UKpia

Statistical Review
2017

UKpia Statistical Review 2017

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Contents

All data is updated as far as possible. Where data is not available the most recent statistics have been used.

About UKPIA

UKPIA represents the non-commercial interests of and speaks for eight companies involved in the UK downstream industry, whose activities cover refining, storage and distribution, and marketing of petroleum products.

Our members are:

UKPIA Associate members are fully engaged in a number of critical subject areas, such as safety, transportation and logistics within the oil and gas industry.

Our associates are:

Introduction from the President

I am delighted to introduce UKPIA's Statistical Review, which this year celebrates its 15th anniversary.

The Review brings together in one document a wide range of statistics and facts focused on the downstream oil industry. I hope that it also provides the reader with a better understanding of the scope of activities and complexity of this vitally important sector. As ever, this publication would not be possible without the work of the Department for Business, Energy & Industrial Strategy's statistics team and UKPIA's Secretariat, together with input from our member companies.

As a result of the timing of the General Election on 8th June, for the first time since its inception, the Statistical Review does not contain an introduction from the Energy Minister. However, following the elections, we look forward to working with the next Government, members of Parliament and officials on policies that will realise a secure energy future for the UK, strengthen and grow our economy, and ensure a thriving industrial base and supply chain to the benefit of generations to come.

Our UK downstream oil sector is vital to meeting the UK's energy and transportation needs and is a significant employer and source of innovation and growth. It supplies over 34% of the UK's primary energy needs and powers 96% of our transportation energy demand. Domestic UK oil refining and marketing assets also make a substantial contribution to the UK economy, not only supporting the employment of over 88,000 people, many with highly specialist skills and technological expertise, but also many more jobs in related industries such as chemicals. The annual contribution of UKPIA members to the economy is some £2.3 billion, with each large refinery estimated to inject over £60 million locally, in addition to the value of its production output.

Equally as important, our industry provides the building blocks of countless products which we rely on in our every day lives. And there is no better opportunity to highlight this than in our key publication of the year. The bold centre spread infographic in this year's Statistical Review highlights the ways in which oil products power our lives and innovation. From vital transport fuels, to textiles and paints, bitumen for our roads, lubricants for vehicles and machinery, and plastics and polymers used in everything from computers to medical equipment and wind turbines, the list is virtually endless.

With oil products expected to continue representing an essential part of our energy supply mix well into the future, the critical importance of our downstream oil sector cannot be overstated. Therefore, as we look ahead, we must ensure that we create an environment where the sector can continue deliver and thrive to the benefit of all, particularly as we look to build a new relationship with the EU and a meaningful energy and industrial strategy for the UK. To help shape this new reality for the UK, our industry stands ready to work collaboratively and enthusiastically with the next government.

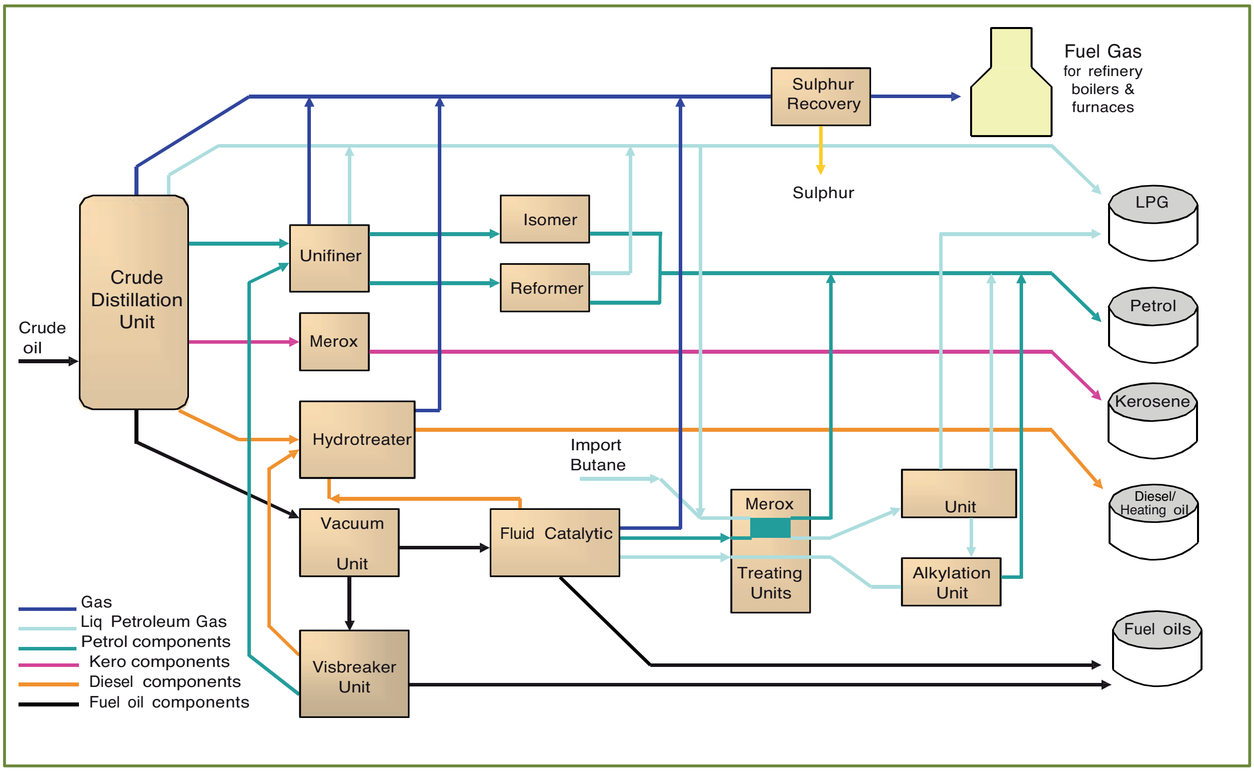
Paul Bray
June 2017

Processing Crude Oil in a Typical UK Refinery

Many refineries in the UK came on stream in the 1950s and 1960s. Since that time they have evolved to meet the growing demand for transport fuels and reducing demand for heating and power generation from oil. The composition of fuels has also changed over recent years to reduce the environmental impact of their use. In addition to transport fuels, refineries produce a wide variety of important feedstocks used in the manufacture of other products, such as petrochemicals, lubricating oils, solvents, bitumen and petroleum coke for aluminium smelting.

