Report prepared for Committee on Climate Change

Competitiveness impacts of carbon policies on UK energy-intensive industrial sectors to 2030

Aluminium Deep Dive

Final Report

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Contents

Executive Summary

The aluminium sector covers a range of economic activities, though economic statistics often aggregate these activities together.

Firstly, there is the production of unwrought aluminium and aluminium alloys. This can be achieved in two ways: primary production of aluminium from alumina (primary production) and secondary production of aluminium from recycled scrap aluminium.

- Primary aluminium production is a particularly electro-intensive process, with energy accounting for 69% of conversion costs, compared to 22% for secondary production[1]. Primary aluminium production occurs in smelters, and tends to be dominated by large firms.
- Secondary aluminium production tends to be spread across a higher number of smaller plants, operated by a larger number of firms.

The aluminium sector also includes downstream aluminium production. This is the production of semi-manufactured and finished aluminium products, primarily from unwrought aluminium ingots.

The three major types of downstream aluminium products are rolled aluminium products, extruded aluminium products and aluminium castings. Downstream aluminium production also includes production of wire products, powder and slugs.

Downstream producers tend not to be vertically integrated with primary and secondary producers, operating separate plants such as rolling mills, extrusion plants and casting foundries.

The key conclusions from this report are as follows:

- The real value of production of the UK aluminium sector contracted by nearly 50% over 1996-2015.
- Global demand for aluminium has more than tripled since 1990, but was significantly weakened in Europe by the 2008 recession.
- Falling domestic demand in the UK sector, including falling demand from the downstream production industry, together with falling demand in the EU, drove the overall sector contraction. In particular, the UK transport equipment sector and the construction sector contracted sharply during the recession, weakening demand for aluminium. In addition, increasingly high electricity costs led to the shift from primary aluminium production to secondary aluminium production in the UK.
- Primary production capacity in the UK plummeted following the closure of the Anglesey smelter in 2009, having failed to secure a new long-term electricity contract, and the closure of the Lynemouth smelter in 2012, attributed to rising energy costs and increasing global competition. Indeed, both closures followed a sharp rise in electricity

[1] https://ec.europa.eu/growth/tools-databases/eip-raw-materials/en/system/files/ged/82%20fn97624_nfm_final_report_5_april_en.pdf

costs in the UK over 2004-09, amid weak UK and EU demand for aluminium during the economic downturn. In contrast France and Germany, which faced lower industrial electricity costs, have kept stronger levels of primary production, though they have seen closures of smaller, less efficient smelters.

- Secondary production in the UK fell overall over 1997-2011, though by a lesser extent than primary production. Secondary production first fell over 1999-2002, linked to the high cost of scrap metal in these years, and falling demand from the domestic downstream production industry. Secondary production contracted further over 2007 amid falling demand along the downstream supply chain in the EU, driven by the financial crisis and its aftermath. However, secondary production increased in recent years after the collapse of primary production.
- Downstream aluminium production has also declined significantly in the UK. Plant closures in the early 2000s were linked to a loss of competitiveness due to a strong pound against the euro, and weak demand in the EU. Indeed, semi-manufactured products were increasingly imported to the UK from the 2000s onward, as domestic demand stayed firm from key downstream users such as the transport equipment sector and the construction sector. UK downstream production fell further during the economic downturn, this time driven by falling demand from downstream users, both in the UK and the EU.
- Labour productivity grew faster in the UK aluminium sector than in France and Germany over 1998-2014. Furthermore, unit labour costs in the UK aluminium production subs-sector were always lower than in Germany over the period of study, and fell below France after the 2008/09 recession.
- The UK aluminium sector faced significantly higher energy costs than in France and Germany in most years of this study. In the UK aluminium production sub-sector, energy costs grew particularly rapidly over 2001-08.
- The increasingly high unit-energy costs in the UK aluminium sector leading up to 2009 reflect a sharp surge in industrial electricity prices over 2004-09, which outpaced the price increases seen in France and Germany. This was driven mainly by rising gas prices pushing up wholesale prices. The UK energy supply is highly dependent on gas – more so than its European competitors.
- Climate change policies have increased costs for the sector, but measures such as compensation, exemptions, tax incentives and the awarding of EU ETS free allowances are limiting the impact. However, the UK was slower to provide relief to industry through its Energy-Intensive Industries (EII) package than other EU countries.
- Chapter two of the main report highlights the findings that UK industrial electricity prices are currently high relative to EU competitors mainly due to higher wholesale prices (driven by the gas prices) and network costs. Climate change policies have a far smaller impact, though some of these costs will have been higher before the full implementation of the EII in 2016.

- Discounting the impacts of policy on electricity prices, the EU is still a less attractive location for primary aluminium investment, due to the higher cost of energy in the region. There is a growing trend toward secondary production in Europe, and the UK is part of this trend, having seen increased production and investment in recent years.
- Recent investments have also been made in UK downstream production, driven by strong demand from the UK transport sector. However, the UK and indeed Europe, face growing competition from China in semi-manufactured products.
- Primary aluminium production, represented by the Lochaber smelter, seems to have been secured in the short term, having recently been acquired by the GFG alliance.
- The impact of carbon costs on overall electricity costs to aluminium producers (accounting for compensations and exemptions) is forecast to increase by 1.1 percentage points up 2030, while total electricity costs for aluminium producers are forecast to increase by around 53%. Though other EU countries will face similar if not larger increases in carbon costs, it is clear that energy efficiency is key to the UK sector's future competitiveness, particularly in the face of increasing competition from outside the EU.

1 The UK Aluminium sector

1.1 Introduction

Defining the aluminium sector

For the purposes of this study we define the aluminium sector as:

- SIC(2007) 24.42 Aluminium production
- SIC(2007) 24.53 Casting of light metals

SIC 24.42 covers upstream aluminium production as well as downstream production of a range of semi-manufactured aluminium products. Upstream aluminium production involves the production of aluminium from alumina (primary production) and from refining recycled waste and scrap (secondary production). It also involves the production of aluminium alloys.

The major downstream aluminium production processes covered under SIC 24.42 are aluminium rolling and aluminium extrusion. Aluminium rolled products include plates, sheets and foil.

It is important to consider that SIC 24.42 covers three distinct activities: i) primary aluminium production, ii) secondary aluminium production and iii) downstream aluminium production (excl. casting). These activities are separated in their nature by key economic factors such as cost structures and needs of their downstream users.

Main products and users

The main users of rolled aluminium products are the transport equipment sector, the packaging sector and the construction sector. Aluminium extruded products include bars, rods and pipes. The key users of extruded products are the transport equipment sector and the construction sector. SIC 24.42 also includes other downstream aluminium production activities such as manufacture of wire, and manufacture of aluminium oxide.

Key structural features

Primary production is dominated by a small number of major global producers that can employ economies of scale. These producers tend to be vertically integrated with activities further upstream such as mining and refining activities. On the other hand, secondary aluminium producers are not as vertically integrated as primary producers. This is because their main production input is scrap aluminium rather than raw materials, which tends to be sourced domestically. Crucially, secondary aluminium production is far less electro-intensive than primary production, energy accounting for around 22% of conversion costs compared to 69% for primary production[2].

Lastly, downstream aluminium producers tend not to be vertically integrated with the primary and secondary producers. This is because the variation amongst downstream products does not allow for economies of scale and scope to the same extent.

Aside from rolling and extrusion, the other major downstream aluminium production activity is covered by a separate SIC code, 24.53. The castings sub-sector involves the production of castings of semi-finished products of

[2] https://ec.europa.eu/growth/tools-databases/eip-raw-materials/en/system/files/ged/82%20fn97624_nfm_final_report_5_april_en.pdf

aluminium, such as power transmissions, car engines and cookware. The main user of aluminium castings is the motor vehicle industry.

Data sources and limitations

The main data sources for production, demand, investment, and competitiveness data are the Annual Business Survey and Annual Business Inquiry[3] for the UK, and the Eurostat Structural Business Statistics[4] for France and Germany. For trade data, the main data source is Eurostat's Comext database. The advantage of these data sources is that they provide data based on the Standard Industrial Classification (SIC) or directly comparable equivalents (e.g. NACE, CPA), allowing for sector level comparisons across indicators and countries. A drawback to this data (and indeed all datasets we are aware of at this level of detail) is that it is generally not available before 1996 (and 1999 for Germany). A further limitation of the SIC-based data is that it does not distinguish between primary aluminium production, secondary aluminium production and downstream aluminium production. For primary/secondary aluminium production, we have drawn on the British Geological Survey Minerals Yearbooks[5] for the UK, and the US Geological Survey Minerals Yearbooks[6] for other countries. For the specific analysis of downstream production, we draw on product level data from Prodcom[7] and Comext[8]. Lastly, for the global data on aluminium production and final aluminium use, we used the International Aluminium Institute global aluminium flow model[9]. A limitation of this data is that it is provided only for a group of regions defined by the IAI[10].

Chapter structure

The structure of this chapter is as follows. First, we outline the key trends in production trade and investment in the UK aluminium sector. Next, we list the potential drivers of change in the sector that will be assessed in this report. We then analyse each driver of change, to understand the underlying factors affecting the performance of the UK aluminium sector. Lastly, we assess the outlook for the sector going forward.

1.2 Key trends in the UK aluminium sector

The aluminium sector generated around £1.9bn of production output in 2015, equivalent to around 0.5% of total UK manufacturing output in the same year. Aluminium production is the larger sub-sector, accounting for 69% of output in the aluminium sector in 2015. In terms of value added, aluminium production accounted for 54% of the total sector, reflecting the higher share of capital costs in aluminium production compared to aluminium casting.

[3] https://www.ons.gov.uk/businessindustryandtrade/business/businessservices/bulletins/uknonfinancialbusinesseconomy/previousReleases

[4] http://ec.europa.eu/eurostat/web/structural-business-statistics/data/database

[5] http://www.bgs.ac.uk/mineralsUK/statistics/ukStatistics.html

[6] https://minerals.usgs.gov/minerals/pubs/commodity/aluminum/

[7] http://ec.europa.eu/eurostat/web/prodcom/data/database

[8] http://epp.eurostat.ec.europa.eu/newxtweb/

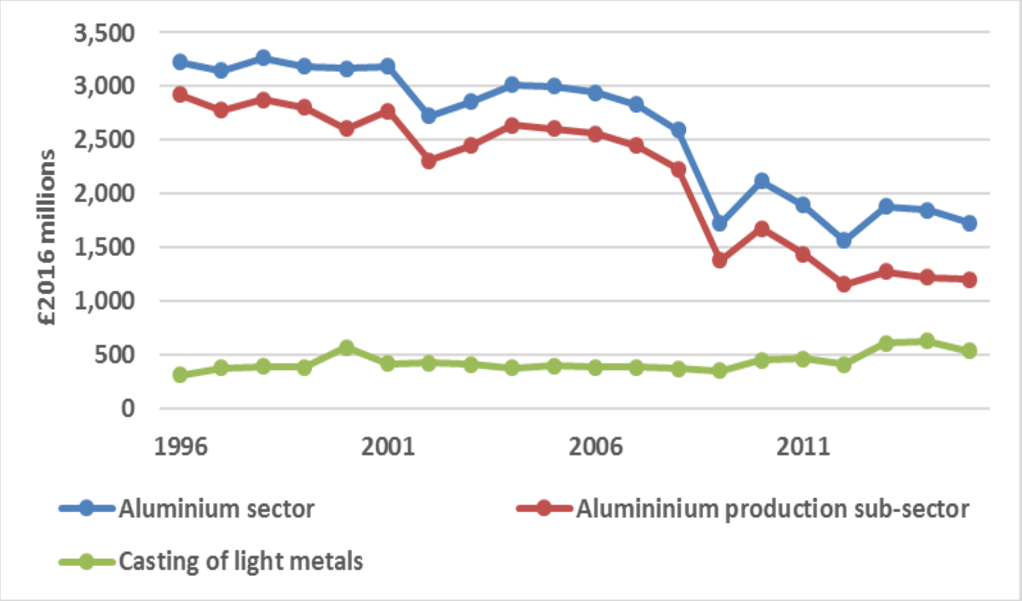
[9] http://www.world-aluminium.org/statistics/massflow/

[10] See footnotes 12-14 for region definitions

Aside from a sharp fall in 2009, output in the aluminium sector declined gradually

The total production value of the aluminium sector fell by around 59% over 1996-2015. In the earlier years, production was largely stable before falling notably over 2001-02, by around 14%. Production recovered over 2003 and 2004, but then gave way to a modest but accelerating decline up to 2008. Over 2008-09, the sector contracted sharply, with production falling by around 38%. Production continued to fall, reaching a period low in 2012, and staying thereabouts up till 2014. Figure 1.1 shows the real value of production in the UK aluminium sector sub-sectors over 1996-2015. Clearly the fall in production was driven by the aluminium production sub-sector, while production in the casting of light metals sub-sector was more stable overall, and has grown in most years since 2009.

