



Silicon metal: Are the good times coming back?

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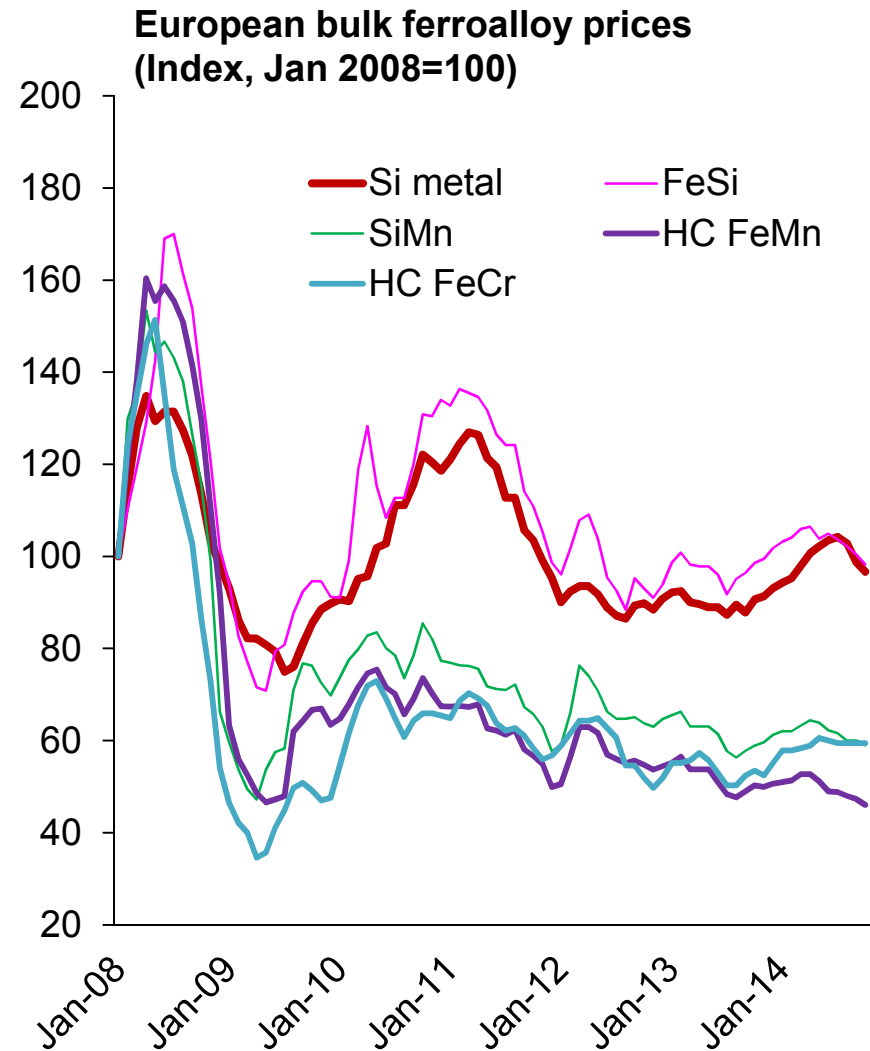
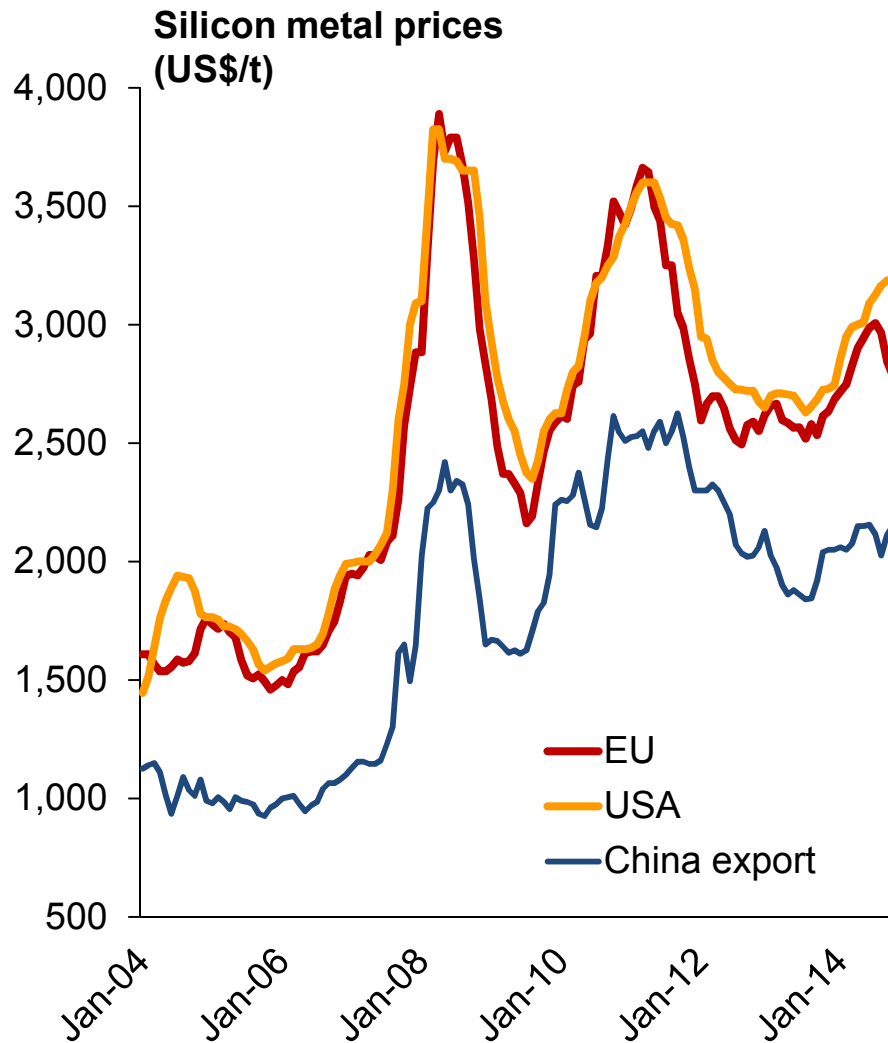


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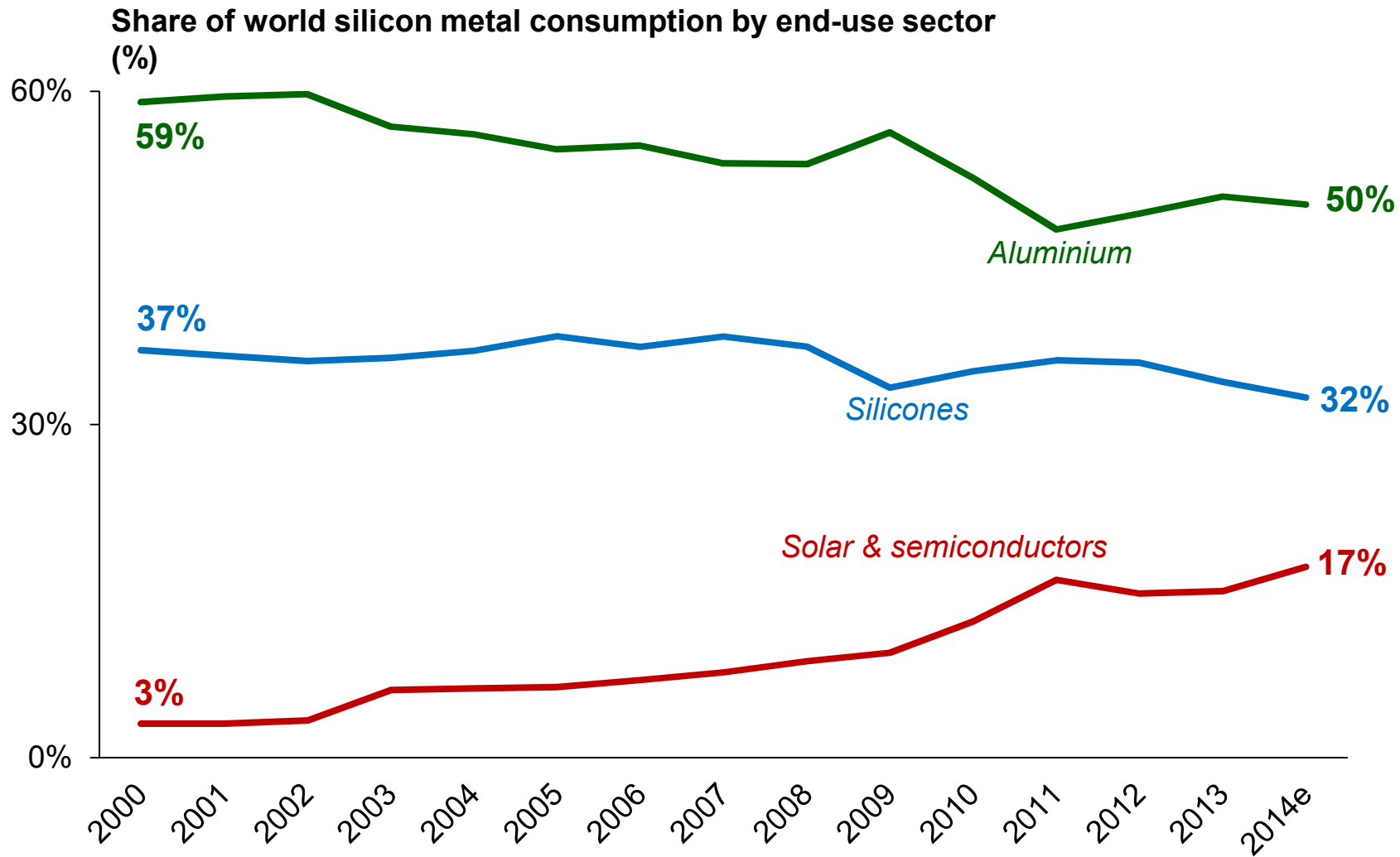
For discussion...