No two refineries are identical. They share common technology such as crude distillation, but each UK refinery takes a slightly different route to achieve the common goal of extracting maximum value from each barrel of crude oil processed.

Typical refinery process units



Refinery operations can be broken down into five main processes:

- Distillation which separates crude oil into different refinery streams
- Conversion and reforming which improve the quality of these streams and adjusts the yields to meet market demand
- Desulphurisation which reduces the sulphur in the streams to the required level
- Blending of the refinery streams to produce the final products meeting current regulations and specifications
- Waste treatment ensures that all waste meets current regulations and standards

Distillation

The starting point for all refinery operations is the crude distillation unit (CDU). Crude oil is boiled in a distillation column, which separates the crude down into fractions with different boiling points. The crude oil enters the column near the bottom and is heated to around 380°C. The lighter fractions are vaporised and rise up the column. As they rise, they are cooled by a downward flow of liquid and condense at different boiling points. This enables fractions with different boiling points to be drawn off at different levels in the column. These fractions range from lighter, low boiling point gases such as propane and butane to heavier, higher boiling point diesel and gas oil. They are then sent on to other refinery units for further processing. What is left over at the bottom of the column is a liquid residue, which requires further processing to be turned into more valuable, lighter products or blending components. This residue is first sent to a second stage of fractional distillation in the vacuum distillation unit (VDU). This unit performs the distillation under reduced pressure which allows the distillation of the crude residue at lower temperatures.

UKpia

Using the same approach as before the VDU separates into different components from gas oil to a heavy liquid residue.

The streams from the CDU and VDU are then processed further by the remaining refinery units to provide the high quality products that consumers expect and that comply with all relevant legislation.

Conversion, Reforming, Desulphurisation and Blending of Different Streams

Distillation does not produce enough of the lighter, more valuable products such as petrol that the market wants. Therefore conversion units, eg fluidised catalytic cracking (FCC), are used to process some of the streams from the vacuum distillation column with the aim of turning the heavy components into lighter transport fuels. Reforming units are used to upgrade the octane number of the petrol components produced from the CDU.

Desulphurisation units are then used to remove sulphur from the products. This enables the products to meet today's tighter fuel specifications. Extra desulphurisation will be required to allow the refinery additional flexibility to process higher sulphur 'sourer' crude oils. Reliance on low sulphur crude oils alone limits the flexibility of a refinery.

Main Products

LPG (liquified petroleum gas) is produced by compressing and cooling gas from the crude distillation unit and the FCC unit.

Petrol streams from the distillation process are cleaned in the unifiner. This unit strips out excess sulphur and nitrogen compounds as hydrogen sulphide and ammonia.

The streams are then sent on to the catalytic reformer and isomer units for processing to raise the octane number of the petrol by modifying its molecular structure. The reformer produces a large amount of hydrogen as a by-product, and this is recycled for use in desulphurisation (hydrotreater) units.

Finally the petrol streams from the reformer, fluidised catalytic cracking unit, the isomerisation unit and the alkylation unit are blended to meet fuel specifications and current regulations.

Jet fuel / kerosene streams from distillation are cleaned in the merox unit. This uses a caustic wash and additives to remove sulphur compounds and to inhibit gum formation.

Diesel / heating oil streams are processed in the hydrotreater, which removes sulphur and other unwanted compounds using hydrogen and a catalyst. The hydrotreater (desulphuriser) is supplied with recycled hydrogen from other process units such as the reformer. The diesel/heating oil streams are separately blended to meet fuel specifications and current regulations.

The lighter **fuel oil** streams from the VDU are processed in the FCC unit whilst the heavier residues from the VDU can be processed in the visbreaker.

In the FCC unit, heavy oils are reacted at high temperature with a catalyst which breaks the heavy fractions into more valuable lighter products. The gaseous and petrol components are then cleaned in a merox unit and some of the gaseous is converted in an isomerisation or alkylation unit into high octane petrol blending components. The FCC's products are blended into petrol, gaseous, diesel/gas oil and fuel oil product streams.

In the visbreaker, the heavy fractions are held at high temperature until they become less viscous. This stream is then blended into other fuel oil product streams.

The **fuel oil** components from the different units are then blended to give fuel oil meeting current regulations and specifications.

Desulphurisation and Waste Treatment

The sulphur recovery unit takes waste hydrogen sulphide from the units which remove sulphur from product streams. The hydrogen sulphide is then reacted with oxygen to give solid elemental sulphur and water vapour. After treatment, this sulphur is sold to other process industries.

All other waste streams are treated according to the current regulations.

Refineries in the UK

The members of UKPIA run the six major operating refineries in the UK, which are situated around the coast for ease of crude tanker access. UKPIA members supply around 85% of the inland market demand for petroleum products. The UK has one of the largest total refining capacity in the EU and some UK refineries are among the largest in Europe.

Over the years, the refining sector has sought to minimise its impacts upon the environment and improvements continue to be made to reduce emissions.

Section 2 covers refining in more detail, with key figures on production, changing product demand and refinery emissions.

Distribution of Products

Around 50 major oil terminals are supplied by pipeline (51% of the volume), rail (15%) and sea (34%) from UK refineries. There is an extensive network of private and Government owned pipelines in the UK, with around 3,000 miles of pipeline currently in use.