Figure 1.1: Real value of production in the UK aluminium sector and sub-sectors, 1996-2015

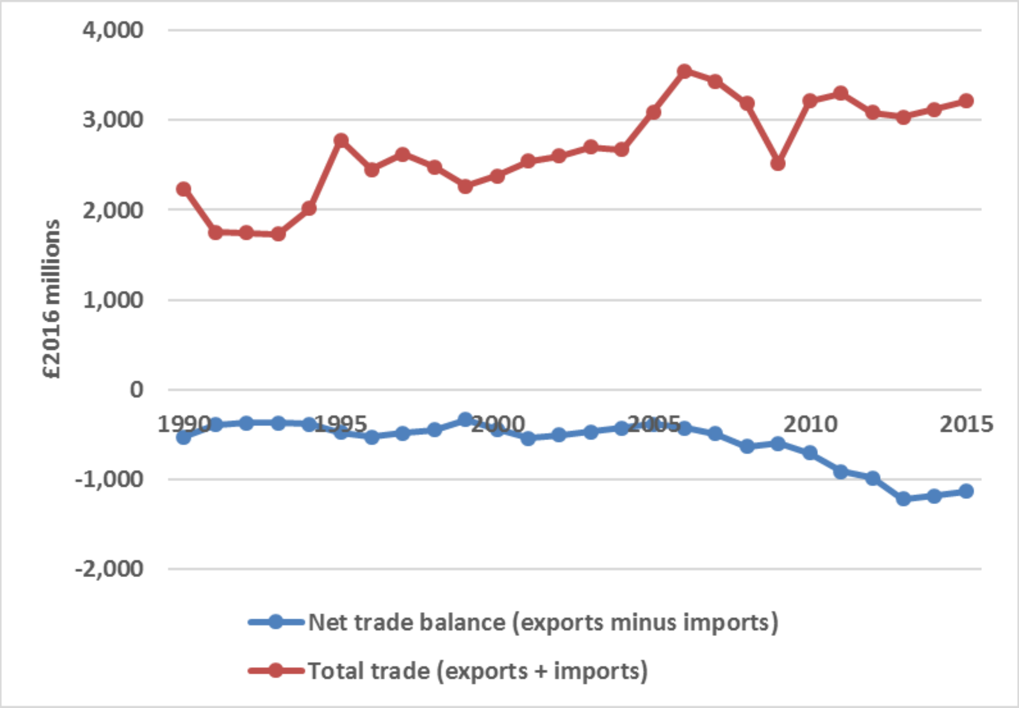


Source: Eurostat (Structural Business Statistics, Short Term Business Statistics and Comext), and CE (MDM-E3 and E3ME).

Net trade was in deficit but stable up to 2006, where after it deteriorated markedly up to 2015

Figure 1.2 below shows total trade volumes and net trade over 1990-2015. Total trade increased by 2% pa on average up to 2008, while net trade was stable, reflecting the increasing globalisation of the aluminium supply chain; import penetration rose rapidly from around 45% in 2000 to 95% in 2008, while exports as a share of output grew similarly fast from 31% in 2000 to 86% in 2008. After a temporary dip in 2009, total trade stabilised over 2010-15. At the same time, the trade balance deteriorated, as aluminium imports increased and aluminium exports fell. This deterioration was driven by a sharp fall in intra-EU exports of 25% in real value over 2006-15 together with an increase in intra-EU imports of 16% over the same period.

Figure 1.2: Net trade and total trade in the aluminium production sub-sector, 1990-2015



Source: Comext and Eurostat (Structural Business Statistics).

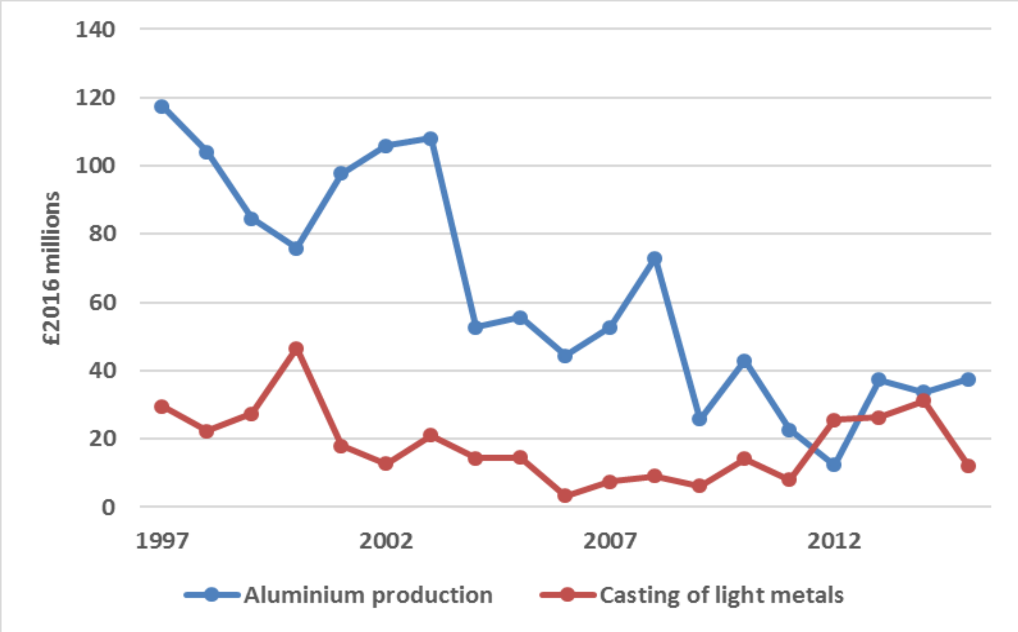
Investment in the aluminium production sub-sector fell sharply over 1997-2012, but picked up a little in recent years

Figure 1.3 plots investment in the aluminium production sub-sector and the casting of light metals sub-sector over 1997-2015. Investment in the aluminium production sub-sector fell sharply over 1997-2012 at a rate of nearly 14% pa, reflecting the closures of primary and downstream aluminium production plants. In 2012 around £12.5mwas invested – 90% lower than in 1997. Investment picked up sharply over 2012-13 and was largely unchanged in 2014 and 2015, suggesting an improvement in confidence about the prospects for the aluminium production sub-sector.

Investment in the castings sub-sector fell over 1997-2006, but also picked up recently

Investment in the casting sub-sector fell over 1997-2006, reaching a period low in 2006 of only £3m. Like in the aluminium production sub-sector, investment has picked up more recently, and was especially high over the years 2012-14. However, these investment levels were not sustained in 2015, though investment was still higher than in most years over 2006-11.

Figure 1.3: Real investment in the UK aluminium sector, 1997-2015



Source: ONS (Annual Business Inquiry and Annual Business Survey), Eurostat (Short Term Business Statistics), and CE (MDM-E3).

In summary, the UK aluminium sector has seen a contraction in overall real production value of around 46% over 1997-2015, accompanied by a sharp fall in investment. This was driven largely by the aluminium production sub-sector, while the casting sub-sector was more stable, and indeed grew strongly in recent years. Trade in aluminium has increased significantly, with both import penetration and export shares of output increasing, partly reflecting increased globalisation of the supply chain, but also suggesting a loss of competitiveness as the domestic sector has declined in output and the net trade deficit has grown.

2 Drivers of change in the UK aluminium sector

2.1 Introduction

Clearly, the UK aluminium sector has seen declining output and investment overall, falling exports, and increased imports. What have been the drivers of this overall decline? In this section, we investigate the following factors:

- Global trends in aluminium demand and primary/secondary production
  - As a globally traded commodity, global demand provides a measure of the size of the world market for aluminium (and its growth), and therefore the potential export market for UK-produced aluminium. Global production and the spread of primary and secondary production indicates the key competitors on the global stage, and the geographical trends towards the different production processes.
- Domestic demand in the UK
  - Domestic demand is a key driver of domestic industry performance. Strong domestic demand reduces the dependence of the domestic sector on demand from external markets. The key indicator of domestic demand is measured by subtracting net trade from total production in each year.
- Structural changes in the UK sector and international competitors
  - Primary production, secondary production and downstream aluminium production are distinct economic activities, facing different competitiveness pressures. It is crucial to understand the developments in each of these areas to get a full picture of the aluminium sector. We will compare developments in the UK sector to the French and German sectors.
- Changes in input costs, productivity and profitability
  - Changes in input costs and productivity are drivers of sector performance and competitiveness. We compare UK unit labour costs, labour productivity, and unit energy costs with those in France and Germany, to assess the drivers of change in the UK aluminium sector. We also compare the gross operating rate, to gauge profitability in the aluminium sector.
- The impact of UK and EU policies on sector competitiveness
  - We assess the role of UK and EU policies on sector competitiveness with a focus on the impact of climate change policies.

2.2 Global demand

Global demand has more than tripled since 1990

Global demand for final aluminium products is ever increasing. Growth in demand averaged 3.3% pa in the 1990s before accelerating to 6.4% pa over 2000-08, driven by growth in the transport and construction sectors, and the increasing popularity of aluminium as a lightweight, high strength material in these sectors. The economic downturn put a temporary halt to growth in aluminium usage, with global demand falling by 3.4% over 2008-09. Nevertheless, as the world economy recovered, global demand accelerated again, with demand growing by 8.4% pa over 2009-14. By 2014, global demand had more than tripled since 1990, to around 69,203kt[11].

China has become the largest global user of final aluminium, followed by North America and Europe

In 1990, North America was the largest user of aluminium at 5,806kt and Europe was the second largest user, at 5,214kt. China only used 918kt of aluminium in 1990. Demand in China increased rapidly over 1990-2014, at nearly 15% pa. Over the same period, demand in the Middle East grew almost as fast, to reach 2,928kt in 2014, while in Europe and North America, aluminium demand grew much more slowly; in Japan aluminium demand fell slightly. As a result, by 2014 the largest consumer of aluminium was China, at 24,657kt – 35% of global demand for final aluminium products. North America was the second largest consumer, at around 12,404kt, followed by Europe at around 9,777kt. Japan is another major consumer of aluminium products, at 2,342kt in 2014.

The recovery in demand in Europe since 2008 has not been as strong as in other major regions

The fall in global demand for final aluminium products over 2008-09 was driven by sharp falls in Europe (24.6%), Japan (18.9%), and North America (15.7%). Over 2009-14, demand for final aluminium products in Europe and Japan grew by around 5% pa, to around the same level in 2014 as in 2008. On the other hand, in North America demand recovered more strongly, growing at around 8.5% pa, and totalling around 25% higher in 2014 than in 2008. The highest growth in demand since 2008 has been in developing countries. In China, aluminium demand grew by 13.4% pa over 2008-14, while in other Asian countries demand grew by 7.1% pa. In the Middle East, demand for aluminium grew by 6.8% pa on average over 2008-14.

2.3 Global production

Primary production growth was led by China, while secondary production grew in North America and Europe

Primary aluminium production has increased by around 7.5% pa since 1990, from 19,514kt in 1990[12] to 53,927kt in 2014. Production grew in most years, but it fell notably during the recession, from 39,971kt to 36,766kt. After the recession, primary aluminium production recovered with robust growth of around 5.1% pa since 2009, although this is somewhat slower than the pre-recession growth rate. Global secondary aluminium production totalled 25,432kt in 2014, led by China at 8,491kt, followed by North America, at 4,505kt, and Europe at 4,426kt. The share of secondary aluminium production in total production is constrained by its dependence on scrap metal as its main

[11] All global use of aluminium data is from the IAI global aluminium flow model

[12] All primary and secondary aluminium production data is taken from IAI global aluminium flow model and the USGS Minerals Yearbook volume III, and the British Geological Survey United Kingdom Minerals Yearbooks

production input, but has grown slightly from 29% of global aluminium production in 1990 to 32% in 2014.

China is by far the largest primary producer

Primary aluminium production is highly concentrated geographically. China is by far the largest global producer, accounting for 53% of primary production in 2014, but most of China's aluminium production is used domestically. The Middle East[13] is also a significant producer of primary aluminium, producing around 9.6% of global primary aluminium in 2014. North America[14] produced 8.5% of global primary aluminium in 2014. Europe[15] produced 7.8% of primary aluminium in 2014.

Rapid primary production growth in China offset declines in Europe and North America

Global primary aluminium production growth was driven by rapid growth in China from 854kt in 1990 to around 28,317kt in 2014. Primary production also increased strongly in the Middle East in recent years, from 2,054kt in 2008 to 5,163kt in 2014. In Europe, primary aluminium production increased by 30% over 1990-2008, from 4,319kt to 5,596kt. However, primary production fell by a third over 2008-2009 to 4,332kt, and continued to fall slowly, reaching 4,191kt in 2014. Primary aluminium production in North America has also fallen since the recession, from 5,779kt in 2009 to 4,585kt in 2014, despite a strong increase in demand for final aluminium products over the same period.