- Silicon metal supply, demand & prices
- Assessment of demand by consumption sector
- Production costs
- Conclusion

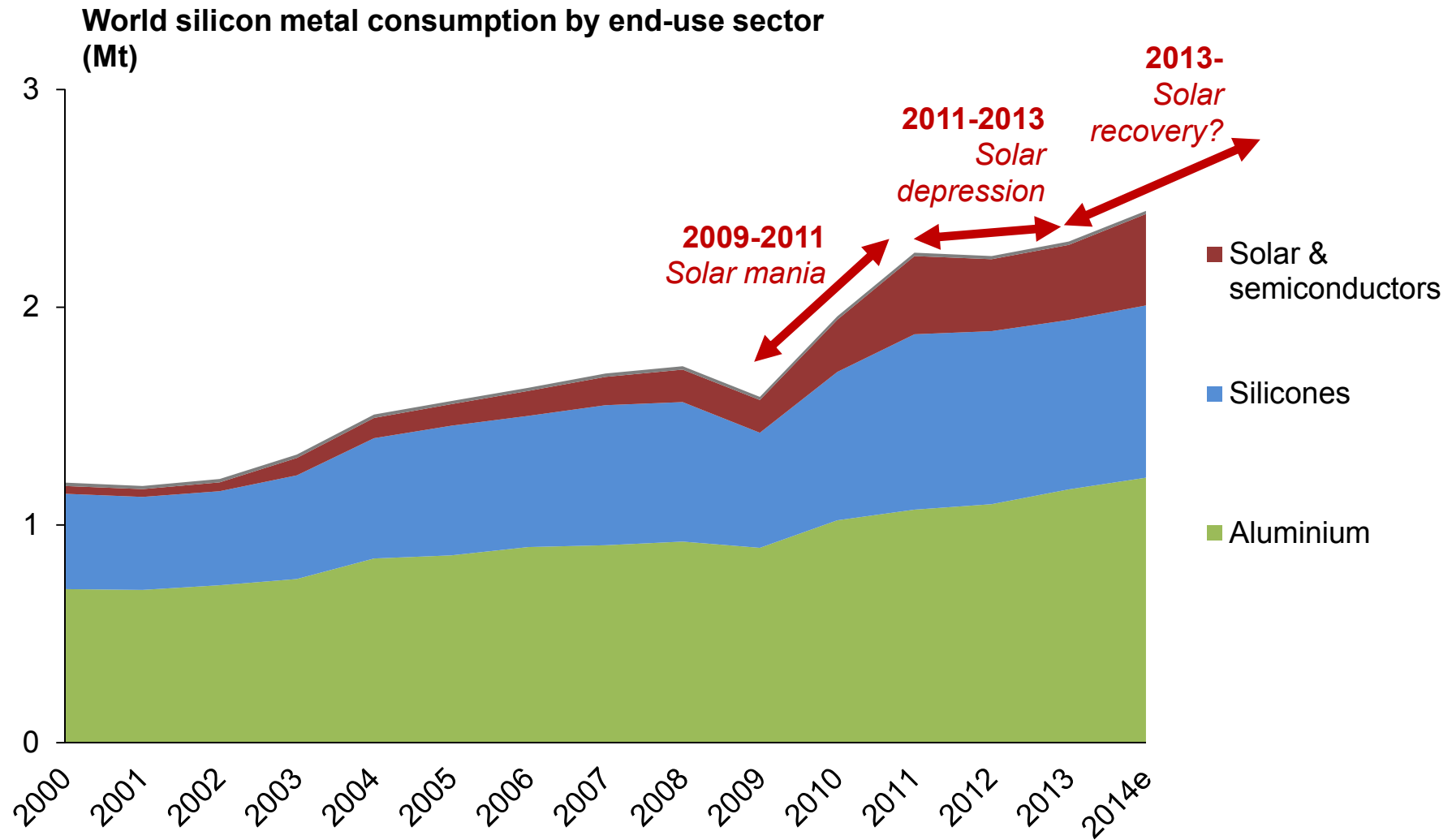
Silicon metal prices have significantly outperformed Mn alloys & FeCr since 2008, and have maintained a very close correlation with FeSi



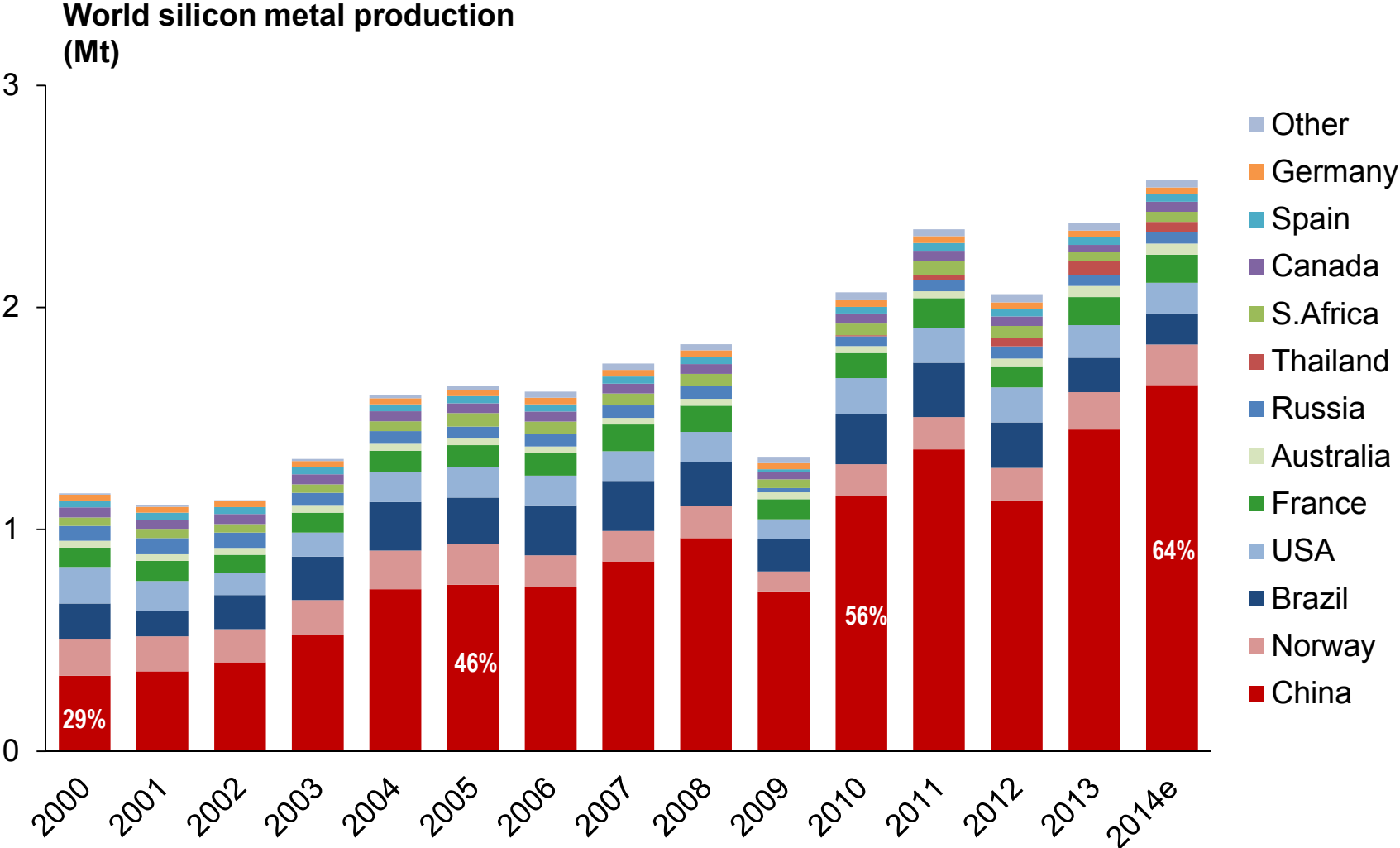
Silicon metal is consumed in three main sectors – the growing importance of solar has been the main story of the past 5-10 years



The ups and downs of the solar industry have had the biggest influence on silicon metal demand trends since 2009 – the tail has wagged the dog!