The 1,500 miles of privately owned UK pipeline network carries a variety of oil products, from road transport fuels to heating oil and aviation fuel. It provides an efficient and robust distribution system across the UK and directly provides jet fuel for some of the UK's main airports. It can take several days for fuel to travel from the refinery to the terminal by pipeline. At the terminal, products are stored in large above-ground tanks and are transported to the filling station by road tankers.

CLH-PS acquired the Government Pipeline and Storage System (GPSS) in 2015.

Privately owned oil pipelines in England and Wales

U.K.O.P.
Shell
BP
Valero
Total

ESSO PIPELINE SYSTEM

MAINLINE PIPELINE SYSTEM
Valero

WALTON GATWICK PIPELINE
BP
Shell
Valero

WEST LONDON PIPELINE
BP
Shell
Valero
Total

FINA-LINE
Total

CLH-PS PIPELINE NETWORK

INGRESS LOCATIONS
(THIRD PARTY CONNECTIVITY):

KILLINGHOLME
(Phillips 66, Total)

BACKFORD
(Essar)

AVONMOUTH

HAMBLE
(BP)

ISLE OF GRAIN
(BP)

Product Distribution

The UK has a number of oil-company and independently-owned terminal facilities, linked either by pipeline, rail or road. Around a half of all terminals are supplied by pipelines, 15% by rail and around a third by sea.

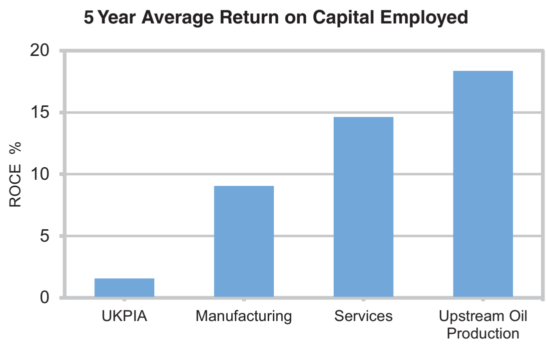
The south of the country heavily relies on pipelines that connect Fawley, Thames Oilport, Stanlow and Pembroke, with distribution terminals serving major demand centres. The north tends to be more dependent on road transport with large road terminals at Stanlow and on the Humber. Scotland is dependent on supplies from Grangemouth and Northern Ireland on imports delivered to the Belfast port.

1. Economic Contribution and Refinery Economics

The UK refining industry is one of the largest in Europe, comprising 6 operating refineries, 50 terminals and an extensive pipeline network carrying over 30 million tonnes of fuel each year. The sector has undergone a number of changes over the years. During the '70s and '80s, refineries invested in additional upgrading such as fluid catalytic cracking, to produce additional petrol from fuel oil. More recently, refiners have had to increasingly adapt and focus on reducing emissions due to a growing number of environmental legislation and tighter fuel specifications, as well as changing consumer needs with the growth of diesel demand partly driven by fiscal policy. Increased environmental and energy policy reforms, as well as taxes, have continued to squeeze the sector, with rates of return over a five-year period remaining low.

The oil refining and marketing industry plays a very important role in the UK's economy and growth, supporting the employment of over 150,000 people at refineries, head offices, forecourts and as contractors, and sourcing around 85% of all inland UK fuel demand. Today, our industry collects over £36 billion in fuel duty and VAT each year, which contributes to around 5% of the Exchequer's total receipts.

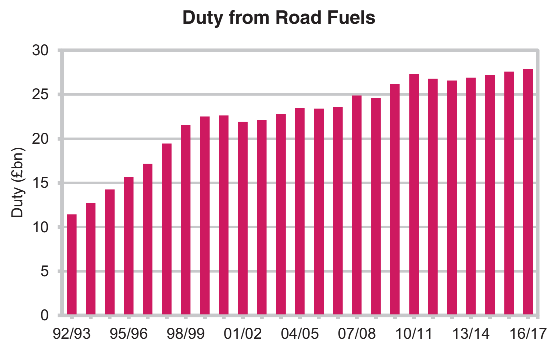
1.1 Average Return on Capital Employed



Source: UKPIA / ONS

- The return on capital employed between 2010-2015 was around 2% for UKPIA members
- Over the same time period, the average return on capital employed for three other comparable industries was approximately 14%, with manufacturing at over 8%, services at just under 15% and upstream at 18%
- Service industries include communications, hotels, catering, distribution, transport and storage

1.2 Duty from Road Fuels

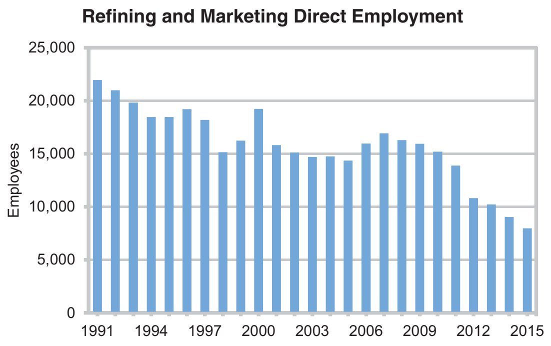


	02/03	04/05	06/07	08/09	10/11	12/13	14/15	15/16	16/17	Change y/y
Duty(£bn)	22.1	23.5	23.6	24.6	27.3	26.6	27.2	27.5	27.9	1.1%

Source: HMT / HRMC

- The 2017 Budget estimates fuel duty receipts for 2016/17 at £27.9 billion. The slight increase from previous years is a result of increased road fuel sales – there was no duty increase in 2016
- In addition to the duty on road fuels, around £8.4 billion was collected as VAT
- This combined figure is around 5% of total public sector current receipts and would cover over 24% of the public sector's total spending on health or 75% of the country's total spending on defence