Secondary production is increasing in Europe and North America

There is a growing tendency towards secondary aluminium production in some geographies. In North America and Europe, the share of secondary aluminium production in total production grew from around 29% in each region, to around 50% in each region. On the other hand, strong growth in primary aluminium production in the Middle East, which has a large supply of low-cost electricity, has not been accompanied by similar growth in secondary production, which accounts for only 8% of total aluminium production in the Middle East in 2014.

2.4 Domestic demand for the UK aluminium sector

Falling domestic demand for the aluminium sub-sector drove the decline in UK output

Demand[16] for the aluminium production sub-sector is determined by two factors: demand for unwrought aluminium from the downstream aluminium producers; and demand for semi-manufactured aluminium products from other downstream users – primarily transport, construction, and packaging. Figure 2.1 below shows real domestic demand for the UK aluminium production sub-sector over 1996-2015. Evidently, demand fell significantly overall, in contrast to increasing global demand, but broadly in line with the fall in production in the sub-sector:

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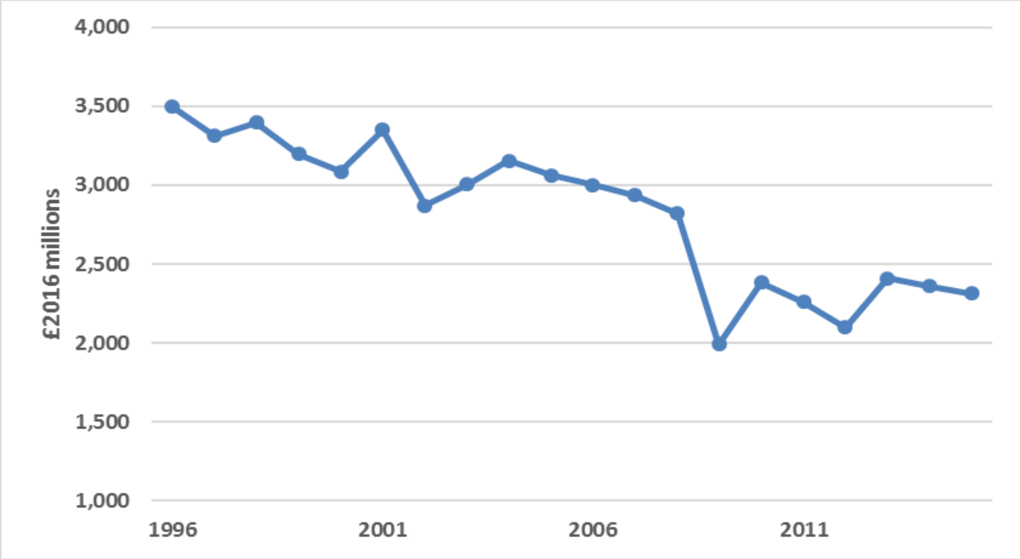
[13] The Middle East comprises Bahrain, Iran, Oman, Qatar, Saudi Arabia and the United Arab Emirates.

[14] North America comprises Canada, Mexico and the USA.

[15] Europe comprises the following countries: Albania, Austria, Belgium, Bosnia, Herzegovina, Bulgaria, Belarus, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Rep. of Moldova, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, TFYR of Macedonia, United Kingdom, Vatican City State.

[16] Apparent domestic demand is calculated as the value of production, plus imports, minus exports. Trade data is unavailable for the castings sub-sector, so we present demand for the UK aluminium production sub-sector only.

Figure 2.1: Real apparent domestic demand in the UK aluminium production sub-sector, 1996-2015



Source: Comext and Eurostat (Structural Business Statistics).

Demand for unwrought aluminium fell

Domestic demand for aluminium fell by around a third over 1996-2015, driven by two periods of decline. The first period of decline occurred over 1996-2002, with demand falling at a rate of 3.2% pa on average. In these years, falling demand was driven by falling demand for unwrought aluminium from the downstream production industry, which faced competitiveness pressures linked to the strong pound, and weak demand from export markets in the EU, where several countries including France and Germany saw short recessions around 2001-02. Total consumption of unwrought aluminium in the UK fell from around 713kt in 1997 to 502kt in 2003[17]. Between 2002 and 2008 domestic demand was more stable, as demand for unwrought aluminium stabilised, with total domestic demand increasing over 2002-04 before falling gradually up to 2008.

The 2008-09 recession caused a sharp contraction in demand

The 2008-09 recession triggered a major demand shock in the aluminium production sub-sector, with domestic demand falling by around 30% over 2008-09. This was driven by sharp economic contractions in major downstream sectors, such as the motor vehicles sector and the construction sector, which were particularly hard hit by the downturn.

Since the recession demand has recovered partially

Over 2009-15, UK demand picked up slowly, growing overall by 2.5% pa, as the downstream aluminium users recovered from the recession. The motor vehicles sector grew particularly strongly, by around 5.5% pa on average over 2009-15 in terms of real GVA, fuelling an increase in demand for aluminium rolled products. On the other hand, demand for aluminium extrusions, which fell sharply over 2008-09, has since been low, only recovering slightly up to 2014 compared to pre-recession levels. This, together with low demand for unwrought aluminium from the declining domestic downstream aluminium industry, meant that demand in the aggregate sector did not recover fully to its pre-recession level.

[17] Prodcom

2.5 Structural changes in the UK aluminium sector

Primary smelter closures led to a sharp fall in production of unwrought aluminium

UK primary aluminium production has collapsed since the closures of two major smelters. First, the Anglesey smelter, owned by Anglesey Aluminium (a joint venture between Rio Tinto and Kaiser Aluminium) with a 145kt[18] production capacity, closed in 2009. The second closure occurred in 2012, when the 180kt Lynemouth smelter, owned by Rio Tinto, closed. Only one small smelter remains operational in the UK – the 47kt[19] Lochaber plant owned by the GFG alliance (who acquired the smelter from Rio Tinto in December 2016).

Primary smelting faced increasing costs alongside rising global competition

The Anglesey smelter closure followed the expiration of the plant's long term electricity contract, and difficulties in finding a commercially viable replacement. Anglesey Aluminium also cited costs arising from EU climate change and environmental legislation, and competition from third world countries in forcing the closure[20]. Likewise, Rio Tinto pointed to a combination of rising energy costs, EU environmental legislation, and fluctuations in the price of aluminium, in bringing about the closure of the Lynemouth smelter[21].

These plant closures have resulted in a large decline in total unwrought aluminium production in the UK. Figure 2.2 shows primary, secondary, and total production volumes of unwrought aluminium in the UK over 1997-2014. Over 1997-2007 primary production increased, as primary smelters improved their efficiency and increased their power usage[22]. In 2007, when all three smelters were operational, UK primary aluminium production was around 365kt. In 2014, UK primary aluminium was only 41kt.

Secondary production fell overall, but grew since 2011

Secondary aluminium production is also lower now than in 1997, but not to the same extent as primary production[23]. Secondary aluminium production increased from 243kt in 1997 to 285kt in 1999. Secondary production then fell gradually over 1999-2002 to around 200kt, driven by a combination of falling demand from the declining downstream production industry, and high scrap metal prices[24]. Production was then fairly stable up to 2007, where it began to fall again reaching a low of 99kt in 2011, driven by falling demand along the downstream supply chain in the EU, owing to the economic downturn. However, since 2011, secondary aluminium production has grown to around 148kt in 2014, filling the gap in demand left by the fall in primary production, and reflecting the current trend of growing secondary production in higher energy cost countries. In addition, data from Prodcom, which covers total primary and secondary production, suggests a strong increase in secondary production over 2014-15 of around 30kt, assuming primary production stayed constant. Overall, total production of primary and secondary unwrought aluminium was quite stable over 1997-2007, but fell sharply over 2007-14, from 558kt in 2007 to 190kt in 2014.

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[18] http://www.riotinto.com/sd2014/casestudies/fresh-start-for-former-smelter-site.html

[19] http://www.riotinto.com/aluminium/lochaber-4820.aspx

[20] https://www.publications.parliament.uk/pa/cm200405/cmselect/cmwelaf/329/4031702.htm

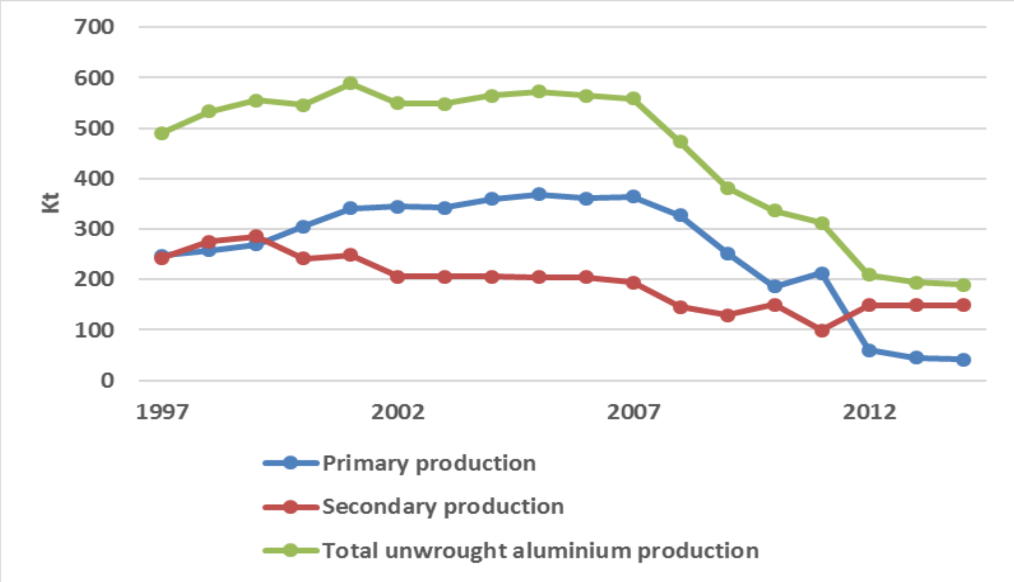
[21] http://www.riotinto.com/documents/RT_Lynemouth_Aluminium_Smelter_England.pdf

[22] https://www.publications.parliament.uk/pa/cm200405/cmselect/cmwelaf/329/4031702.htm

[23] https://www.lightmetalage.com/

[24] https://minerals.usgs.gov/minerals/pubs/country/2001/ukmyb01r.pdf

Figure 2.2: Primary, secondary and total unwrought aluminium production in the UK, 1997-2014



Source: UK Minerals Yearbooks.

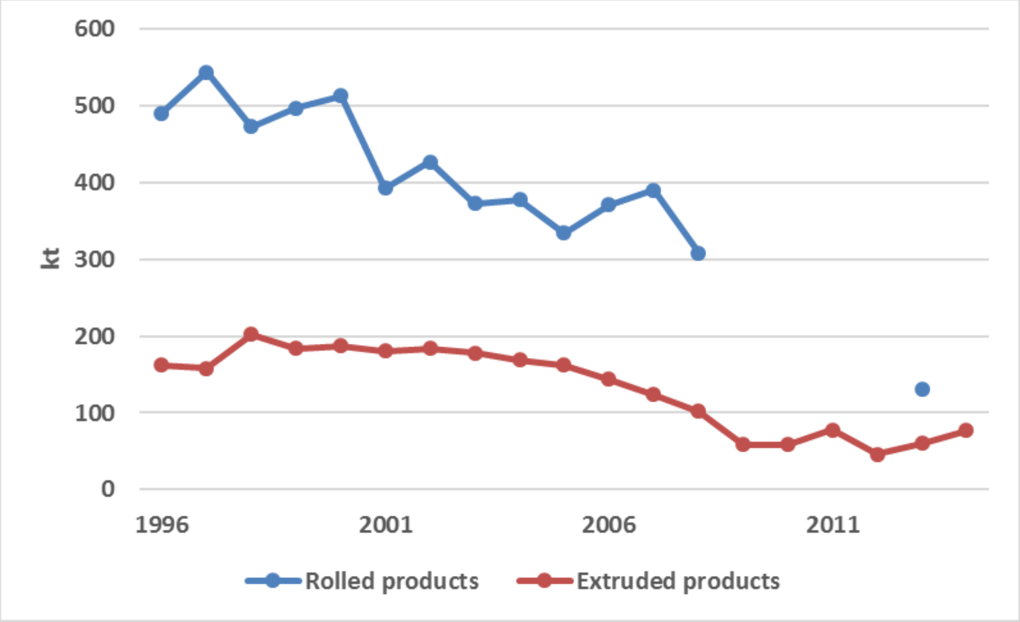
Downstream production contracted sharply

The UK's downstream aluminium production industry includes two aluminium rolling plants and twelve extrusion plants. Together, they produced somewhere in the region of around 200kt of rolled and extruded products in 2013. However, this is much lower than production levels in the late-1990s when 600-700kt of rolled and extruded products (around 500kt of rolled products and 200kt of extruded products). By 2013 production of rolled aluminium products had fallen to around a fifth of its 1996 level.