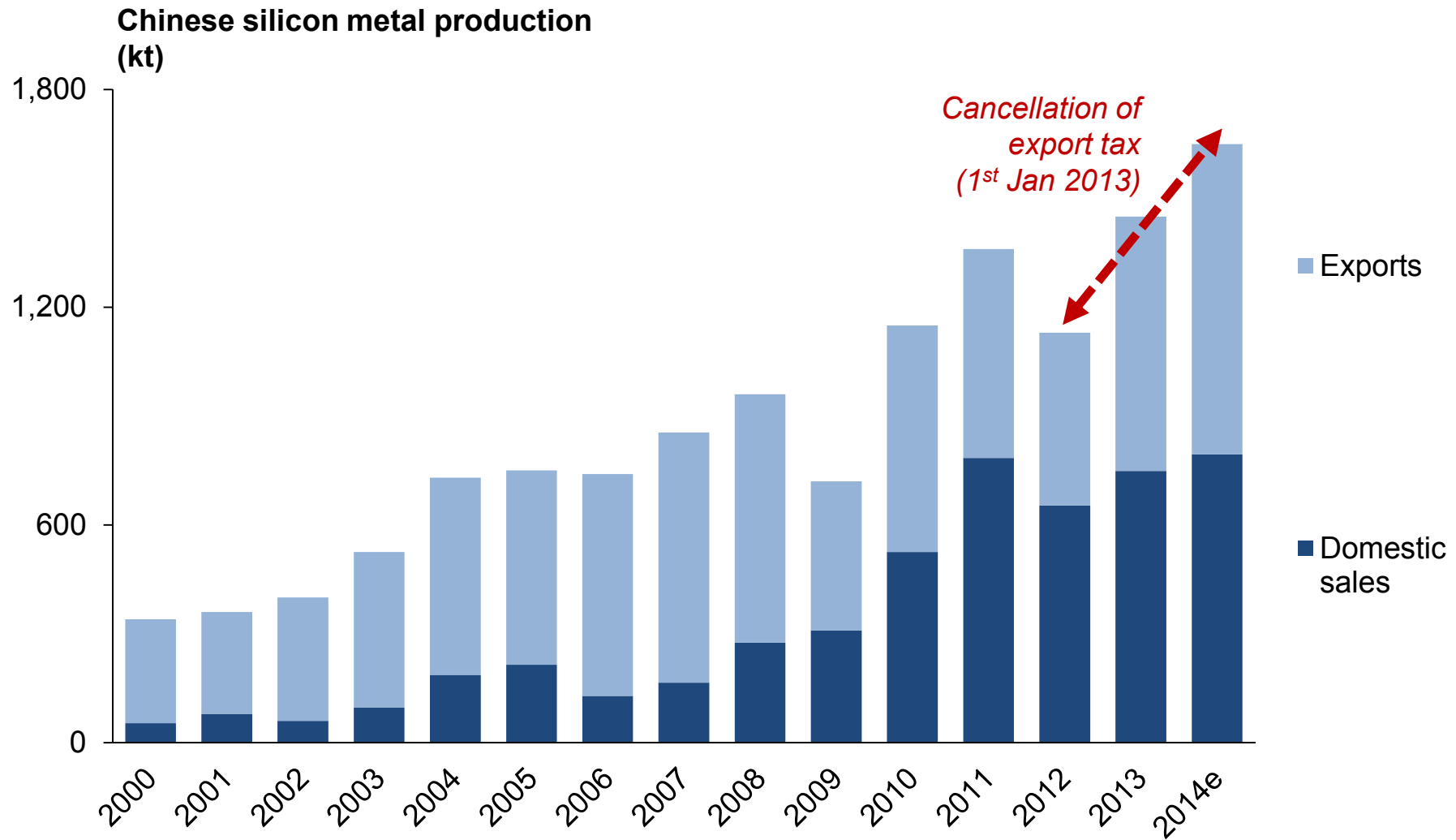


World silicon metal production is expected to reach 2.6Mt in 2014, with China now accounting for nearly two thirds of global output

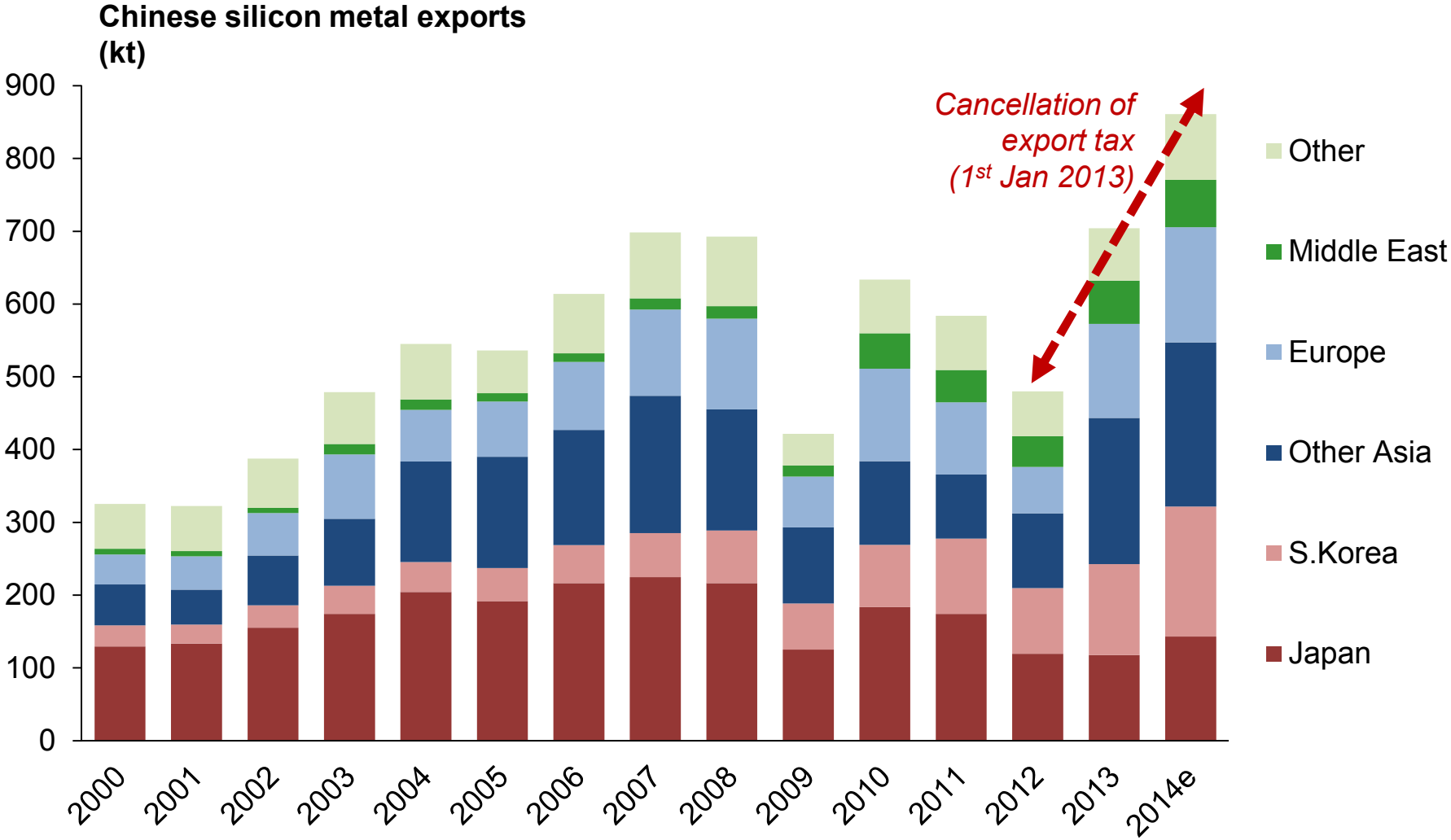


Source: AlloyConsult

Unlike most other ferroalloys, China's recent production growth in silicon metal has primarily been export driven

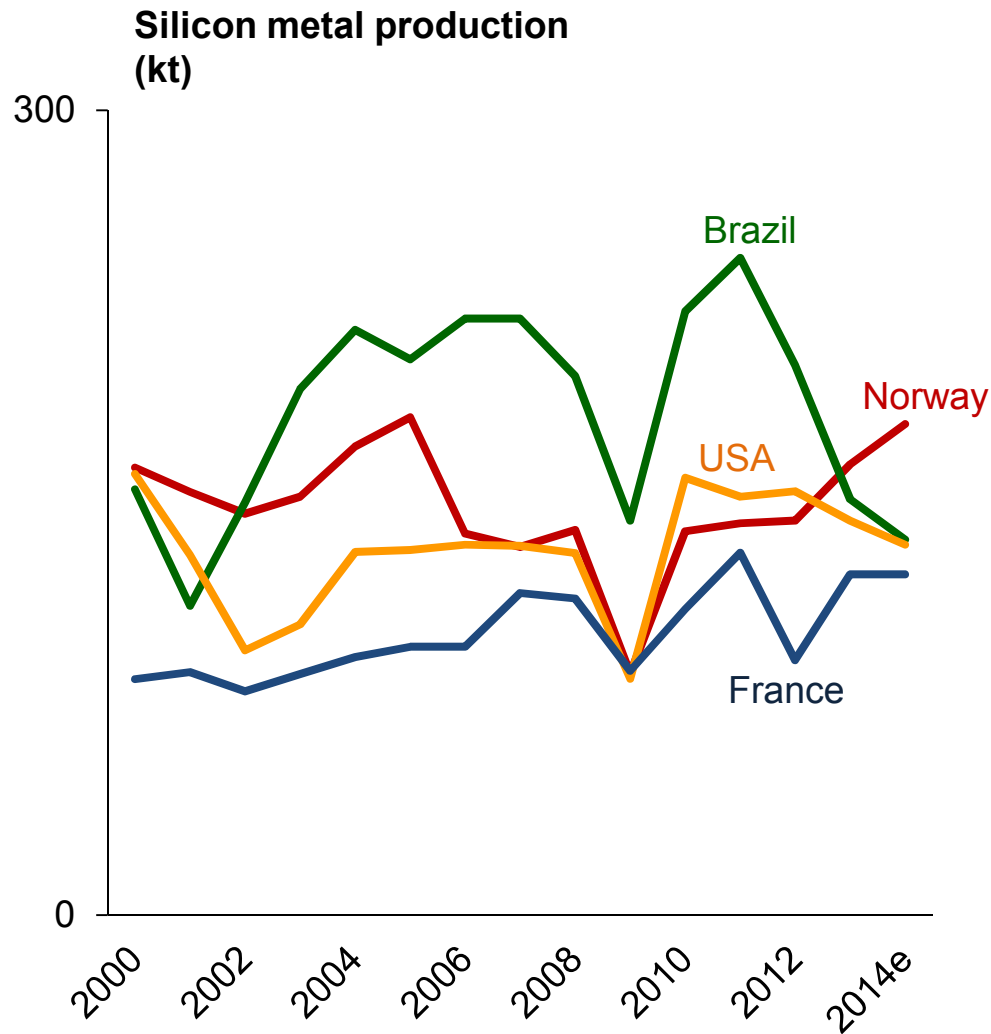


Chinese exports have risen by 80% between 2012 and 2014 – significantly higher volumes are going to S.Korea, Other Asia, Europe & Middle East



