 times higher than low cost regions for aluminium smelting



- Canada reflects smelter owned hydro power
- Africa and Australia have cheap coal
- Scandinavia has abundant hydro (especially Iceland)
- Middle East gas is often a stranded asset
- Prices are much higher in countries that have to pay market prices for their fuels

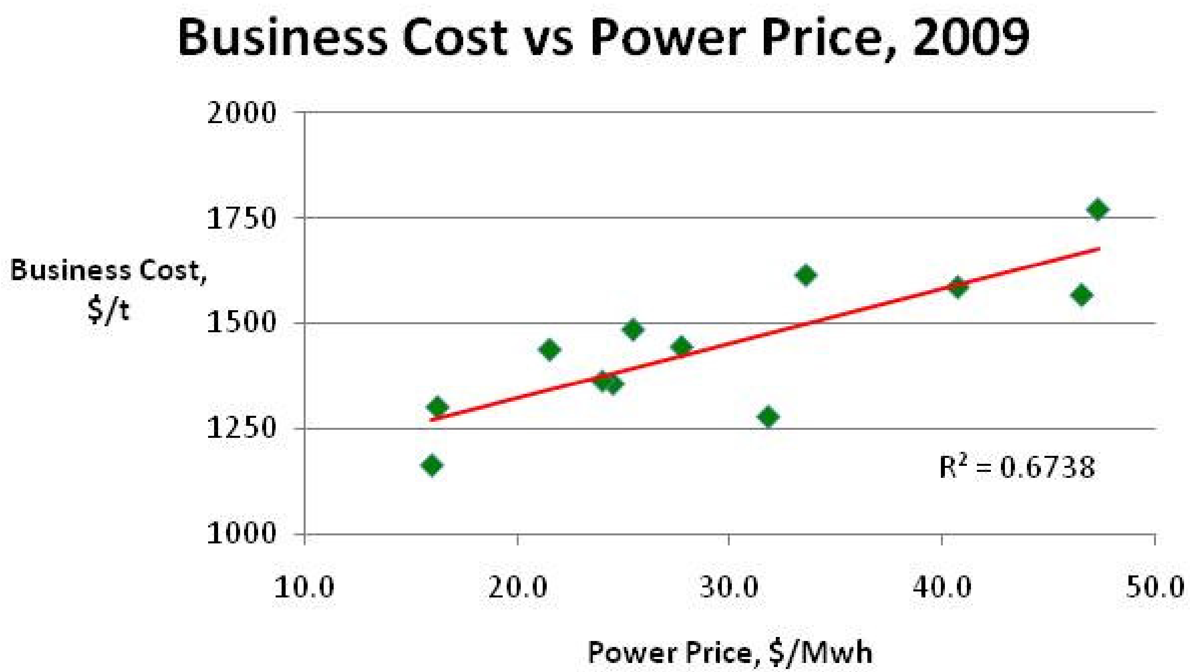
Source: CRU Aluminium Smelting Cost Service

The future of power-intensive industries depends critically on the high cost regions' energy policies

- ✓ The ability of each region's electric utilities to manage cost pressures related to environmental issues
- ✓ Successful defense of the concept of regional preference with respect to access to low cost legacy power resources
- ✓ Breaking the link between oil and gas permanently – or accepting some coal fired power at the margin

- ➢ One of the largest issues facing the aluminium industry in the next few years will be the renegotiation of long-standing contracts

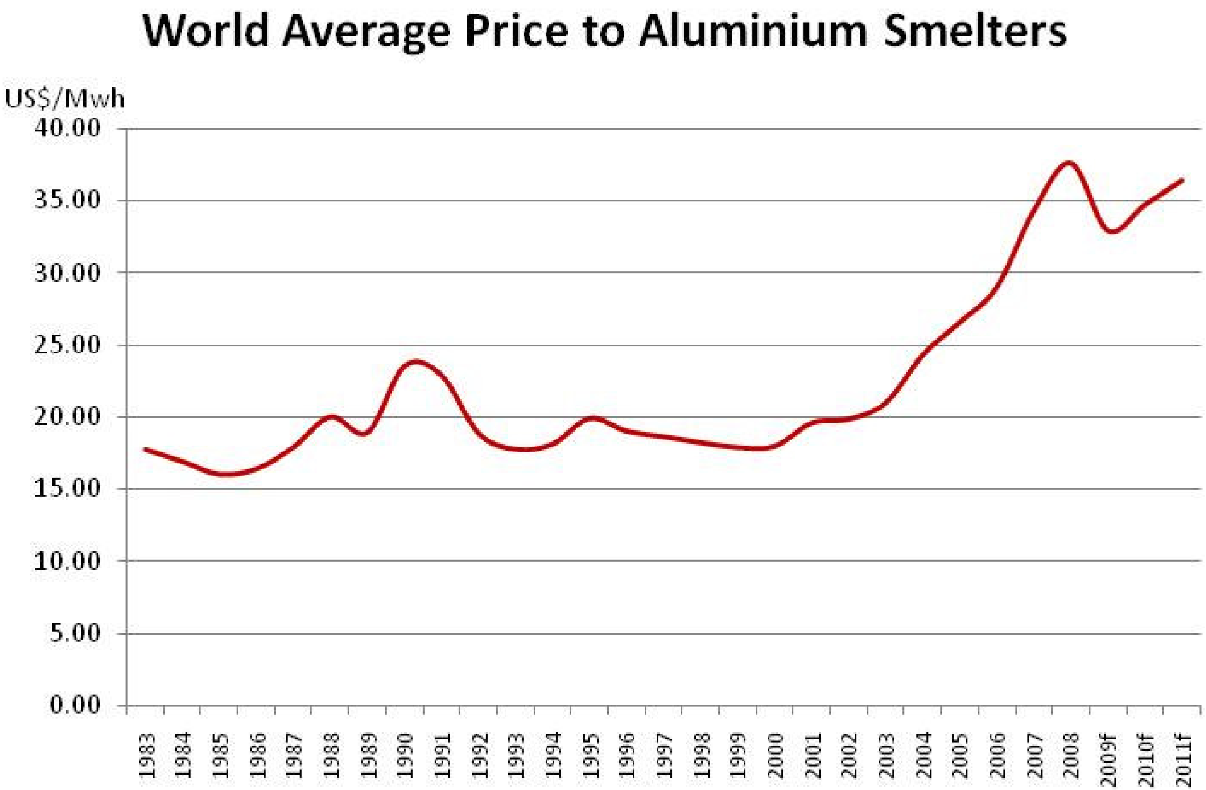
Power prices are clearly the main determinant of the competitive quality of an aluminium smelter