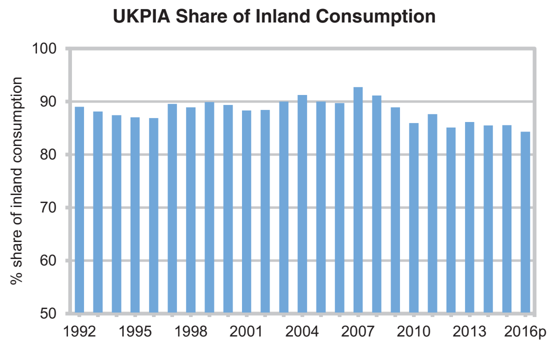
1.3 Refining and Marketing Direct Employment



Source: UKPIA

- The refining and marketing industry is a major employer in the UK, with approximately 8,000 people directly employed by UKPIA members in 2015
- The downstream sector as a whole supports the employment of over 150,000 people in other roles, such as service station staff, contractors and road tanker drivers

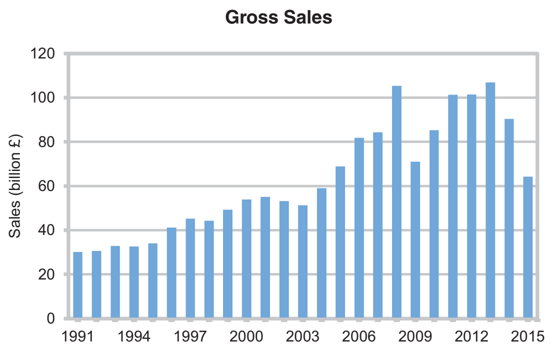
1.4 UKPIA Share of Inland Consumption



Source: UKPIA

- In 2016, around 85% of inland oil consumption in the UK was supplied by UKPIA member companies
- This provided vital energy resilience and security of supply to the nation, along with the provision of high quality fuels at competitive prices
- The UK has consistently some of the lowest pre-tax prices for diesel and petrol in Europe

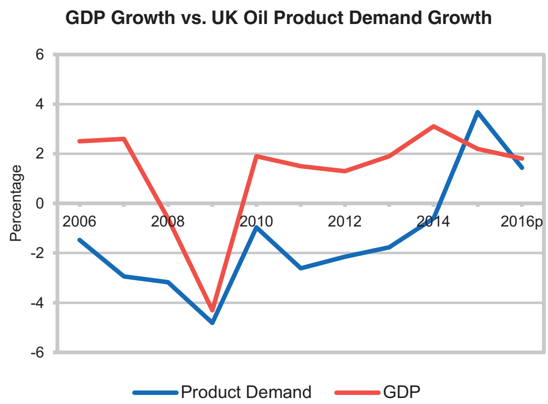
1.5 Gross Sales



Source: UKPIA

- In 2015, gross sales by UKPIA member companies was £64 billion, including duty
- The graph reflects the value of oil during each year

1.6 Annual Oil Trade

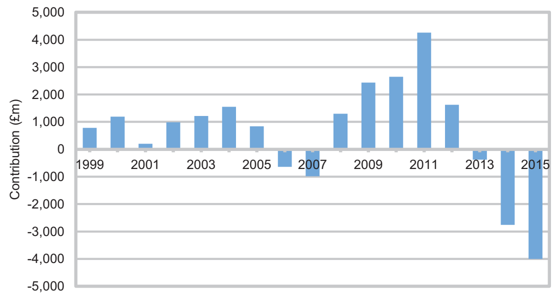


Source: BEIS / ONS

- Oil product demand growth is one of the key indicators to an economy's health, and reflects loosely both cyclical and growth trends
- The impact of the 2008 credit-crisis can be clearly seen from the GDP and product demand growth curve; they indicate a deep recession in 2008 and another downward trend in 2012
- As the economic recovery started to pick up, product demand rose from 2013 and peaked in 2015, also aided by oil price changes

1.7 Contribution to Balance of Payments

Contribution to Balance of Payments from Imports and Exports of Petroleum Products (excluding crude)

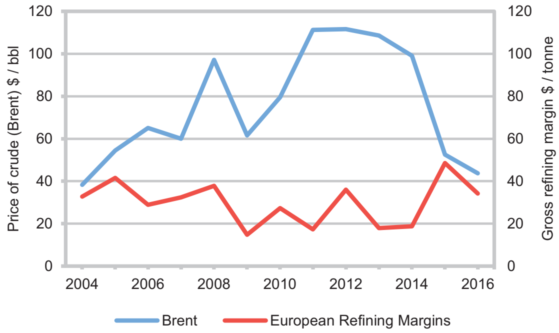


Source: BEIS

- The graph illustrates the net value of imports and exports of refined petroleum products
- Oil refining has historically been a major contributor to the UK's balance of payments
- Even though the UK became a net importer of crude oil in 2005, it remained a net exporter of refined petroleum products. The UK became a net importer of refined petroleum products in 2013
- Compounded by the growing demand for diesel and jet fuel and the closure of two refineries since 2012, the UK has become increasingly reliant on large-scale imports for those products
- Exported oil products, on the other hand, are heavily dependent on international markets. The UK remains a net exporter of petrol
- Oil products will remain central to the nation's energy needs for decades to come, alongside a developing role for alternative fuels and energy sources

1.8 Regional Refining Margins

European Gross Refining Margin Indicator and Price of Brent



Source: Total Ltd 'European Refining Margin Indicator' (ERMI)