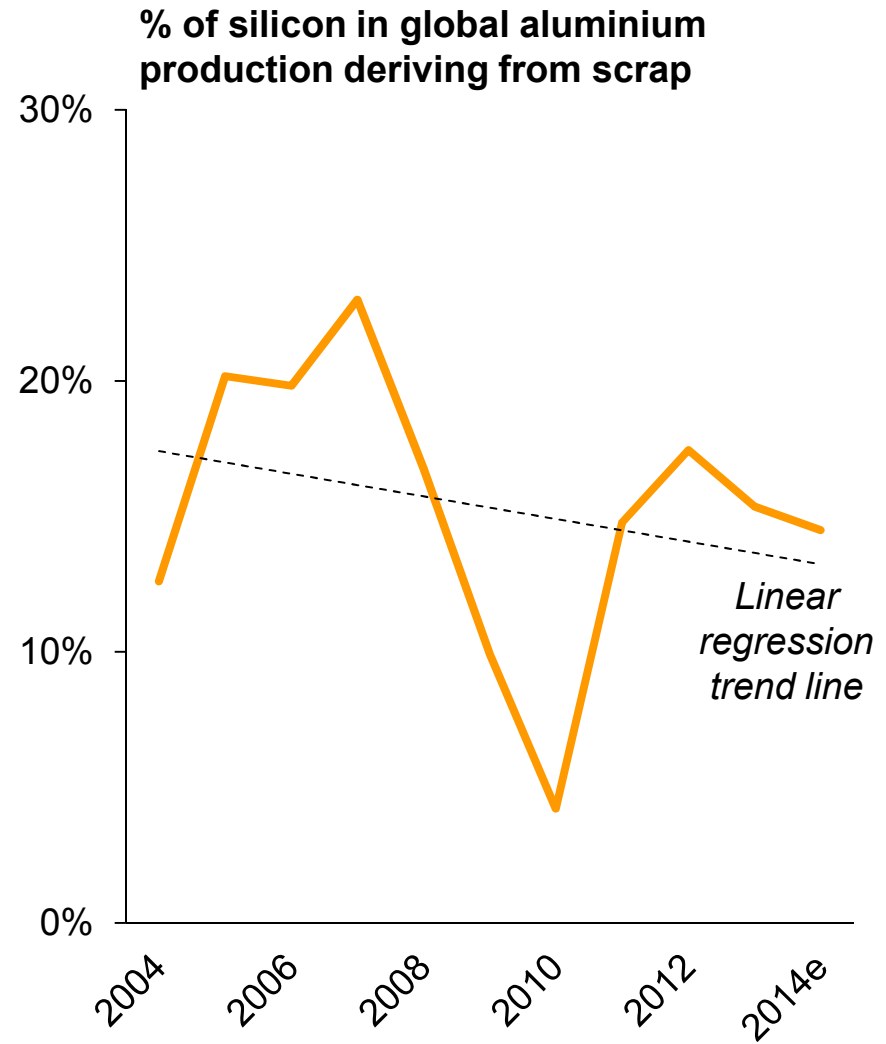
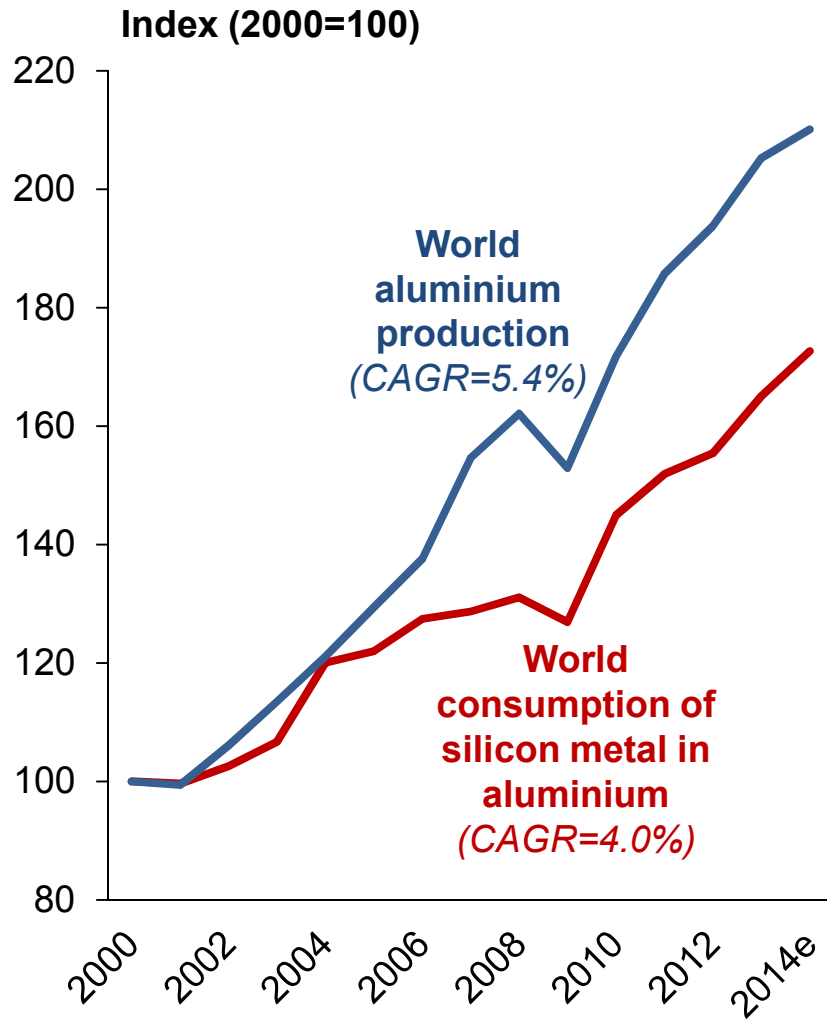
Source: AlloyConsult

Outside of China, the main development in silicon metal production has been reduced Brazilian output, due to electricity shortages



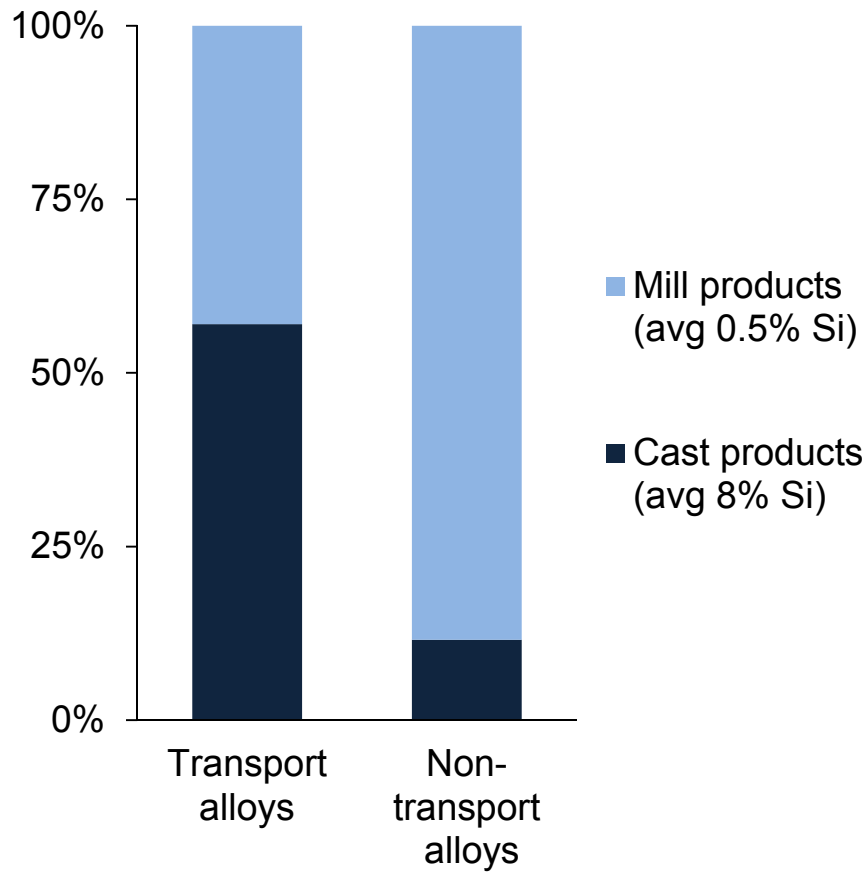
- Brazilian output nearly halved since 2011, due to electricity shortages
- Expiry of long-term power contracts at end-2014 throws up significant uncertainty for 2015 and beyond
- Higher production in Norway, partly due to furnace conversion from FeSi
- New furnace in Australia, on-stream since 2012
- Overall, non-Chinese output has been broadly stable for 15 years
- New projects proposed in Canada and Iceland