- Accounts for two-thirds of the variance
- Labour costs are only a factor in very poor countries
- Cast house economics and premiums can be important in some parts of the world
- Technology mainly affects capital costs via economies of scale

Source: CRU Aluminium Smelting Cost Service

There are signs of a fundamental shift in the energy prices paid by aluminium smelters



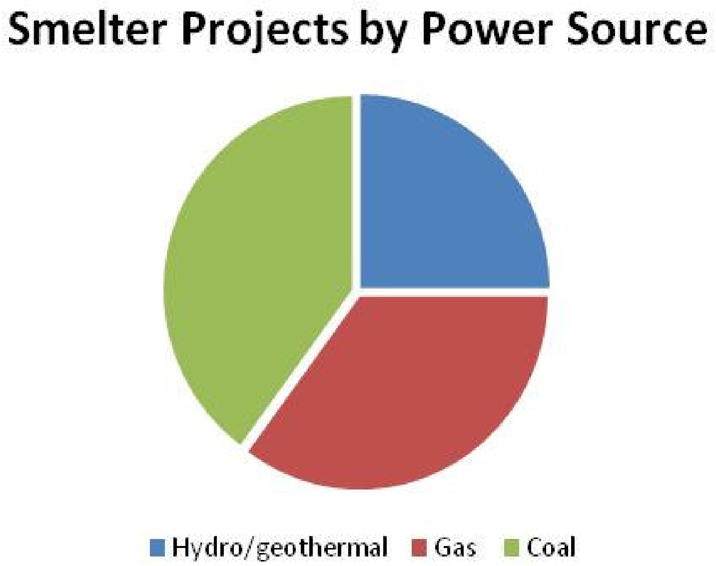
- 20 year stability from 1982 to 2002 at ~$20/MWh
- Three key factors
  - stable fuel prices
  - deregulation
  - closure of high cost smelters
- New level emerging in $30-40/MWh range?
- Compare to $80/MWh for average industrial tariff

Source: CRU Aluminium Smelter Power Tariffs, 2009

There is no shortage of places to build new smelters, but coal still features heavily in the mix due to China and India

CRU Smelter Project Database (000 tpy)

	Firm	Probable	Possible	Total
Gas Surplus	1513	1000	3445	5958
China (coal)	1510	3750	350	5610
Russia (mostly hydro)	1350	0	0	1350
India (coal)	1175	360	0	1535
Iceland/Greenland	360	0	700	1060
Canada (hydro)	0	185	170	355
West Africa (hydro)	0	0	1800	1800
Others (mixed)	270	0	1220	1490
Totals	6178	5295	7685	19158



Note: The context is that aluminium consumption peaked at 38m tonnes in 2007 and the market currently faces a 3-4 m t surplus inventory overhang

Source: CRU Long-Term Outlook for Aluminium, 2009

There has clearly been a structural change in power prices on offer to new smelters

Item	1982-2002	Since 2002
New smelters in higher risk countries	$14-$17/Mwh	$23-$28/Mwh
New smelters in lower risk countries	$16-20/Mwh	$25-$30/Mwh
Expansions and modernisations	$18-$25/Mwh	$28-$32/Mwh
Marginal smelters in US/Europe	$32-37/Mwh	$40-$55/mwh

Gas economics depends critically on price: $2/GJ ≈ $25/Mwh; $5/GJ ≈ $45/Mwh

The critical energy issues for smelters are linked to government policy

- Will China and India continue to offer very cheap coal-based power to new smelters in an era of rising environmental concerns and increasing opportunity costs associated with demand growth?
- Will the gas surplus countries continue to offer gas to local power stations tied to aluminium smelters at prices based on the cost of production rather than the netback from LNG or pipeline exports?
- If either of these things stop happening, the development of African hydroelectric energy becomes far more probable and implies further real price increases, at which point nuclear power may also enter the picture.
- What will be the cost impact of green compliance, and how fast will developed nations implement full Kyoto/Copenhagen commitments?

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Thank you for your attention.

CRU contacts for further information or follow up:

CRU Analysis
Principal Consultant, Aluminium
Kelly Driscoll
Location: London, UK
Tel: +44 (20) 7903 2220
kelly.driscoll@crugroup.com

CRU Strategies
Senior Managing Consultant
Robin Adams
Location: Seattle, WA, USA
Tel: +1 (360) 321 4707
robin.adams@crugroup.com