- The refining margin is the difference between cost of crude purchased and value of product sales. This element is needed to cover fixed costs of operator and maintenance, as well as to remunerate capital
- The underlying trend for European refining margins over the last decade has been cyclical
- The Total European Refining Margin Indictor (ERMI) is an indicator intended to represent the margin after variable costs for a hypothetical complex refinery located in Northern Europe that processes a mix of crude oil and other inputs commonly supplied to this region to produce and market the main refined products at prevailing prices in this region

2. Refineries

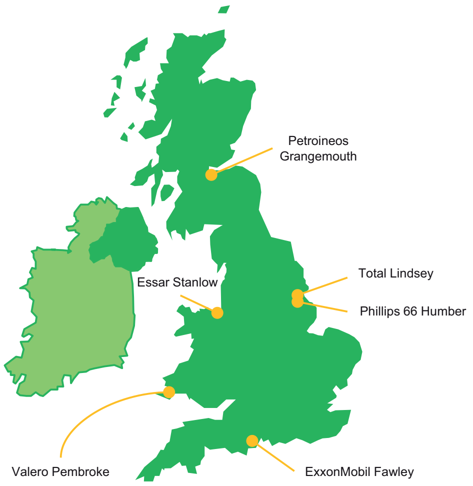
There are six major crude oil refineries operating in the UK, situated around the coast for ease of crude tanker access. Onwards distribution is achieved via an extensive pipeline system plus road, rail and sea transport.

Around 60% of the UK's crude feedstock is low sulphur crude from the North Sea, of which 17% from the UK Continental Shelf*. Europe remains the largest region from which the UK imports crude oil, with Norway continuing to be the single largest source at 42% of total imports. Crude oil imports from Africa have increased steadily over the past ten years a now account for over 26% of all imports.

The majority of oil products processed at UK refineries is consumed in the UK. Demand for petroleum products grew in 2016 to 69 million tonnes, an increase of 1.5% from the previous year. UK refinery production fell to just over 60 million tonnes of product, down 20% from 2011, principally owing to lost production from the closure of the Coryton refinery in 2012 and the Milford Haven refinery in 2014 and capacity reductions. This has meant that the total volume of petroleum products imported into the UK is increasingly higher than the volume exported. The UK became a net importer of petroleum products in 2013, making it a net importer of all fossil fuels for the first time.

** BEIS - 2015 data*

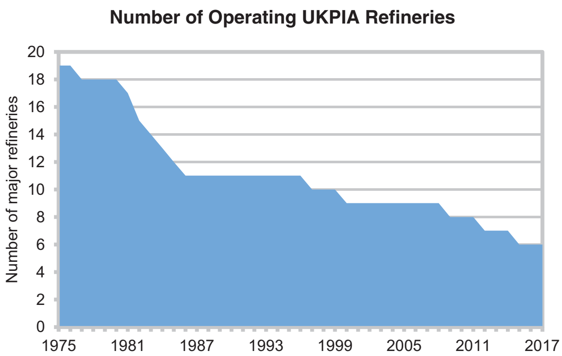
2.1 UK Refineries



Source: UKPIA

- There are six major crude oil refineries operating in the UK which supply the bulk of the inland market demand for petroleum products
- The refineries are situated around the coast and most are connected to pipelines for product distribution

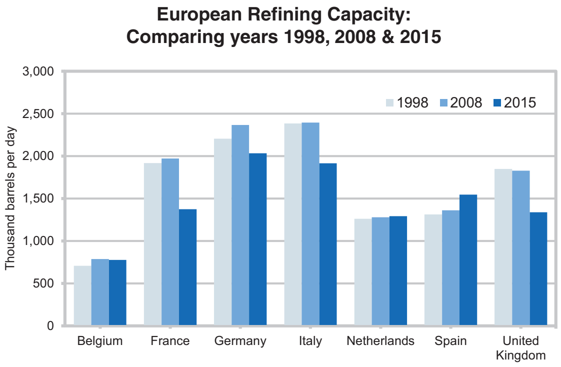
2.2 Number of Refineries



Source: UKPIA

- The number of major oil refineries in the UK has fallen from a high of 19 in 1975 to 6 currently in operation
- There is one smaller speciality refinery in the UK producing bitumen
- Two refineries have closed since 2012. The Petroplus Coryton refinery closed in June 2012 and the Murco Milford Haven refinery ceased operation in December 2014

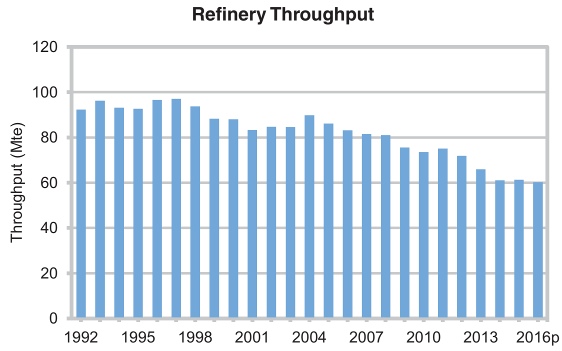
2.3 European Capacity



Source: BP Statistical Review of World Energy 2016

- The UK's refining capacity has declined in recent years due to refinery rationalisation and closures
- It now has the fifth largest refining capacity in Western Europe, with total refining capacity at approximately 1.3 million barrels per day
- Western European refining capacity has seen a steady decline, reducing from over 16 million barrels per day in the 1980s to 10.3 million in 2015
- France has seen a capacity reduction of about 30% in the past ten years, Germany's capacity has declined by 14% and Italy's by over 23%