Aluminium production has significantly outpaced silicon metal consumption in aluminium – despite a declining silicon scrap usage rate

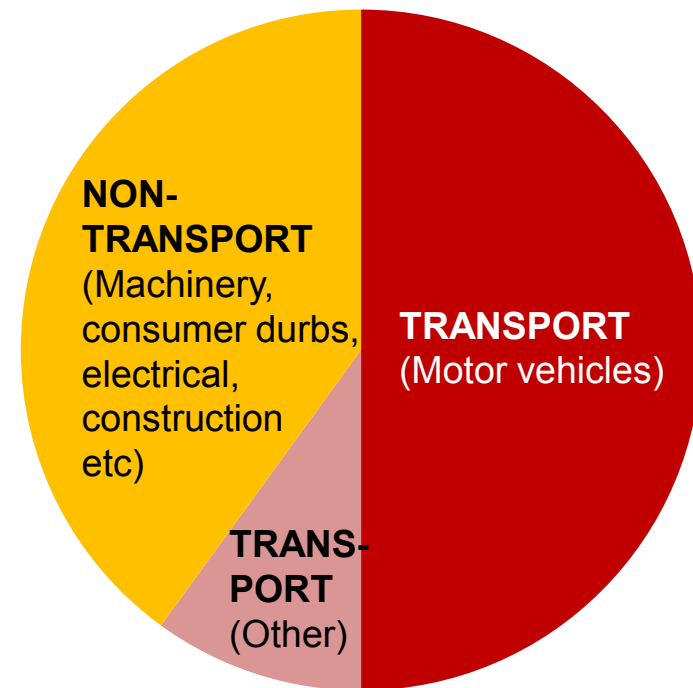


The transport sector accounts for about 60% of the silicon metal used in aluminium

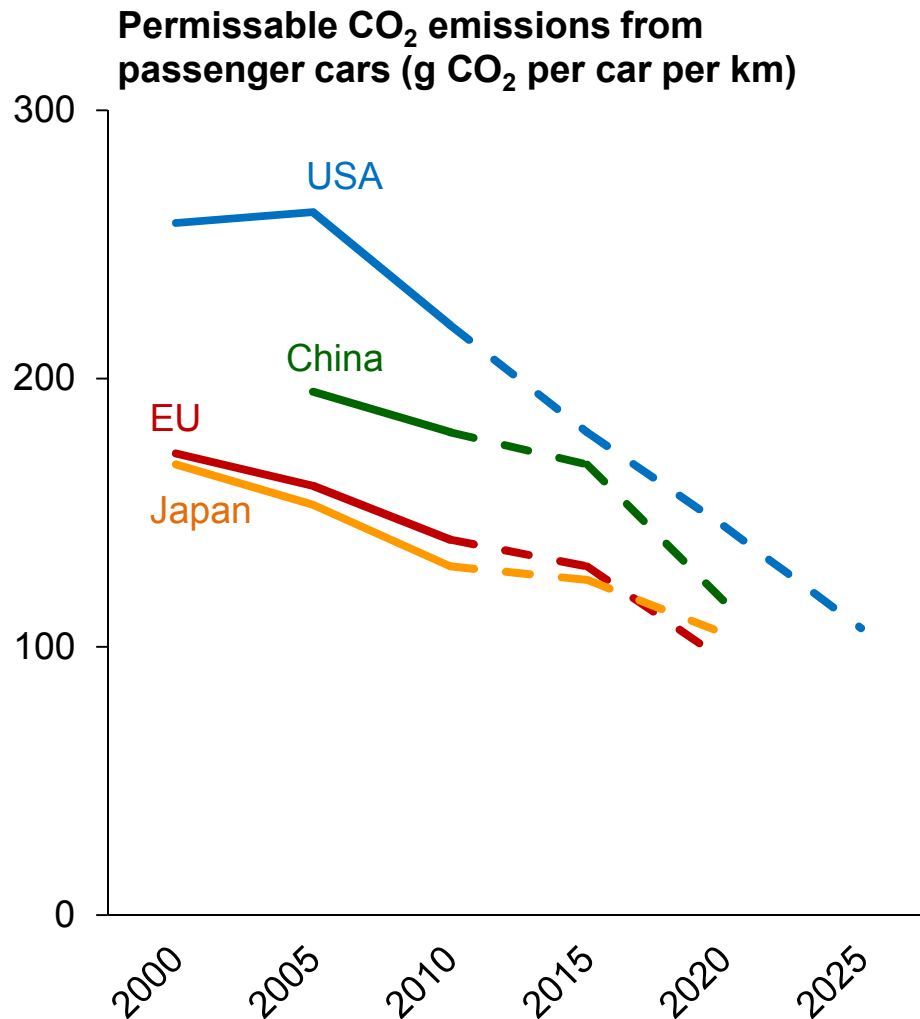
Division of aluminium alloys by sector and type



Silicon metal used in aluminium by estimated end-use

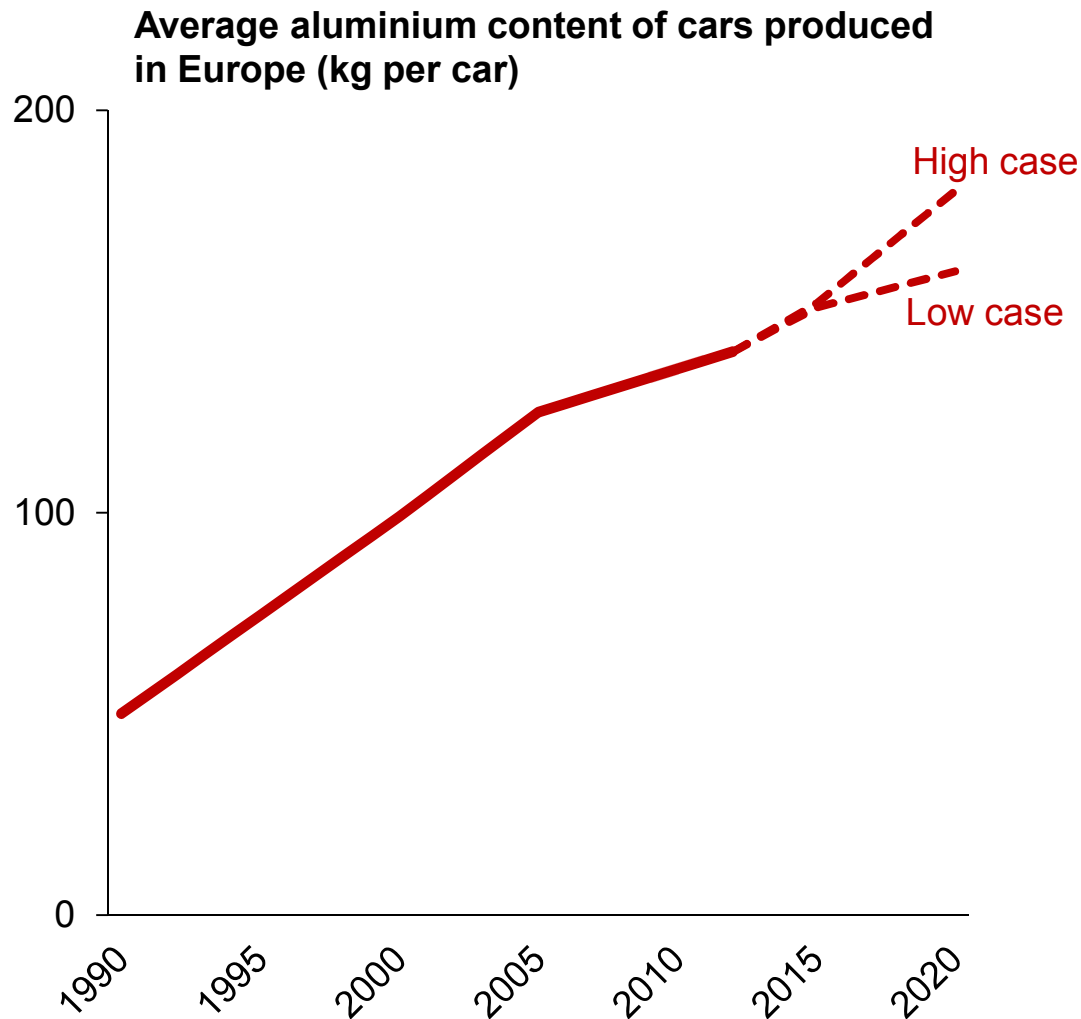


Permissible CO₂ emissions from vehicles will decline substantially in the next 10 years, especially in regions where limits are less strict at present



- The EU and Japan have so far led the world in terms of automotive fuel efficiency / CO₂ emission standards
- Over the next 10 years, standards in China and the USA will become much more strict, and will close the gap with the EU and Japan
- Lower CO₂ emissions requires greater fuel efficiency, which requires a lighter automobile
- Other pressures on automakers add weight to cars – eg. greater crash resistance & better specification
- Using lighter materials with same strength is the best solution (good for aluminium, bad for iron & mild carbon steels)