Downstream production faced pressure from increasing global competition

In the early 2000s, downstream producers in the UK faced increasing global competition, combined with a strong pound against the euro damaging the price competitiveness of UK exports. Furthermore, demand was low in EU export markets, with France and Germany falling into short recessions over 2001-02. During these years, Alcan significantly consolidated its operations, cutting 300 jobs in its Rogerstone rolling mill in 2001, and closing its Falkirk rolling mill in 2004, citing "increasing global competition" as the backdrop against the decision to close. Downstream producers were further hit by weak demand in the UK and in export markets during the economic downturn, with the 2009 closure of the Rogerstone sheet mill, then owned by Novelis, attributed to "a significant decline in orders". Figure 2.3 shows annual production figures of aluminium rolling products and aluminium extrusion products over 1996-2014:

Figure 2.3: UK production of aluminium rolling and extrusion products, 1996-2014



Note: Rolled products defined as: Aluminium alloy plates, sheets and strips >=0.2 mm thick; and aluminium foil of a thickness <= 0.2 mm. Extruded products defined as: Aluminium bars, rods and profiles (excluding rods and profiles prepared for use in structures); and Aluminium alloy bars, rods, profiles and hollow profiles (excluding rods and profiles prepared for use in structures). Data for rolled products is unavailable for the years 2009, 2010 and 2011

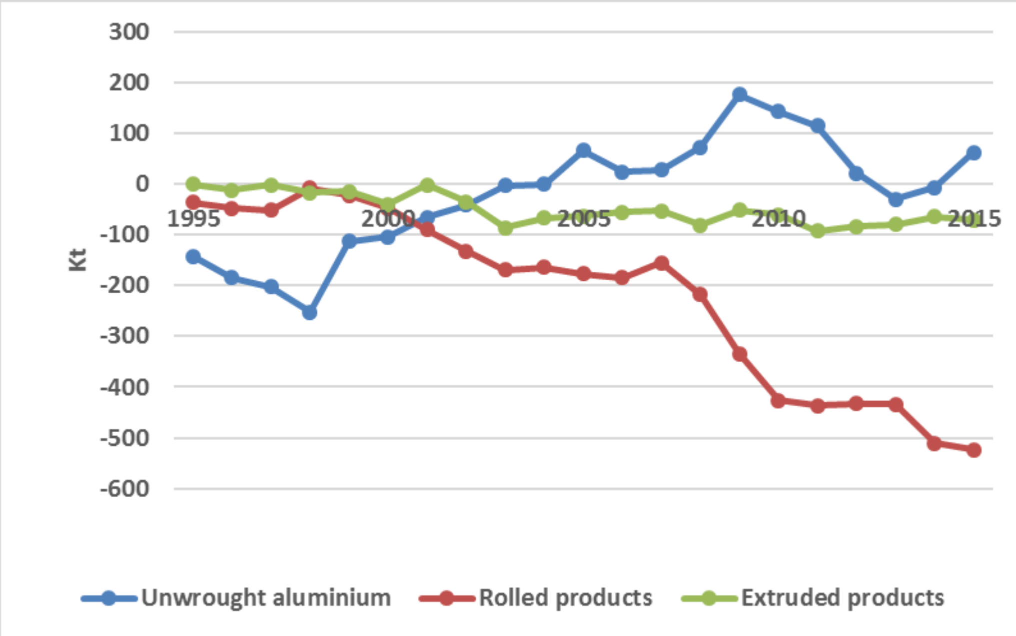
Source: Eurostat (Prodcom).

Unwrought aluminium was increasingly exported and semi-manufactured products imported

As downstream production declined in the UK, unwrought aluminium was increasingly exported, and semi-manufactured products were increasingly imported. Figure 2.4 shows net trade of unwrought aluminium, rolled products and extruded products over 1995-2015. Net trade in unwrought aluminium increased from a deficit of 142kt in 1995 to a surplus of 175kt in 2009, as producers of unwrought aluminium looked to export markets to replace falling demand from the domestic downstream production industry. Net trade of unwrought aluminium then fell back over 2009-13, amid falling production of unwrought aluminium driven by the two major primary smelter closures. Net trade increased again over 2013-15, particularly in the latter year, as secondary aluminium production, and exports increased.

Net trade in rolled products deteriorated steadily from around 2000, amid firm demand from downstream users in the construction and motor vehicles sector, and falling domestic production. Over 2007-09, the fall was particularly severe, driven by a fall in rolling product exports from around 253kt to 72kt after the closure of the Rogerstone rolling mill. Net trade in extruded products was evenly balanced up to 2001 where it fell to around -86kt over two years, driven by increased imports and falling domestic production. It has hovered around -50kt to -100kt ever since.

Figure 2.4: Net trade of unwrought aluminium, rolled products, and extruded products in the UK, 1995-2015



Note: Rolled products defined as: Aluminium alloy plates, sheets and strips >=0.2 mm thick; and aluminium foil of a thickness <= 0.2 mm. Extruded products defined as: Aluminium bars, rods and profiles (excluding rods and profiles prepared for use in structures); and Aluminium alloy bars, rods, profiles and hollow profiles (excluding rods and profiles prepared for use in structures). Data for rolled products is unavailable for the years 2009, 2010 and 2011

Source: Eurostat (Comext).

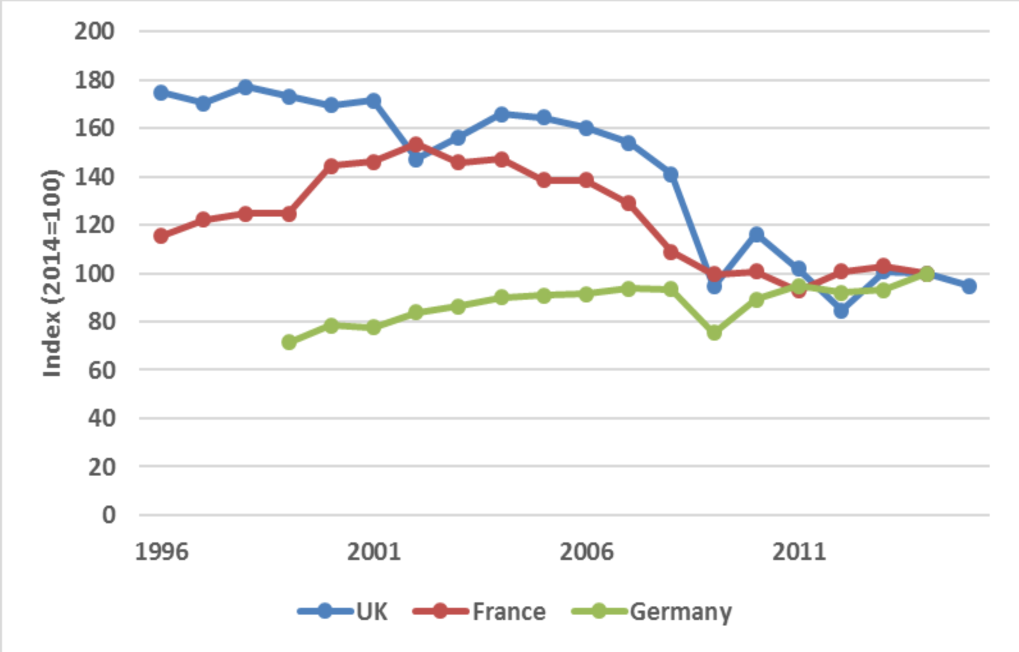
2.6 Structural developments in France and Germany

Production in the French sector also fell sharply, but the German sector grew overall

The aluminium sector in Germany was worth £3.1bn in GVA in 2014, accounting for 0.135% of total GDP while the French sector was worth £0.8bn or 0.049% of GDP, and the UK sector was worth £0.5bn or 0.026% of GDP. Total production in the aluminium sector in 2014 in Germany was £10.4bn, in France £3.5bn and in the UK £1.7bn.

Production in the French aluminium sector enjoyed robust growth over 1996-2002. But since peaking in 2002, aluminium production in France has been in steady decline. Production fell to a new low in 2009, and has remained there or thereabouts ever since. Production in the German sector grew modestly but steadily, by around 3% pa over 1999-2008. A sharp contraction in 2009 was followed by a strong recovery over 2009-10, followed by healthy growth of 3% pa over 2010-14, with German aluminium production reaching hit a new high of around £14.5bn in the 2014. Figure 2.5 shows the real production value index over 1996-2015 for the aluminium sector in the UK, France and Germany.

Figure 2.5: Real aluminium sector production value in the UK, France and Germany, 1996-2015



Note: Data unavailable for Germany before 1999. Data unavailable for France and Germany in 2015.

Source: Eurostat (Structural Business Statistics and Short Term Business Statistics), and CE (MDM-E3 and E3ME).

Primary production is strong in France and Germany, despite some smaller smelter closures

Primary aluminium production levels in France and Germany are among the highest in Europe, though in both countries primary production has fallen since the late 1990s, partly due to closures of smaller smelters. There are two primary smelters in France – Dunkerque owned by Rio Tinto, and St. Jean de Marienne owned by Trimet – both with a much larger capacity than the UK Lochaber smelter, at 270kt and 145kt respectively (compared to 47kt at Lochaber). In Germany, there are four smelters, three of which are owned by Trimet – in Hamburg (130kt), Essen (165kt) and Voerde (90kt). The other, in Neuss, is owned by Hydro and has a capacity of 230kt. Smelter closures in France include the 25kt capacity Lannemezan plant in 2006, and the 48kt capacity Auzat smelter in 2003. In Germany, the 70kt capacity smelter was closed by Hydro in 2006.

Smelter closures in France and Germany were linked to outdated technology

While there were smelter closures in France and Germany, they appear to have arisen for a different reason to those in the UK. The closures of the Lannemezan and Auzat smelters in France and the Stade smelter in Germany were linked to outdated production technologies in the smelters, undermining competitiveness in the face of global competition and rising energy costs[25][26]. Outdated production technology was not a factor in the UK plant closures, which were regarded as among the most efficient smelters in the world, and were closer in capacity to the surviving smelters in France and Germany.

[25] http://hydro.com/globalassets/1-english/investor-relations/quarterly-reporting/other/hydroinformationmemorandumfinal.pdf

[26] http://www.prnewswire.co.uk/news-releases/alcan-to-begin-progressive-closure-process-of-lannemezan-aluminum-smelter-in-june-2006-153987705.html

Secondary production is also strong in Germany. In France, it is around the same level as the UK

Germany has equally strong secondary aluminium production, at around the same level of output as primary production, while in France, secondary aluminium production is around half that of primary production. In Germany, the strong primary and secondary aluminium production levels are likely linked to strong demand from the downstream production sector, and indeed the wider manufacturing sector, which is the largest in the EU. There are around 50 secondary producers in both France and Germany, compared to 40 in the UK, and 461 in the EU28, indicating the presence of larger scale secondary production plants in Germany. Secondary production in France was between 200kt and 240kt over 1990-2008, but fell in 2009 to 138kt, and has not fully recovered since, at 180kt in 2013. In Germany, secondary production was around 417kt in 1990, growing to 721kt by 2008. Following the downturn, it fell to 597kt in 2013 but this was still around 40% higher than 1990 production levels.

Downstream production is stronger in France and Germany compared to the UK

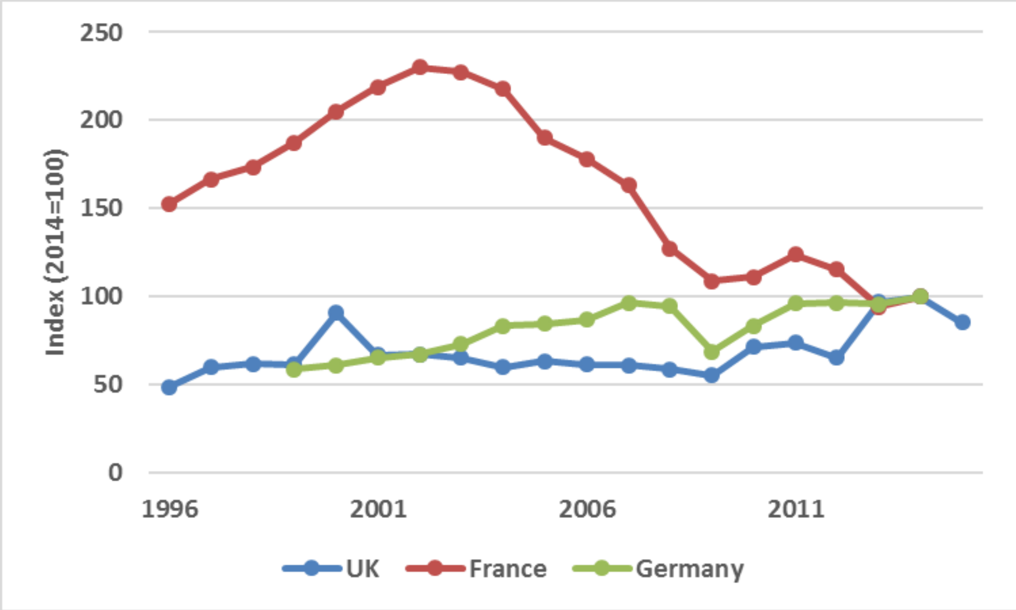
France and Germany have the two largest rolled products sub-sectors in the EU, accounting for 13% and 33% of rolling mill employment, with 6 plants and 13 plants respectively, whereas the UK has only 2 plants, accounting for 3% of employment in Europe. While downstream production of semi-manufactured products has declined in the UK, in France and Germany production has been much stronger, due in part to weaker euro relative to the pound. In France, production of aluminium alloy plates, one of the key rolled products, grew from 380kt in 1995 to 523kt in 2015, an increase of 38%. In Germany, aluminium alloy plates production grew particularly strongly in recent years. In 2006 aluminium alloy plates production was 1,550kt, falling to 1,285kt in 2009, before growing strongly up to 2,002kt in 2015. In the UK production of aluminium alloy plates fell from 414kt in 1995 to 161kt in 2014, despite mostly stable domestic demand, which increased strongly in recent years.