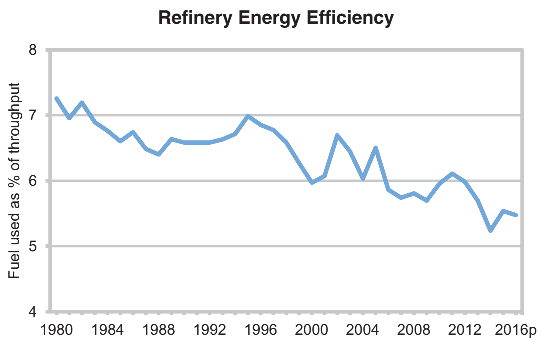
2.4 Refinery Throughput



Source: BEIS

- Since the refinery closures in 1997, 1999, 2009, and most recently in 2012 and 2014, UK refining throughput has fallen from a peak of 97 million tonnes of crude oil in the late '90s to 60 million tonnes in 2016
- Over the past 7 years, UK refining throughput has been on a downward trend, partly due to the economic recession, as well as refinery closures and capacity reductions
- Throughput depends on product demand, capacity and other factors, such as timing of maintenance shutdowns

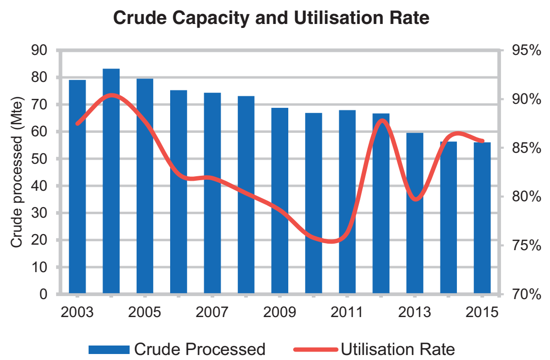
2.5 Refinery Energy Efficiency



Source: BEIS

- Refineries use a small percentage of throughput as fuel to provide energy to refine crude oil into products for consumers
- Fuel use by refineries continues to be on a downward trend
- More energy is required to meet the current high demand for cleaner transport fuels and to meet challenging environmental standards, but this has been offset by improved energy efficiency at refineries

2.6 Crude Capacity and Utilisation

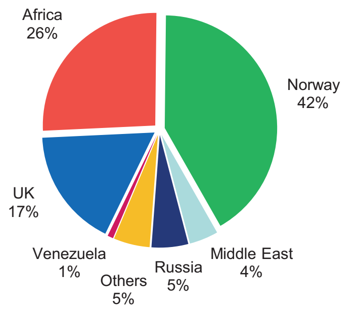


Source: BEIS

- The capacity utilisation rate is the proportion of total production capacity which is actually being utilised over a specific period of time
- Crude oil capacity utilisation rate is equal to crude oil processed, divided by primary distillation capacity
- UK refineries in 2015 had a combined utilisation rate of 86%

2.7 Sources of Crude Oil

Sources of Crude Oil 2015



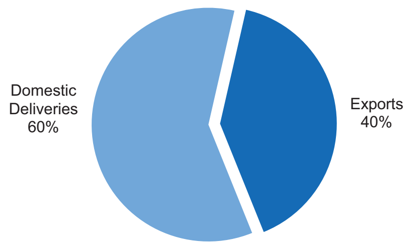
ktonnes	2005	2007	2009	2011	2013	2014	2015	change y/y
Ind. Prod.	84,721	76,575	68,199	51,972	41,101	40,328	45,698	13%
Imports	58,885	57,357	55,002	58,092	58,967	53,638	50,480	-6%
Exports	54,099	50,999	45,351	33,625	33,105	30,869	33,660	9%

Source: BEIS

- Following years as a net exporter of crude oil, the UK became a net oil importer in 2005. Production from UK oil fields peaked in the late 1990s and has generally declined over the past several years. However, output from the UKCS rose in 2014 and 2015. Much of the increase is attributable to new fields coming online
- Currently, around 5% of crude oil imported to the UK arrives from Russia, and 4% from the Middle East. The latter represents a large increase relative to an average of 1% of previous years
- Imports from Africa have risen considerably since 2004 from 3% to 26% today

2.8 Destinations of Oil Products

Destinations of Oil Products 2016



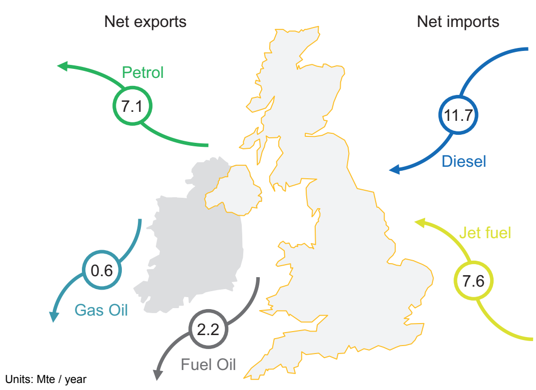
ktonnes	2010	2011	2012	2013	2014	2015	2016	change y/y
Exports	26,065	27,800	29.904	26,910	22,748	22,835	24,290	6.4%
Imports	23,665	22,656	26,207	28,418	29,093	31,918	35,131	10.1%
Inl. Deliv.	66,295	64,243	63,048	62,397	62,554	64,771	65,849	1.7%

Source: BEIS (provisional data)

- The majority of oil products processed at UK refineries is consumed in the UK market – approximately 60%
- The total volume of petroleum products imported into the UK is increasingly higher than the volume exported. The UK became a net importer of petroleum products in 2013, making it a net importer of all fossil fuels for the first time. Petroleum product imports in 2016 increased by 10% compared to the previous year
- The EU and US are the main destination for UK oil product exports. The US, in particular, represent a considerable portion of UK's excess petrol exports