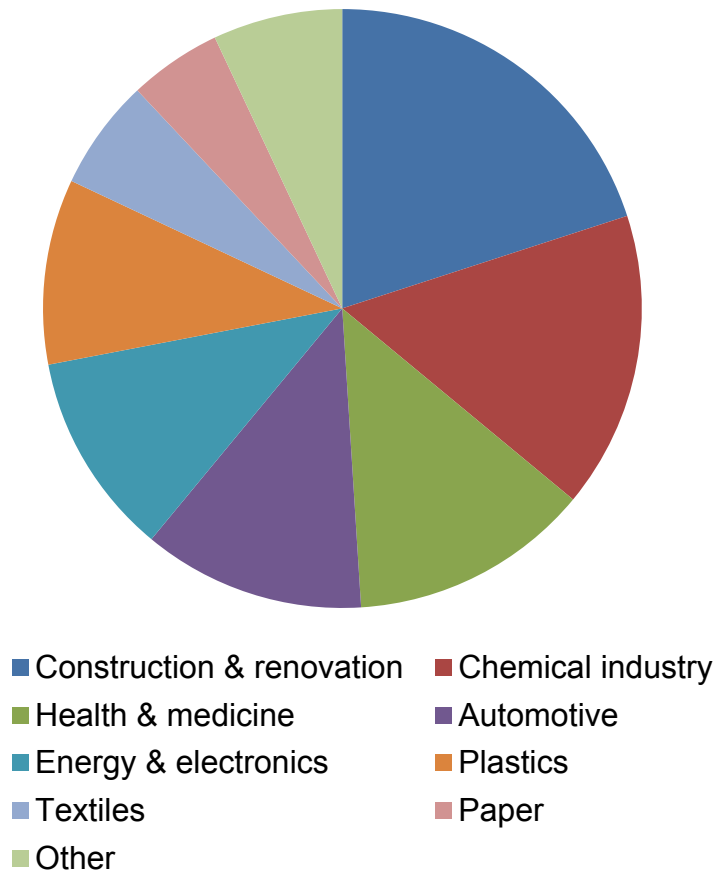
The average aluminium content of a European car has nearly tripled since 1990, and will rise by a further 15-30% by 2020



- Aluminium's superior strength-to-weight ratio makes it more effective for building fuel-efficient cars than steel or iron
- Main disadvantage of aluminium is higher cost – but legislation forces auto makers to act
- Average aluminium content of European-produced cars has nearly tripled since 1990
- There will be a further increase of 15-30% by 2020, and faster increases in other regions
- Automotive-related alloys account for the highest amount of silicon used in aluminium

Silicone consumption is driven by disposable income – significant growth potential exists from developing countries growing their middle class

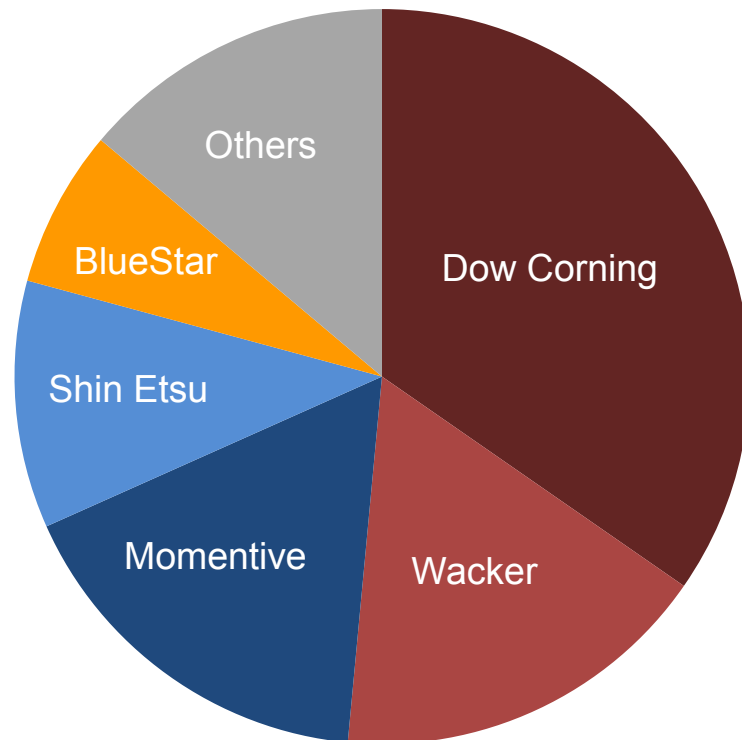
World silicone consumption by end-use (value basis)



- Extremely wide array of consuming sectors; approx 10,000 individual applications – more constantly being developed
- Many are driven by consumer disposable income (eg. beauty, health, home renovation) – most consumption still in west, but substantial growth potential from developing countries building a bigger and richer middle class (especially China)
- Complex upstream & downstream production process – silicon metal most important raw material (approx 0.5kg/t of silicone)

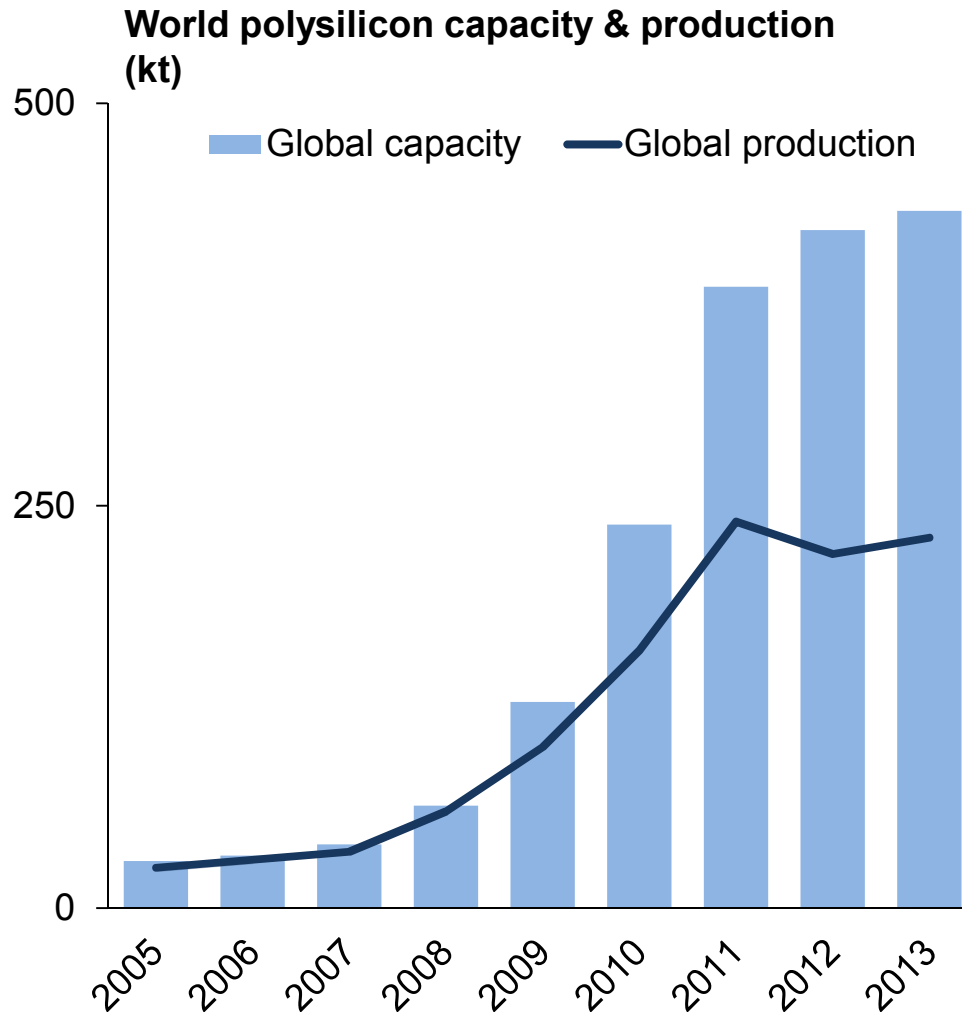
The silicone industry is highly consolidated, with the top 5 producers accounting for approx. 85% of world output

World silicone production by company (value basis)



- World silicone production is extremely consolidated – the top 5 producers control approx. 85% of world output
- Until recent years, most upstream capacity was in US, Europe & Japan, with developing world largely served from exports
- Massive investment in integrated silicone plants in China in recent years – much of it JVs with big 5
- Increased efforts to integrate upstream into silicon metal production over past 15 years (DC, Holla, Simcoa, Elkem-BS)

We are just emerging from 2-3 years of massive oversupply in polysilicon, during which time polysilicon prices fell by 80%