Germany has the second most aluminium extrusion plants in the EU after Italy, at 63 plants. France has 16 extrusion plants, a few more than in the UK (which has 12 plants). Production of aluminium alloy bars, rods, profiles and hollow profiles in France was around 140kt in 1995, and 150kt in 2015, an increase of 7%. In Germany, production of aluminium alloy bars, rods, profiles and hollow profiles was around 420kt in 1995, and 22% higher in 2015 at 513kt. In the UK production of aluminium alloy bars, rods, profiles and hollow profiles fell by 56% over 1995-2014, from 163kt to 71kt. In the case of aluminium alloy bars, rods, profiles and hollow profiles, falling UK production was accompanied low domestic demand. On the other hand, UK production of rolled products fell even while domestic demand increased, suggesting that UK producers were unable to compete against foreign imports.

Casting of light metals is driven by the domestic motor vehicles sector in each country

The casting of light metals sub-sector in all three countries were broadly driven by domestic manufacturing, motor vehicles in particular. The UK sub-sector was fairly stable up to 2012, and picked up strongly over 2012 as the domestic motor vehicles sector grew. Production in Germany's casting sub-sector has grown strongly in real value since 1999, driven by growing demand from the transport manufacturing sector. On the other hand, the castings sector in France declined rapidly after 2002, production more than halving in real value over 2002-14. In this case, the decline was driven by falling domestic motor vehicle production, as well as weak performance by French mechanical engineering companies[27]. Figure 2.6 plots the production value of the casting of light metals sub-sector over 1996-2015 in the UK, France and Germany.

Figure 2.6: Real production value of the casting of light metals sub-sector in the UK, France and Germany, 1996-2015



Note: Data unavailable for Germany before 1999. Data unavailable for France and Germany in 2015.

Source: Eurostat (Structural Business Statistics and Short Term Business Statistics), Comext, and CE (MDM-E3 and E3ME).

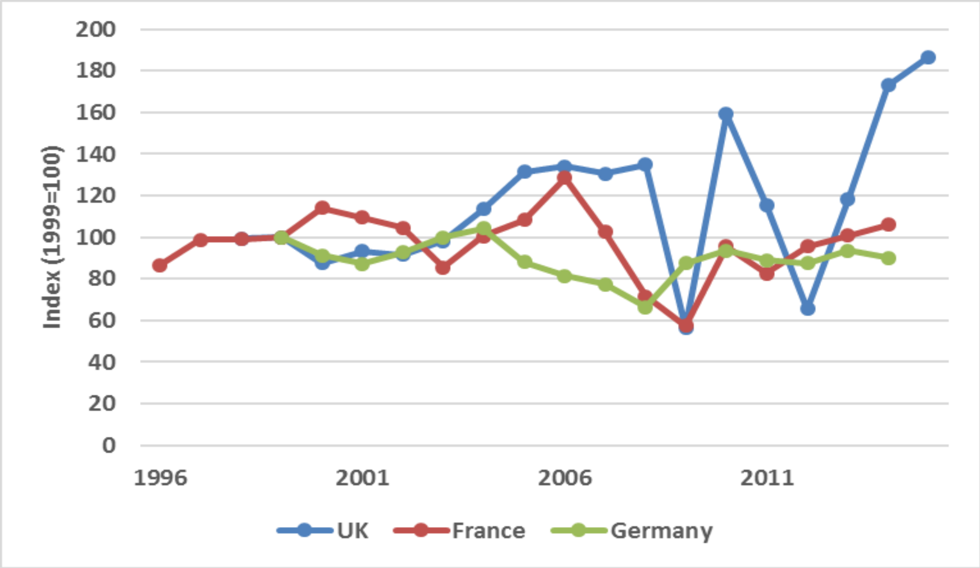
2.7 Input costs and profitability in the UK, France and Germany

Labour productivity in both UK sub-sectors increased strongly over 1998-2014, outperforming France and Germany

Figure 2.7 below shows the trend in real labour productivity in aluminium production sub-sector in the UK, France and Germany over 1996-2015. French labour productivity increased by 48% over 1996-2006, but then fell sharply by 55% over 2006-09. Real labour productivity recovered in France over 2009-14, but had yet to reach its pre-recession peak by 2014. In Germany, real labour productivity fell by around 10.6% pa over 2004-08. Contrary to in the UK and France, German labour productivity in aluminium production grew strongly over 2008-11, but then remained around that level up to 2014. Crucially, whereas labour productivity in the UK nearly doubled between 1996 and 2015, in France and Germany it was stagnant, with labour productivity in 2014 largely unchanged on labour productivity in the late-1990.

[27] https://www.heat-processing.com/fileadmin/HPO/Dateien_Redaktion/Selected_Reports/150616_GIFA_Presentation_EN.pdf

Figure 2.7: Real labour productivity in the aluminium production sub-sector in the UK, France and Germany, 1996-2015



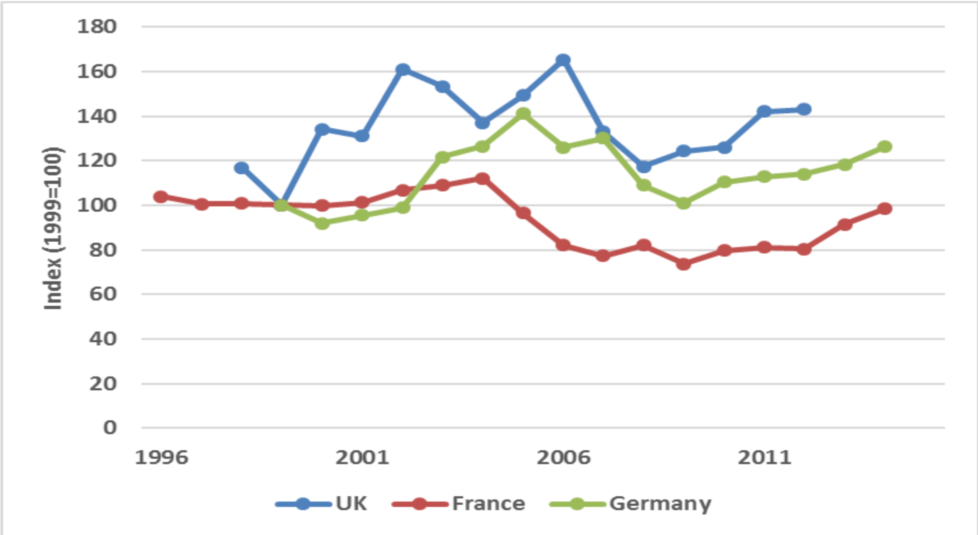
Note: Data unavailable for Germany before 1999. Data unavailable for France and Germany in 2015.

Source: ONS (Annual Business Inquiry and Annual Business Survey), Eurostat (Structural Business Statistics and Short Term Business Statistics) and CE (MDM-E3 and E3ME).

In casting of light metals, labour productivity growth was strongest overall in the UK

In the castings of light metals subsector UK real labour productivity grew by 65% over 1999-2006. Labour productivity then fell by 29% over 2006-08, followed by steady growth up to 2012 of around 5% pa on average. German labour productivity in casting of light metal followed a similar trend to the UK but with slower productivity growth overall. In France, real labour productivity grew slowly up to 2004, but then fell sharply over 2004-09, coinciding with the sharp contraction of output in the sub-sector. Since 2009, real labour productivity in the French sub-sector grew at a similar rate to the UK and German subs-actors. Figure 2.8 plots real labour productivity in the casting of light metals sub-sector in the UK, France and Germany over 1996-2014.

Figure 2.8: Real labour productivity in the casting of light metals sub-sector in the UK, France and Germany, 1996-2014



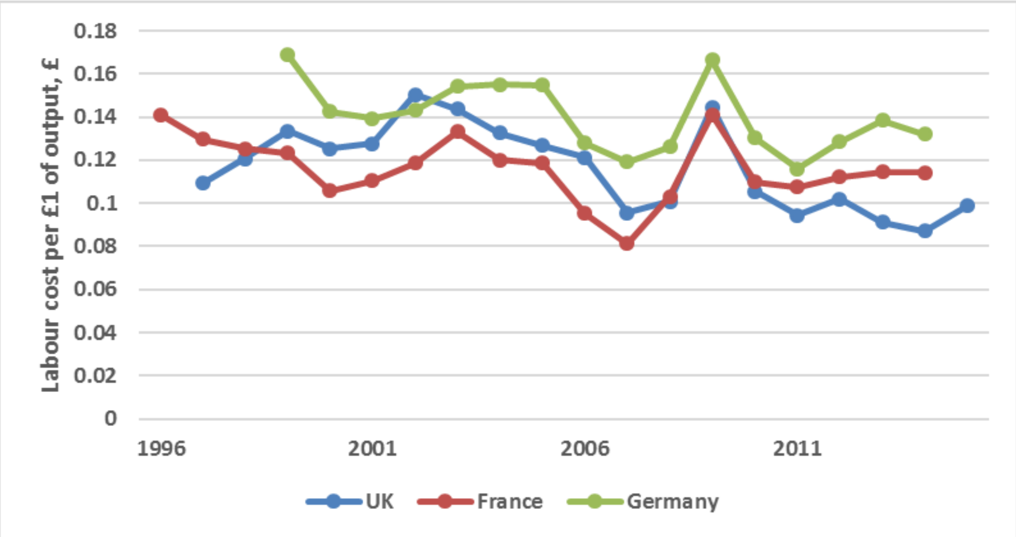
Note: Data unavailable for Germany before 1999. Data unavailable for France and Germany in 2015. Data unavailable for the UK before 1998, and after 2012.

Source: ONS (Annual Business Inquiry and Annual Business Survey), Eurostat (Structural Business Statistics and Short Term Business Statistics) and CE (MDM-E3 and E3ME).

Unit labour costs in the UK aluminium production sub-sector have always been lower than in Germany and are now lower than in France

Unit labour costs[28] in the UK aluminium sector fell relative to unit labour costs in France and Germany in the post-recession years. Figure 2.9 plots the evolution of unit labour costs in the UK, France and Germany in the aluminium production sub-sector. From the late-1990s through to 2006, unit labour costs in the UK first rose, to around £0.15 in 2002, before falling steadily to £0.12 in 2006. Over the same period, unit labour costs in France and Germany moved roughly in line with UK unit labour costs, as increasing international competition and consolidation drove efficiency improvements in all three. German unit labour costs were typically £0.01-0.02 higher, and French unit labour costs were typically £0.01-0.02 lower. Unit labour costs in all three countries fell sharply over 2005-07 (by around £0.04) before increasing sharply during the global economic crisis of 2008 and 2009. Unit labour costs in all three fell back sharply again in 2010 as economic activity picked up and since then unit labour costs have picked up a little in Germany; have been largely unchanged in France; and have edged downwards in the UK, in line with the general trend of slow wage growth post-recession. With the exception of one year, Germany has always had the highest unit labour costs; France had the lowest up to 2009, where after the UK has had the lowest unit labour costs: £0.08-0.10 compared to £0.12-0.14 in Germany.

Figure 2.9: Unit labour costs in the aluminium production sub-sector in the UK, France and Germany, 1996-2015



Note: Data unavailable for Germany before 1999. Data unavailable for France and Germany in 2015.