2.9 UK Net Product Flows

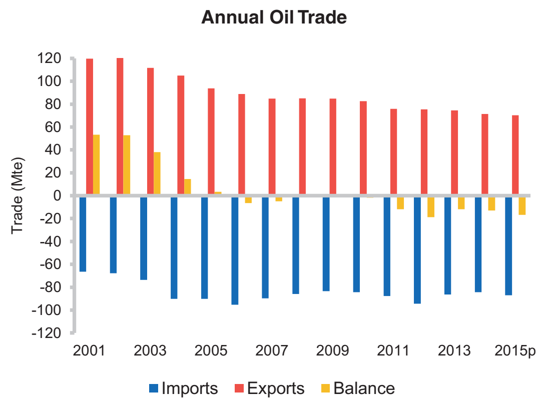
UK Net Product Flows 2016



Source: BEIS, DUKES (Table ET 3.4, imports vs. exports)

- These are net product flows; they represent the overall import and export balance of the various grades shown
- UK refineries, in common with those in the EU, were configured predominantly to produce petrol and therefore have a mismatch between domestic production and demand
- Fiscal policy in the EU has driven up demand for diesel and demand for air transport has also increased aviation fuel use
- Consequently, the UK has a deficit of aviation fuel and diesel, whilst it exports surplus petrol and fuel oil

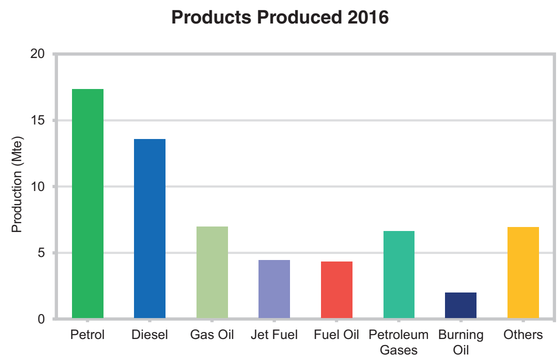
2.10 Annual Oil Trade



Source: BEIS

- The chart illustrates UK's annual trade; imports and exports of crude oil and petroleum products
- The negative imbalance in trade from 2006 has largely been a result of increased imports and a decrease in exports of crude oil; a consequence of depletion of the UK continental shelf
- The petroleum products balance has also shifted. A growing demand for diesel and aviation fuel has led to an increase in imports for these fuels, whilst exports of fuel oil have declined and exports of petrol have increased

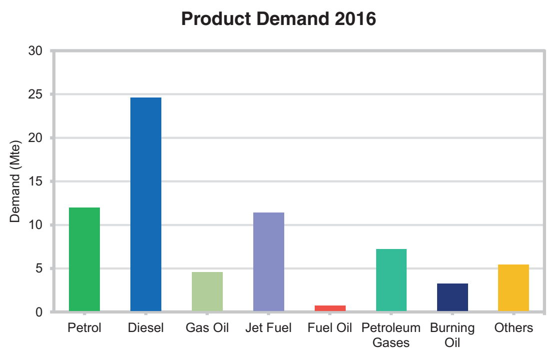
2.11 Products Produced



Source: BEIS (provisional data)

- UK refineries are configured to meet historically higher demand for petrol and fuel oil
- As a result of a reducing demand of these products, refineries now produce an excess of petrol and fuel oil and are in deficit in others, such as jet fuel and diesel
- Changing refinery production to meet demand will require major investment
- For more information, refer to the IHS Purvin & Gertz report *'The Role and Future of the UK refining Sector':* www.ukpia.com/publications.aspx

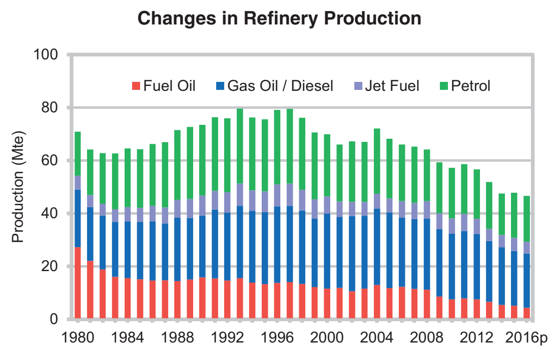
2.12 Product Demand



Source: BEIS (provisional data)

- The majority of oil product demand comes from the transport sector
- UK refineries do not produce enough jet fuel or diesel. Consequently, these are increasingly supplemented by imports to meet demand

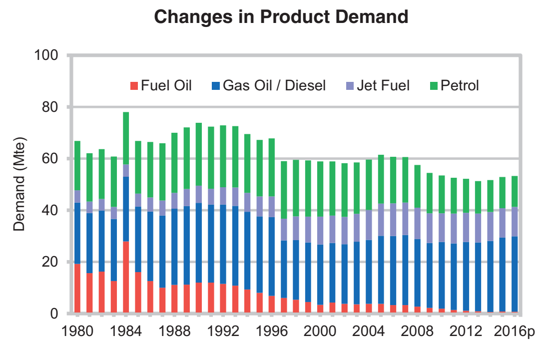
2.13 Changes in Refinery Production



Source: BEIS

- The major change in refinery production over the last forty years has been a significant reduction in the quantity of fuel oil produced
- Middle distillate (gas oil/diesel and jet) production share, at about 54%, is higher than ever before, whilst the production share of fuel oil has greatly reduced

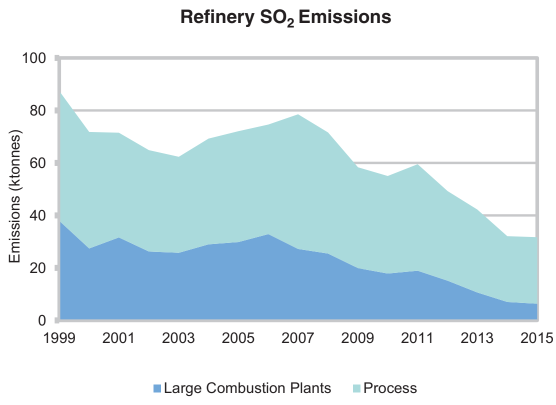
2.14 Changes in Product Demand



Source: BEIS

- The major change in product demand since 1979 has been the decline of the fuel oil market - natural gas replacing fuel oil for power generation and gas oil for space heating - and the growth of transport fuels
- Since 1990 demand for petrol has almost halved, whilst jet fuel has seen demand rise by over 70%
- Overall demand has grown slightly in the past three years, following a downward trend over the previous eight years, linked in part to the economic crisis which affected nearly all categories of oil product consumption, except diesel which has remained virtually flat