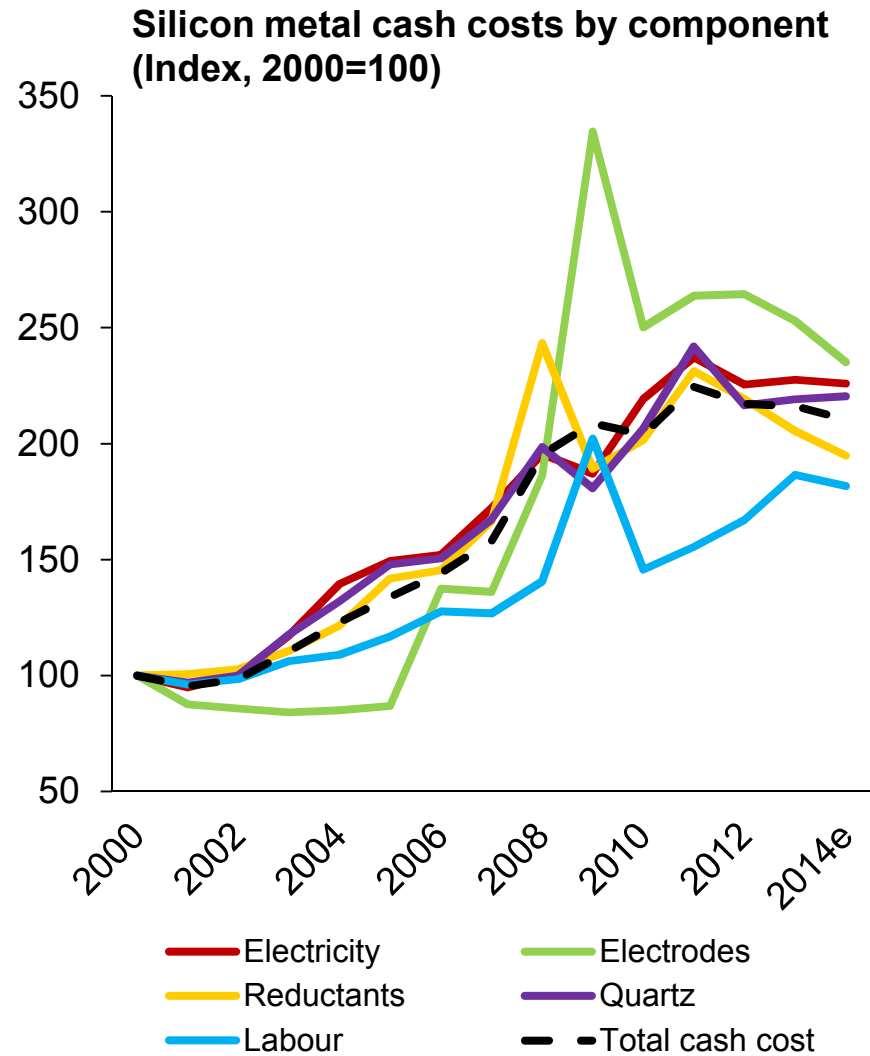
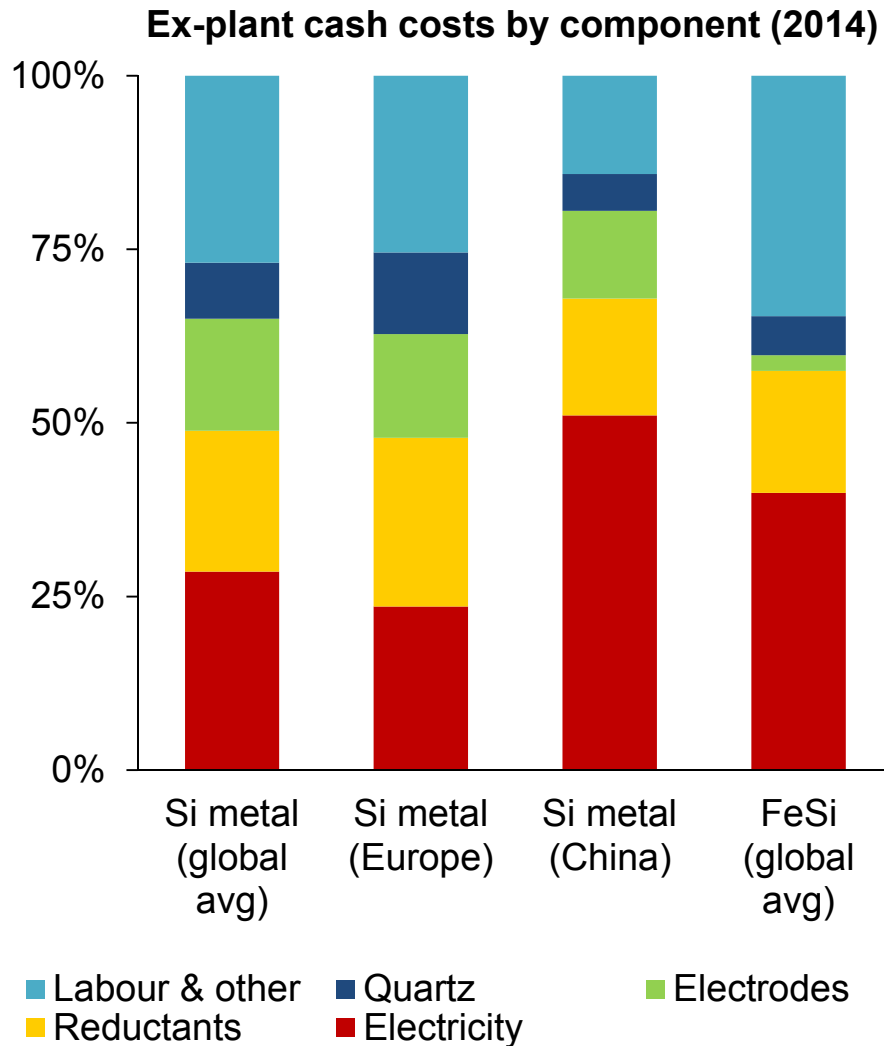


- The solar sector has been very prone to hype....the hype of 2008-2011 resulted in a sevenfold increase in polysilicon capacity between those years!
- Demand suddenly hit the buffers after 2011, resulting in a massive global glut of unused capacity, and polysilicon prices falling by 80%
- Solar hype (good or bad) rubs off on sentiment in the silicon metal market, despite it still being the smallest of the three consuming sectors

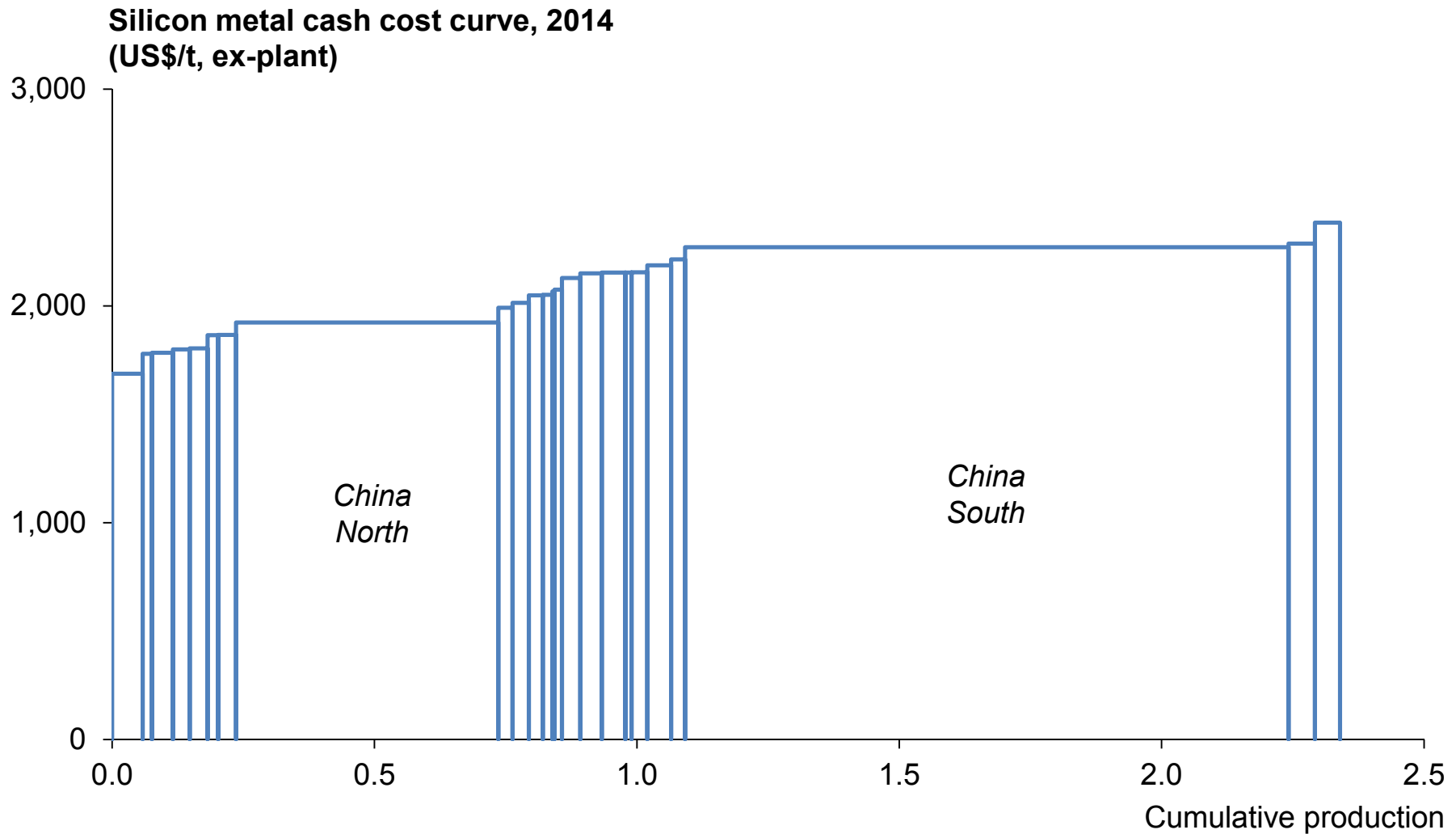
The solar / polysilicon sector has picked up strongly in 2014, and will probably remain the fastest growth sector for silicon metal long-term