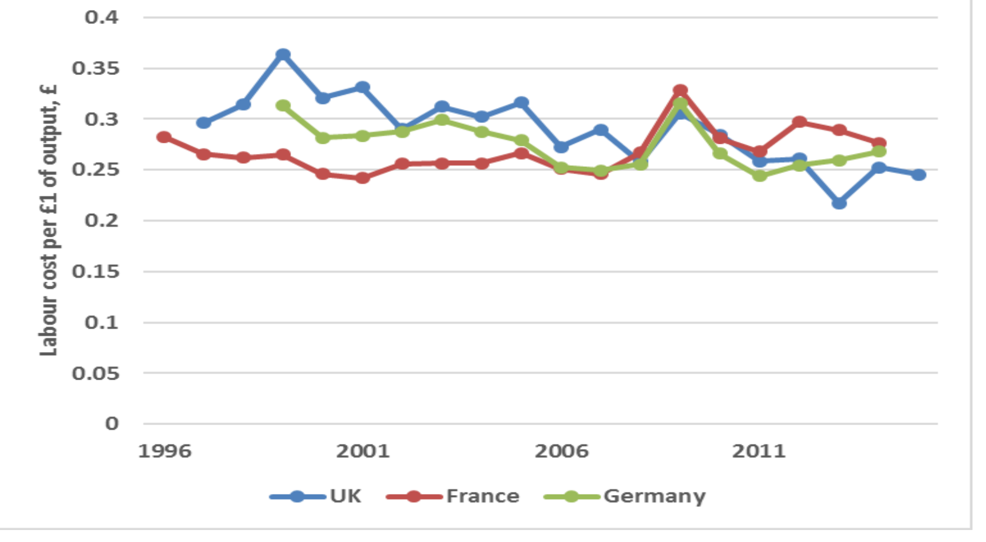
Source: ONS (Annual Business Inquiry and Annual Business Survey), Eurostat (Structural Business Statistics and Short Term Business Statistics) and CE (MDM-E3 and E3ME).

[28] Unit labour costs are a composite measure derived from labour productivity and average wages. For that reason, care must be taken when interpreting trends or changes in unit labour costs, to understand what is driving the change. Unit labour costs in individual years can be prone to swings as a result of structural change. It can be more informative to look at the trend over time.

In the casting of light metals sub-sector, unit labour costs were the highest before the recession, but the lowest after

In the casting of light metals sub-sector, although unit labour costs in the UK declined over 1999-2008, they remained higher than in France (where unit labour costs were flat) and Germany (where unit labour costs fell by less) over 1999-2008. Unit labour costs in all three jumped sharply and converged in 2009, before falling back in 2010 and 2011. Since then, however, unit labour costs in France and Germany have picked up slightly. In the UK they have continued to weaken and are now the lowest, again reflecting suppressed wage growth in the UK economy since the recession. Figure 2.7 plot the evolution of unit labour costs in the UK, France and Germany in the aluminium production sub-sector and the casting of light metals sub-sector respectively.

Figure 2.10: Unit labour costs in the casting of light metals sub-sector in the UK, France and Germany, 1996-2015



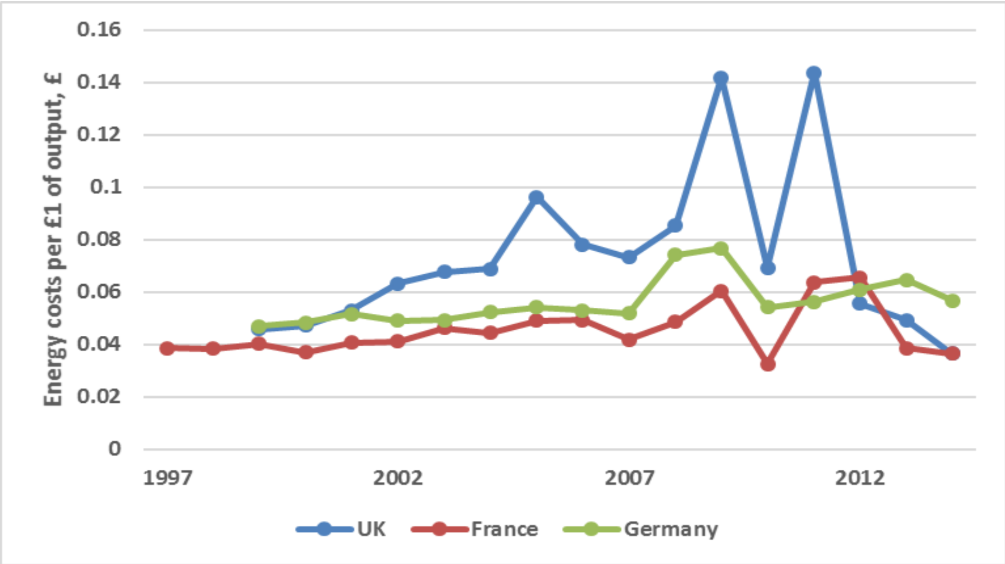
Note: Data unavailable for Germany before 1999. Data unavailable for France and Germany in 2015.

Source: ONS (Annual Business Inquiry and Annual Business Survey), Eurostat (Structural Business Statistics and Short Term Business Statistics) and CE (MDM-E3 and E3ME).

Energy costs were markedly higher in the UK for most of the historical period

Figure 2.11 displays unit energy costs in each country over 1997-2015. In 1999, UK unit energy costs were a little less than in Germany, with French unit energy costs the lowest. UK unit energy costs then rose above Germany in 2001, and continued to rise, notably surging by 38% over 2004-2005, before falling back to a little under £0.1 in 2007 – around a third higher than in Germany and nearly twice as high as in France. Over the period 2007-12, UK unit energy costs were highly volatile, with the large upswings in 2009 and 2011. The first upswing reflects a sharp fall in output amid the recession and the closure of the Anglesey smelter, while energy purchases only fell slightly. The second upswing was driven by a sharp increase in energy costs, together with a small fall in output. Over 2012-15, unit energy costs, in the UK, now mainly reflecting secondary and downstream aluminium production, fell below Germany, and to around the same level as France.

Figure 2.11: Unit energy costs in the aluminium production sub-sector in the UK, France and Germany, 1997-2014



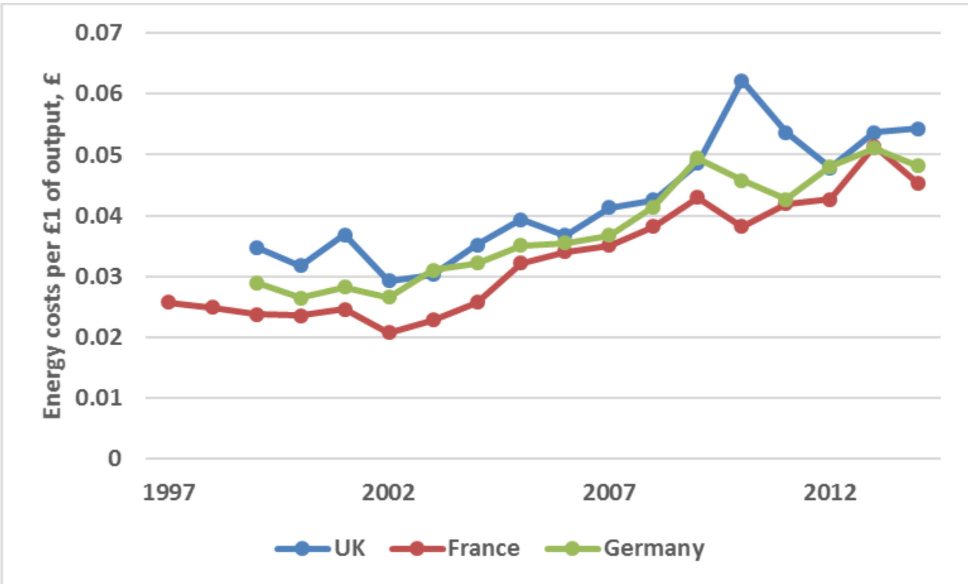
Note: Data unavailable for the UK and Germany before 1999.

Source: ONS (Annual Business Inquiry and Annual Business Survey), Eurostat (Structural Business Statistics and Short Term Business Statistics) and CE (MDM-E3 and E3ME).

Unit energy costs in casting of light metals were closer to the French and German sub-sectors

Unit energy costs in the less energy-intensive casting of light metals sub-sector were closer in the UK to those in France and Germany over 1999-2014, but still higher in most years. In all three countries, unit energy costs grew at a similar rate. In the UK, unit energy costs in the casting of light metals sub-sector grew by around 3% pa on average over 1998-2014. Figure 2.12 plots unit energy costs in the casting of light metals sub-sector in the UK, France and Germany over 1997-2014.

Figure 2.12: Unit energy costs in casting of light metals sub-sector in the UK, France and Germany, 1997-2014



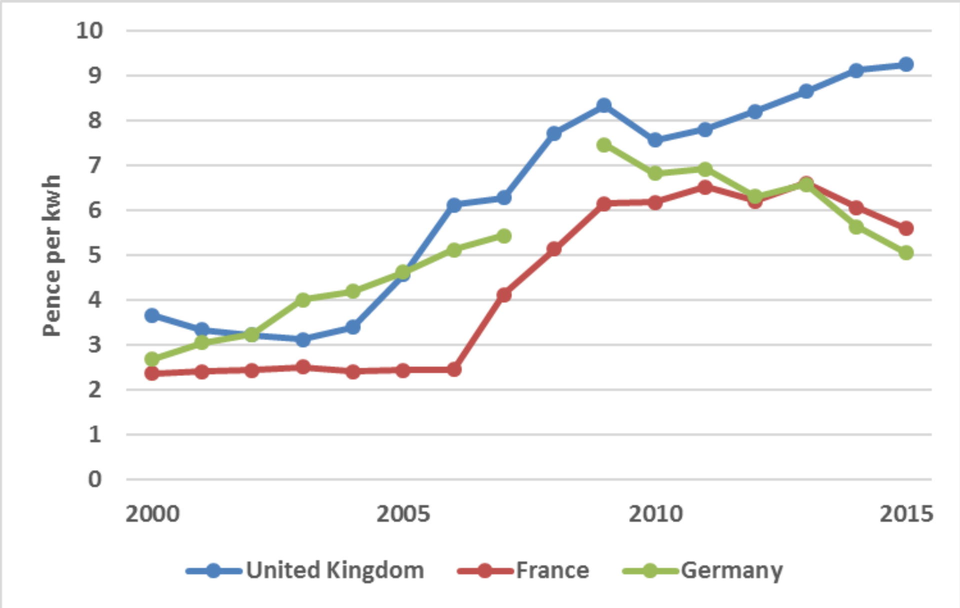
Note: Data unavailable for the UK and Germany before 1999.

Source: ONS (Annual Business Inquiry and Annual Business Survey), Eurostat (Structural Business Statistics and Short Term Business Statistics) and CE (MDM-E3 and E3ME).

A surge in electricity prices over 2004-09 drove the increasingly high UK unit energy costs up to 2009

Figure 2.13 shows average industrial electricity prices in the UK, France and Germany over 2000-15. Though all three countries saw a sharp increase in electricity prices over 2000-09, prices in the UK rose particularly sharply, by around 145% over 2004-09. This sharp surge in UK industrial electricity prices relative to France and Germany appears to have driven the widening gap between UK unit energy costs in the aluminium production sub-sector and France and Germany leading up to 2009. After 2009, UK electricity prices remained higher than in France and Germany, and continued to rise over 2010-15. In France, industrial electricity prices stabilised over 2009-13, and fell over 2013-15, while in Germany electricity prices fell over 2009-15, arriving in 2015 at the lowest of prices in the three countries.

Figure 2.13: Average industrial electricity prices excl. taxes in the UK, France and Germany, 2000-2015

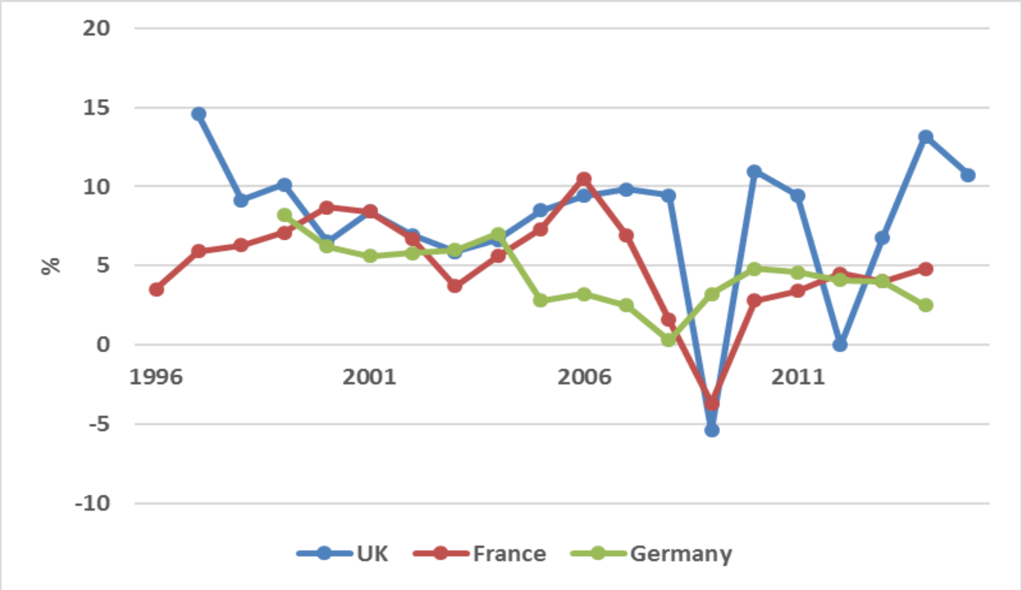


Source: BEIS.