- Photovoltaic solar installations need to be assessed **cumulatively** because of their extremely long life-span (20-40 years). It is the rate of increase that drives polysilicon & silicon metal consumption
- Solar market massively impacted by government incentives & subsidies
- Europe led the 2008-2011 solar boom, fuelled by generous government incentives to install solar panels. The widespread removal of these due to spending cutbacks post-2011 arguably drove the solar bust of 2011-2013
- New PV solar installations are growing strongly again – expected growth of approx 25% in 2014. Asia leading the growth – Europe now accounts for less than 30% of new installations
- Forecast growth rate of 7% to 23%pa (EPIA), heavily dependent on degree of incentives/subsidies, will continue to be very cyclical

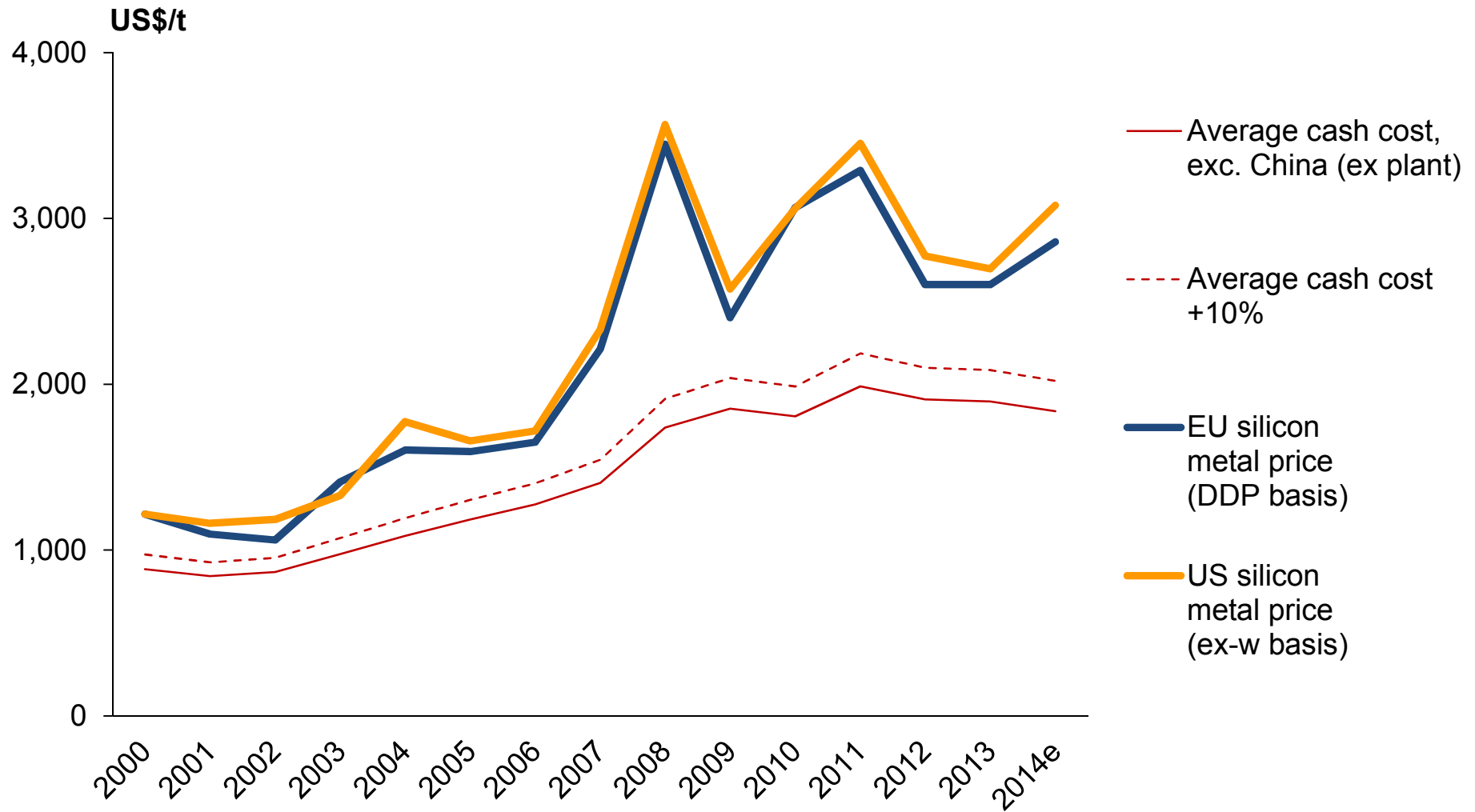
Average silicon metal production costs have roughly doubled over the past decade...Chinese cost structure is very different to elsewhere



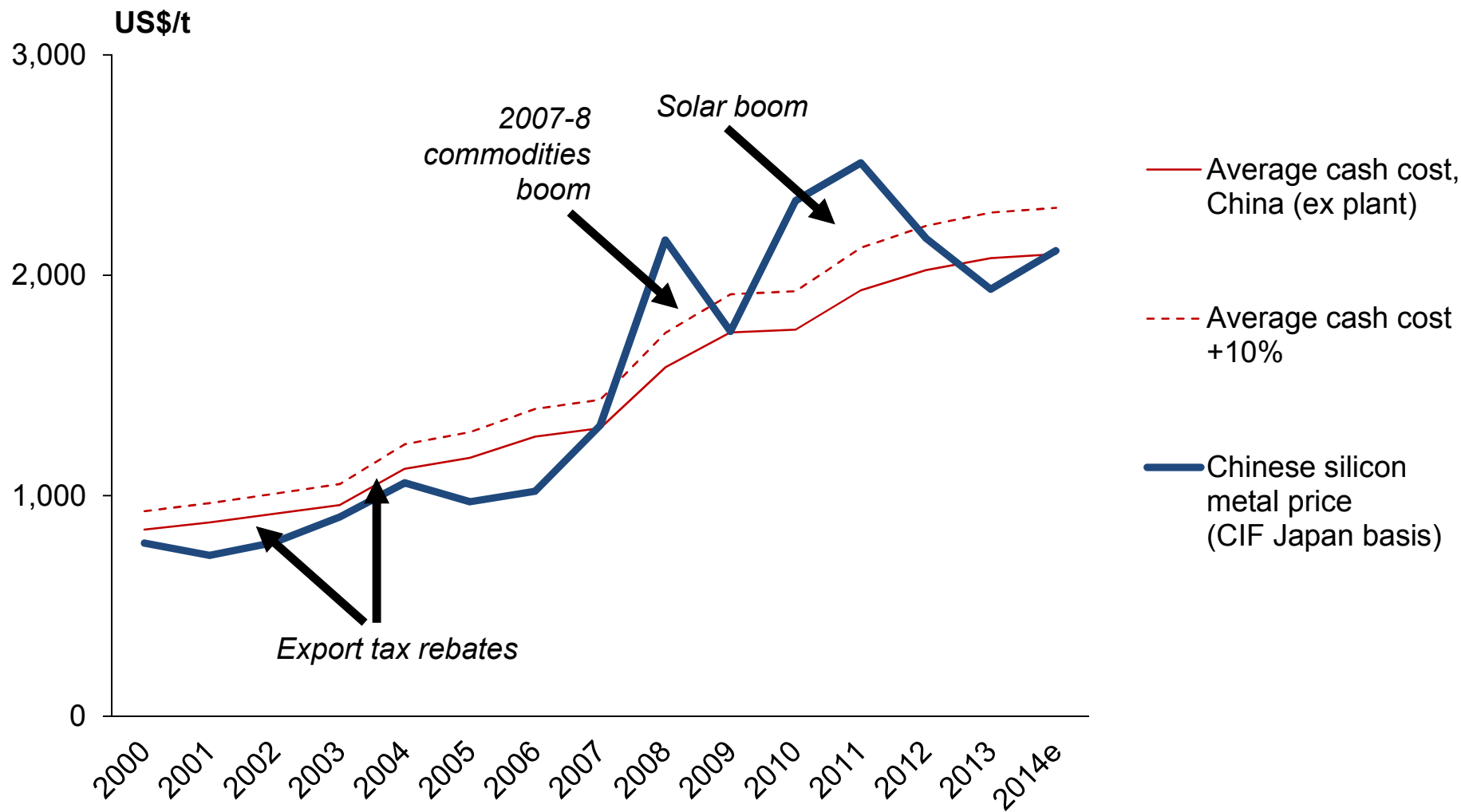
Geography (ie. power price) largely determines the competitiveness of Chinese plants – the majority are still in the high-cost southern provinces



Silicon metal has been a consistently profitable business in the European and US markets – partly this reflects AD duties against Chinese imports



It is a different story for Chinese producers, who only seem to encounter profitable market conditions during temporary boom periods



Concluding thoughts...

- The price correlation between silicon metal and FeSi is often overlooked, but remains very strong
- The continued substantial growth of Chinese silicon metal output & exports is now unique amongst the bulk ferro alloys
- Developments in Brazil a potential source of volatility for 2015 and beyond
- Solar will continue to grow its share of silicon consumption, though subject to more volatility than the other sectors. Inevitably the hype that surrounds this sector rubs off on silicon metal too (both good and bad)
- The growth of silicon consumption in aluminium will pick up, largely due to favourable trends in the automotive sector
- The difference between prices in USA/Europe and China/elsewhere is increasingly not reflected in the cost curve...could changes to AD duties narrow the difference in the future?



Thank you for your attention



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