The UK aluminium production gross operating rate fell over 1997-2003, but grew overall since then

Gross operating rate – an indicator of profitability – in the UK aluminium production sub-sector fell by around 8.5 percentage points over 1997-2003, but then grew by around 4 percentage points up to 2008. After plunging in 2009 and 2012 (coinciding with the recession in the former year and primary smelter closures in both years), the gross operating rate recovered in 2013 and 2014, and stayed relatively high in 2015, indicating profitability in the UK's current aluminium sector. In France and Germany, profitability has weakened over the historical period and in recent years the gross operating rate has been lower (below 5%) than in the late-1990s (above 5%).This may indicate falling profitability in primary aluminium production, which still forms a far higher proportion of total aluminium production in these countries compared to in the UK. Figure 2.15 graphs the gross operating rate in the aluminium production subs-sectors in the UK, France and Germany over 1996-2015.

Figure 2.14: Gross operating rate in the aluminium production sub-sectors in the UK, France and Germany, 1996-2015



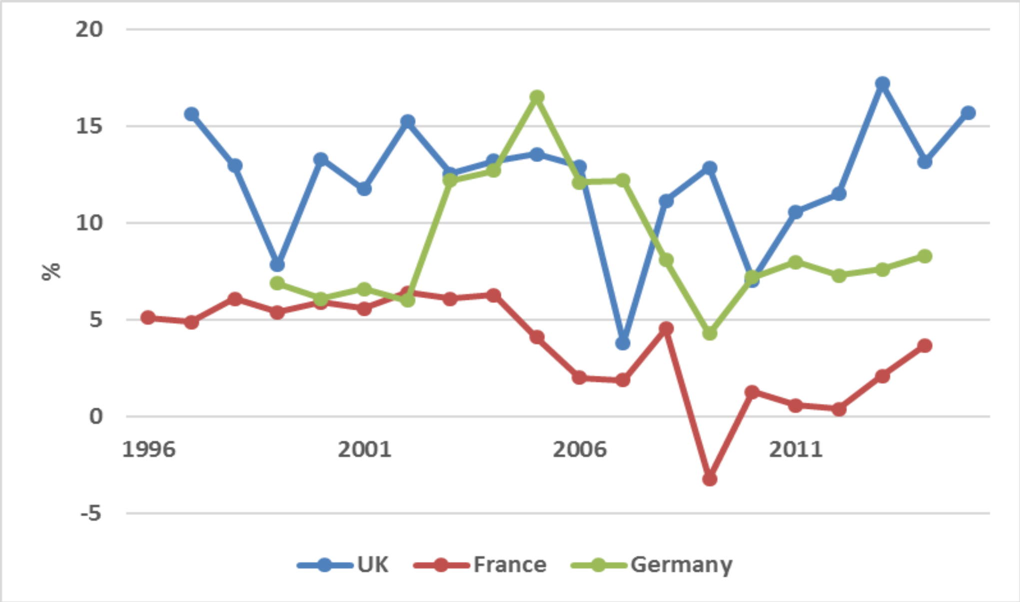
Note: Data unavailable for Germany before 1999. Data unavailable for France and Germany in 2015. Data unavailable for the UK for 1996.

Source: ONS (Annual Business Inquiry and Annual Business Survey), Eurostat (Structural Business Statistics and Short Term Business Statistics) and CE (MDM-E3 and E3ME).

The UK has a relatively high profitability in casting of light metals

In the casting of light metals sector the UK gross operating rate was volatile but relatively high (at 10-15% in most years) compared to France (rarely above 6%) and Germany (rarely above 10%). Notably, the UK gross operating rate peaked in 2013, and was again very high in 2015, suggesting high profitability in recent years corresponding with the recent increase in output. Conversely, the gross operating rate in the declining French casting of light metals sub-sector was relatively flat up to 2004, at 5-6% in most years, and very low in the years after 2005; it picked up a little over 2012-14 but remained below 5%. Figure 2.14 shows the gross operating rate in the casting of light metals sub-sector in the UK, France and Germany over 1996-2015.

Figure 2.15: Gross operating rate in the casting of light metals sub-sector in the UK, France and Germany, 1996-2015



Note: Data unavailable for Germany before 1999. Data unavailable for France and Germany in 2015. Data unavailable for the UK for 1996.

Source: ONS (Annual Business Inquiry and Annual Business Survey), Eurostat (Structural Business Statistics and Short Term Business Statistics) and CE (MDM-E3 and E3ME).

2.8 The role of climate change policies

The aluminium sector was not affected directly by the ETS

The EU's flagship climate change policy, the Emissions Trading Scheme (ETS), was launched in 2005 designed to cap industry emissions. The aluminium sector was not included in the EU ETS directly in Phases I and II though it was included in Phase III from 2013. As the sector had been identified as at risk of carbon leakage it has received a proportion of its allowances for free. Hence, up to 2013, the main way in which the aluminium sector was affected by the ETS was indirectly, through higher electricity prices.

Rising gas prices were the main driver of rising UK electricity prices over 2004-09

The main factor behind the surge in UK industrial electricity prices over 2004-09 was not climate change policies, but a sharp rise in UK gas prices. The UK's electricity supply is particularly dependent on gas compared to continental Europe[29][30]. Rising gas prices thus pushed wholesale electricity prices upwards in the UK by more than in competitor countries such as France and Germany. Our analysis in Task 1 confirms that a higher wholesale price was a key factor in 2015 and 2016 in pushing UK industrial electricity prices above those faced by EU competitors. Task 1 also found that network costs were significantly higher in the UK in 2015 and 2016.

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[29] http://rwecom.online-report.eu/2005/ar/reviewofoperations/environment/economicenvironment/ukelectricityprices.html

[30] http://rwecom.online-report.eu/2008/ar/reviewofoperations/environment/economicenvironment/ukelectricitypricesia.html

The ETS increased costs indirectly for UK and other EU producers through higher electricity prices

However, climate change policies also contributed to rising energy prices in the UK and Europe. Aluminium producers are vulnerable to indirect costs of the ETS, since the price of electricity emissions tends to be passed on by generators into the electricity price. Such costs may have driven the rising unit energy costs in the 2000s seen in the UK, France and Germany. Indeed, CEPS estimated the cumulative indirect costs over 2005-12 of the ETS to primary aluminium producers in the EU at between €125 and €160 (£106 to £135) per tonne, depending on different pass through rates of the carbon price to electricity prices. In the intermediate pass through scenario, the study attributed these costs to around 4% of total production costs on average, but with a more significant impact on profit margins in crisis years. The costs to secondary producers, who are far less energy intensive, was estimated at between 0 and €2.5 (£2.1) per tonne. To downstream users, the estimated indirect costs of the ETS varied, due to wide variation in energy intensity between different types of downstream production, and different technologies used in different plants.

UK-specific policies such as the Climate Change Levy and the Renewables Obligation further raised electricity prices

Aside from the ETS, UK-specific climate change policy also contributed to rising electricity prices. Two key policies launched near the start of the UK's climate change program are the Climate Change Levy (CCL), introduced in 2001, and the Renewables Obligation, introduced in 2002. Such policies were viewed by industry as more stringent than similar policies faced by European competitors. The CCL was claimed by the Aluminium Federation to have damaged competitiveness due to the fact that it was introduced in the UK before comparable policies had been introduced in other EU countries[31]. Though the CCL initially provided an 80% discount through Climate Change Agreements for primary producers[32], secondary production was not eligible until three years later, raising the price of production for the secondary producers relative to primary producers. This may explain the fall in UK secondary production over 2001-02 seen earlier in this report (see Figure 2.2) The Renewables Obligation (RO), required electricity suppliers to source an increasing proportion of electricity from renewable sources, hence indirectly pushing up electricity prices at an increasing rate. Feed-in-Tariffs were designed to encourage uptake of a range of small-scale renewable and low-carbon electricity generation technologies. Energy-intensive industry receives 85% compensation for the indirect costs of the RO/FiTs, but this was only recently introduced in the Energy Intensive Package (EII), through which RO/FiTs compensation only began in 2016.

The UK CPS caused further controversy through its potential effect on electricity prices despite compensation

Another key UK climate change measure is the Carbon Price Support (CPS), announced in March 2011 with the intention to raise the UK carbon price above the EU price, and introduced in 2013. The policy was designed to improve energy efficiency and incentivise investment in low carbon technologies, but it also raised electricity prices indirectly. The announcement of the CPS was controversial amongst industry, especially because such a policy had not been adopted in competitor countries. Indeed, Rio Tinto blamed the closure of the Lynemouth smelter on the incoming CPF legislation as well as future ETS costs, despite the announcement by the government that

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[31] https://www.publications.parliament.uk/pa/ld200506/ldselect/ldsctech/21/5030208.htm

[32] researchbriefings.files.parliament.uk/documents/SN00235/SN00235.pdf

compensation would be provided through the EII and the fact that aluminium would be granted free allowances upon its introduction to the ETS.

Relief for the cost of renewables was introduced earlier in Germany

While the UK only implemented compensation for the RO/FiTs in 2016, Germany introduced relief for energy-intensive industry far earlier for its key renewables act, the Renewable Energy Sources act (EEG), introduced in 2000. Industry exemptions from the EEG surcharge grew steadily from around 37 terawatt hours (7% of electricity consumption) in 2004, to 106 terawatt hours (20% of electricity consumption) in 2014[33]. In 2015, industry exemptions from the EEG surcharge in Germany stood at around €4.8bn (£3.5bn) to 2,000 companies[34]. In contrast, the UK government has paid compensation for climate change policies of over £400m since August 2013. The total is made up of amounts on individual schemes: over £90m for the EU Emissions Trading System (ETS), over £140m for the Carbon Price Support (CPS) mechanism, and over £170m for Renewables Obligation (RO) and small scale Feed in Tariffs (FiT).

Climate change policies were never the main factor behind rising electricity prices, but were a larger factor before relief was introduced

Our analysis in Task 1 found that climate change policies only formed a small impact on electricity costs paid by aluminium producers in 2016. The carbon cost accounted for only 1.5% of electricity costs faced by aluminium producers in 2016 and carbon price support (the CPF) accounted for 4.5%. The RO /FiTs accounted for 2.6% of industrial aluminium electricity prices in 2016. Indeed, the main driver of rising electricity prices in the UK was rising gas prices, which pushed up wholesale costs. However, our estimates for 2016 account for compensation and exemptions that have not always been in place. Before EII support for the carbon cost was introduced in 2011, its impact on electricity bills is likely to have been greater. In addition, EII compensation for the RO/FiTs was only implemented in 2016, so the cost of the RO/FiTs to the aluminium sector will also have been higher in previous years. DECC estimated the impact of the ETS on electricity bills in 2010 for medium-sized domestic electricity users at around 6.2% and the impact of the RO on electricity bills in 2010 at around 5%. This gives some indication of the impact of these policies on aluminium producers, though these impacts would likely be smaller for the larger producers, who have more bargaining power to negotiate cheaper energy contracts.

Primary producers also faced difficulties securing long term electricity contracts

Sartor (2013) notes that difficulties in securing long term electricity contracts that arose in the late 2000s from the stricter enforcement of EU anti-trust and competition law. This is a commonly cited reason for primary plant closures in Europe. Long-term electricity contracts are crucial to energy-intensive producers, for hedging against fluctuating electricity prices and to mitigate the effects of electricity price increases. Indeed, the closure of the Anglesey Aluminium plant in 2009 followed the termination of its contract with the nearby Wylfa power station.

[33] https://www.agora-energiewende.de/fileadmin/downloads/publikationen/Impulse/EEG-Umlage_Oeko-Institut_2014/Impulse_Summary_Revision_of_EEG_Exemptions_EN.pdf

[34] http://www.eef.org.uk/uksteel/Publications/energy-costs-and-the-steel-sector-a-uk-steel-briefing.htm

Discounting the impacts of policy, the EU is still a less attractive location for primary aluminium investment

Market forces have also affected the competitiveness of the EU aluminium sector. Unwrought aluminium is traded globally on the London Metal Exchange, effectively making producers price takers (in a globally competitive market). This prevents them from passing on higher production costs as they are unable to raise prices. Furthermore, fast-growing demand for unwrought aluminium in emerging economies has incentivised major producers to locate new smelters in these areas. Also, primary smelters are highly energy intensive, and so locations with large abundant supplies of low cost electricity are more attractive for investment than most EU countries. Indeed, Mckinsey and Ecofys (2006) concluded that most of EU primary smelting capacity would be shut down irrespective of carbon costs, due to general developments in energy prices.

3 Sector outlook

Demand from the transport sector has spurred recent investments

While primary aluminium production is unlikely to attract new investment as firms are drawn to invest in countries with abundant low cost energy reserves, a significant part of the recent investment in the aluminium sector was directed towards secondary aluminium production. Notably, Novelis expanded its aluminium recycling operations in Latchford, Warrington[35] , in part due to growing demand from Jaguar Land Rover. In addition, increased investment in downstream aluminium production includes recent investment by Bridgnorth Aluminium in its Shropshire plant, which operates both aluminium casting and rolling facilities[36]. Furthermore, Magna announced in 2016 that they will build a new casting facility in Telford, to support Jaguar Land Rover, with production due to start in 2018[37]. The facility will support up to 295 jobs.

Demand is growing from the motor vehicles and aerospace sectors

On the demand side, the UK has seen strong growth in the motor vehicles sector and the aerospace sector, two of the largest consumers of semi-finished aluminium products, and with high export volumes. Furthermore, aluminium is an increasingly popular manufacturing material in these sectors. A recent study by European Aluminium predicted the current average use of aluminium per car will increase from 150kg to 200kg by 2025, driven in particularly by increased use of rolled products as a lightweight alternative to steel, allowing emissions reductions. As an example, Alfed (2016) note that Rolls Royce recently announced that their new Phantom model will be produced using a lightweight aluminium platform.

The Lochaber smelter has recently been acquired

The future of primary aluminium production in the UK appears safe for now, as the UK's last remaining smelter at Fort William, Lochaber was acquired in 2016 by the GFG Alliance, allaying fears over its future after Rio Tinto announced it was reviewing its Lochaber operations. The new owners intend to integrate the plant with their downstream engineering and manufacturing operations, indicating that the downstream sector will also benefit from the acquisition[38].

European aluminium production faces increasingly high pressure on prices from China

A major threat to the UK and indeed European aluminium sectors is the increasing supply of cheap imports from China. China has significant overcapacity in its aluminium industry which could increase if the Chinese economy slows down. European Aluminium claim that primary production capacity in China will equal total world demand by 2020, while Chinese capacity for rolled products is already equal to total demand in the EU. Furthermore, Chinese manufactures are moving into the production of higher value rolled products[39], which could potentially disrupt the European supply of such products to the motor vehicles and aerospace industries. The threat has intensified since China began pushing for market economy status within the WTO, which could undermine the ability of the EU to impose anti-dumping

[35] http://www.novelisrecycling.co.uk/novelis-commissions-expanded-uk-recycling-plant/

[36] http://www.birminghampost.co.uk/leads-deals/manufacturer-secures-62-million-finance-7224758

[37] http://www.magna.com/media/press-releases-news/2016/05/25/news-release---magna-announces-new-aluminum-casting-facility-in-the-uk

[38] http://www.libertyhousegroup.com/news/gfg-alliance-companies-to-acquire-power-plant-smelter/

[39] https://www.ft.com/content/9e8bdf98-7032-11e6-9ac1-1055824ca907

legislation, though European parliament has rejected China's claim for the time being.

The impact of carbon costs on industrial electricity prices is set to grow

The impact of carbon costs on overall electricity costs faced by aluminium producers looks set to increase. In Task 1 of this study we forecast electricity costs for UK electro-intensive producers up to 2030. The cost of carbon together with carbon price support for the aluminium production sub-sector was estimated at around 5.2% of the total electricity cost in 2016. According to our forecast, this cost component is set to increase to around 6.3% of total electricity costs in 2030. We also projected electricity costs for European producers with similarly high electro-intensity to the aluminium sector. The cost of carbon is projected to increase in these sectors by more than for the UK aluminium sector in both France and Germany, in France from 2.5% of electricity prices to 9.7%, and in Germany from 3.3% to 14.0% of electricity prices. Overall, electricity costs for UK aluminium producers are forecast to increase by 53%, driven by an increase in the wholesale price of electricity. In France and Germany, electricity costs for the electro-intensive sectors are forecast to increase by 75% and 78% respectively, though they will still be significantly below UK prices, owing to the high wholesale costs and network costs in the UK. Clearly, energy efficiency in the UK aluminium sector will be key to future sector competitiveness.

4 Conclusions

The UK aluminium sector contracted overall by 46% over 1997-2015

Production of the UK aluminium sector (in value terms) contracted by around 46% over 1997-2015, accompanied by a sharp fall in investment. This was driven largely by the aluminium production sub-sector, while the casting sub-sector was more stable, and indeed grew strongly in recent years. Trade in aluminium has increased significantly, with both import penetration and export shares of output increasing, partly reflecting increased globalisation of the supply chain, but also suggesting a loss of competitiveness as the domestic sector has declined in output and the net trade deficit has grown.

Global demand has tripled, but the recession dampened demand in Europe

The decline of the UK aluminium sector contrasts with strong growth in global demand for final aluminium products, which has tripled since 1990, led by China but also in Europe. However, global demand fell sharply during the recession, and the recovery in demand in Europe since 2008 has not been as strong as in other major regions, increasing the pressures felt on UK producers facing weak domestic demand.

Falling domestic demand drove the UK sector contraction

In the UK, falling domestic demand in the aluminium sector drove the overall decline in sector output. In particular, the transport equipment sector and the construction sector contracted sharply during the recession. However, part of this fall in demand was driven by the decline in UK downstream production, rather than falling demand for semi-manufactured products. Indeed, demand for rolled aluminium products has increased particularly strongly in recent years, even while UK production has declined sharply. Falling demand in EU export markets also played a part, particularly in the early 2000s, and during the recession.

Primary production collapsed in UK, but not in France and Germany

Structural changes in the UK sector are the other key aspect to understanding the overall fall in output. The closures of the two large primary smelters (the Anglesey smelter and the Lynemouth smelter) led to a sharp fall in production of unwrought aluminium. These smelter closures were attributed by their owners in part to particularly high and rising energy costs in the UK amid increasing global competition, and difficulties securing a long-term energy contract in the case of the Anglesey smelter. Indeed, our analysis indicates that unit energy costs were significantly higher in the UK than in France and Germany over 2002-11, driven by a sharp rise in industrial electricity costs. In contrast, France and Germany, where unit energy costs have been more stable (and industrial electricity prices lower), have retained strong primary production levels, though both countries saw closures of smaller, less efficient smelters. We also find that primary aluminium production was supported by stronger domestic demand in France and Germany compared to the UK.

Secondary production also fell, as demand from the UK downstream industry fell

Secondary aluminium production is now the main way in which unwrought aluminium is produced in the UK. Yet secondary production also declined over 1999-2011, though by a lesser extent by primary production. Secondary production first fell over 1999-2002, linked to the high cost of scrap metal in these years, and falling demand from the domestic downstream production industry. Secondary production contracted further over 2007 amid falling demand along the downstream supply chain in the EU, driven by the financial crisis and its aftermath. However, secondary aluminium production has since picked up, after the collapse of primary production, and a recovery in EU demand.

Downstream production fell rapidly in the UK, unlike in France and Germany

It is equally important to note that downstream aluminium production has fallen significantly in the UK, unlike in France and Germany, where strong downstream production industries support demand for unwrought aluminium. Downstream producers in the UK have blamed plant closures on increasing global competition, and were particularly hard hit by the strong pound against the euro in the early 2000s, combined with weak EU demand. Downstream production in the UK was also hurt by the economic downturn, this time driven by falling demand from downstream users, both in the UK and the EU.

Labour productivity and unit labour costs were competitive in the UK

Labour productivity and labour costs appear to have been competitive in the UK aluminium sector compared to France and Germany, suggesting other factors at play in the decline of the UK sector. Labour productivity in both the UK aluminium sub-sectors increased strongly over 1998-2014, outperforming France and Germany. Furthermore, unit labour costs in the UK aluminium production sub-sector have always been lower than in Germany and are now lower than in France.

UK energy costs were particularly high compared to France and Germany in most years

Energy costs appear to have put the UK aluminium sector at a disadvantage to its competitors in France and Germany. Unit energy costs were consistently higher in the aluminium production sub-sector over 2001-12, and higher than France and Germany in most years over 1997-2014. Furthermore, the gap between energy costs in the UK aluminium production sub-sector and the comparator country sub-sectors grew increasingly larger.

UK electricity prices surged due to rising gas prices over 2004-09

The increasingly high unit energy costs in the UK aluminium sector leading up to 2009 reflect a sharp surge in industrial electricity prices over 2004-09, which outpaced the price increases seen in France and Germany. This was driven mainly by rising gas prices pushing up wholesale prices. The UK energy supply is highly dependent on gas – more so than its European competitors.

EU and UK climate change policies further raised UK electricity prices

The aluminium sector was not directly affected by the ETS, as it was not included in the scheme until 2013, and was granted free allowances upon its inclusion. However, a range of EU and UK climate change policies have raised UK electricity prices, including the ETS, the Climate Change Levy (CCL), the Renewables Obligation (RO), Feed-in-Tariffs (FiTs) and the Carbon Price Support (CPS). Primary aluminium producers are particularly exposed to electricity price increases, due to the high electro-intensity of the primary aluminium production process.

A large proportion of climate change policy compensation and exemptions were only introduced very recently

Aluminium producers in the UK have been compensated or exempted from many of these policies, though not fully, and in some cases only very recently. For the CCL, aluminium producers were provided 80% rebates from 2001 onwards, increasing to 90% in 2013, conditional on signing energy efficiency agreements (the Climate Change Agreements). From 2014, metallurgical processes were exempt from the CCL.

For the RO/FiTs, ETS and CPF compensation is provided by the Energy Intensive Industries Package (EII). However, the full implementation of the EII was delayed, with compensation for the RO/FiTs (and several other less costly policies) only introduced in 2016. The UK government has paid compensation of over £400m since August 2013. The total is made up of amounts on individual schemes: over £90m for the EU Emissions Trading System (ETS), over £140m for the Carbon Price Support (CPS) mechanism and over £170m for Renewables Obligation (RO) and small scale Feed in Tariffs (FiT). In contrast, relief in Germany for the Renewable Energy Sources Act (EEG) has been available to energy-intensive industries since the early 2000s, and in 2015 totalled around £3.5bn.

Wholesale prices and network costs are largely behind higher electricity prices; the impact of CC policies was greater before the EII

Our analysis in chapter two of the main report indicates that UK industrial electricity prices are currently high relative to EU competitors mainly due to higher wholesale prices (driven by the gas prices) and network costs. In 2016 the indirect EU ETS cost to aluminium was only worth 1.5% of the electricity price, carbon price support (the CPS) 4.5% of the electricity price, and the RO/FiTs was worth 2.6% of the electricity price. Before the EII was fully implemented in 2016, some of these costs will have been higher – namely the carbon cost and the cost of the RO/FiTs, though still less so than the particularly high wholesale and network costs in the UK.

The EU is a less attractive location for primary investment, policies notwithstanding

Discounting the effects of climate change policies, the EU is still a less attractive location for primary aluminium investment. The recovery in demand since 2009 has been weak, and primary producers in the EU have faced difficulties securing long-term electricity contracts. New investment is drawn to low cost regions with a large supply of energy, such as in the Middle East. In the aluminium production sub-sector, profitability in France and Germany, which still maintain strong primary aluminium production levels, has fallen since the early 2000s, perhaps reflecting pressures on margins from higher energy costs compared to global competitors in China and the Middle East.

Secondary production is growing in Europe and in the UK

Indeed, there is a growing trend towards secondary production in Europe, which is far less energy-intensive than primary production. In the UK, secondary production has increased in recent years, and new investment has been directed towards expanding secondary production operations, amid growing demand from the transport equipment sector.

Downstream production has seen recent investment in the UK, but faces mounting competition from China

New investments have also been made in downstream production, in particularly in aluminium rolling and aluminium casting, again driven by the growing UK transport equipment sector. While demand for aluminium casting is traditionally driven by the transport equipment sector, rolled aluminium is becoming increasingly popular as a lightweight replacement for steel in the production of low-emission vehicles. On the other hand, China has begun to move towards producing higher value semi-manufactured products, and so the competitive pressures faced by the sector are likely to keep growing in the future.

The impact of carbon costs on industrial electricity prices is set to grow

The impact of carbon costs on overall electricity costs faced by aluminium producers looks set to increase, with carbon costs set to account for 6.3% of total electricity costs in 2030 compared to 5.2% in 2016 according to our findings from chapter two in the main report. Overall, electricity costs for aluminium producers are forecast to increase by around 53%, driven by an increase in the wholesale price of electricity. In France and Germany, the carbon cost component, together with industrial electricity prices, are forecast to increase by more than in the UK, though industrial electricity prices will still be lower than in the UK. Clearly, energy efficiency in the UK aluminium sector will be key to future sector competitiveness.

Appendices

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