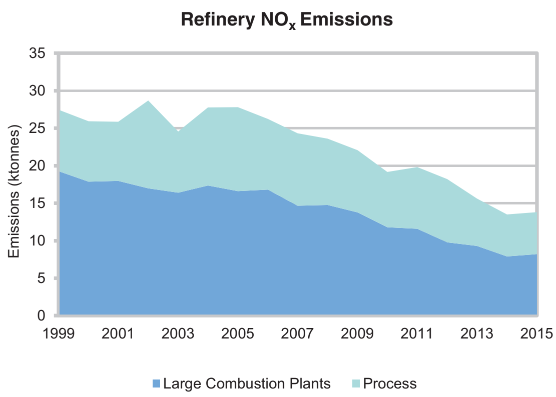
2.15 Refinery SO_2 Emissions



Source: NAEI

- Refineries release SO_2 from process units and the combustion of refinery fuels containing sulphur in furnaces and boilers (large combustion plants, LCPs)
- Refinery SO_2 emissions declined by 56% between 2005 (the baseline year for the National Emissions Ceiling Directive) and 2015
- This reduction has been achieved through capacity reduction, fuel switching (heavy fuel oil to gas) and investment in gas-fired CHP power generation and additional sulphur recovery

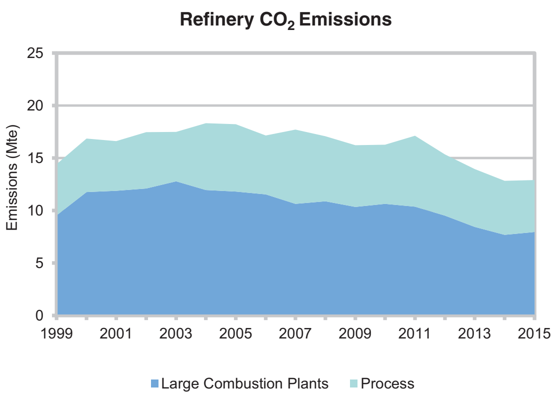
2.16 Refinery NO_x Emissions



Source: NAEI

- NO_X is formed mostly from nitrogen present in air when fuels are burnt at higher combustion temperatures
- Refinery NO_X emissions declined by 50% between 2005 and 2015, largely due to capacity reduction (including 3 refinery closures), fuel switching in refinery combustion plants and investment in low- and ultra-low NO_X burners

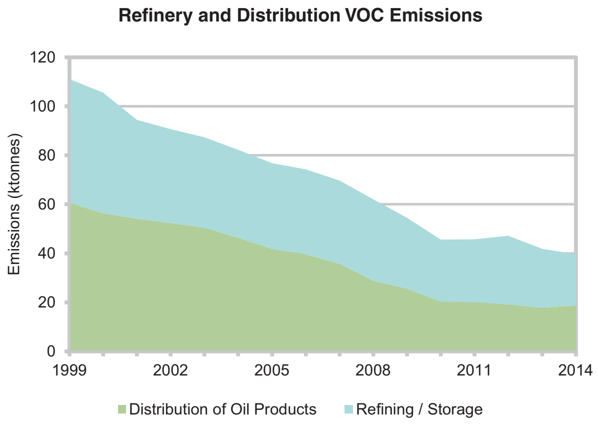
2.17 Refinery CO_2 Emissions



Source: NAEI

- Refineries contribute around 2.5% of the UK's CO_2 emissions and are subject to regulation under the EU Emissions Trading Scheme
- Although it takes more energy to both manufacture low sulphur fuels and upgrade fuel oil to distillate, refinery CO_2 emissions continue to decrease as a result of refinery closures and investment in improved energy efficiency (including CHP power generation)

2.18 Refinery and Distribution VOC Emissions



Source: NAEI

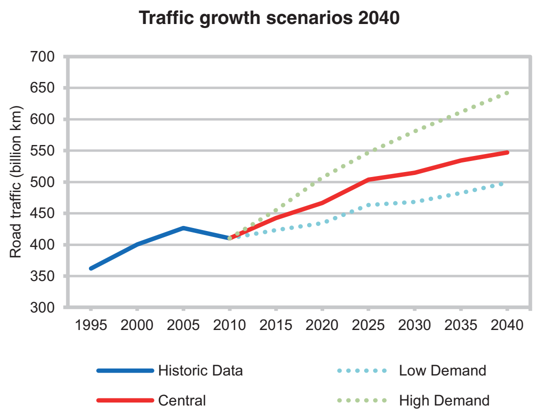
- Volatile organic compounds are produced from the evaporation of oil products
- The historical data shows a marked and continuing downward trend in downstream VOC emissions
- The reduction in NMVOC (Non Methane Volatile Organic Compounds) emissions has been achieved following investment in improved sealing and vapour recovery equipment at storage and loading/unloading facilities and at many of the higher throughput filling stations

3. Road Transport Fuels

Although there was a reduction in overall transport fuel demand during the severe economic downturn that began in 2008, road fuel sales have recovered slightly over the past three years.

Diesel demand has increased steadily over the past thirty years and diesel now accounts for over 64% of total road fuel sales. This is part of a European-wide trend, which has been largely fiscally driven. As a result of the marked rise in popularity of diesel vehicles and the increased growth in freight transport, diesel sales in the UK set a new record of 29.4 billion litres in 2016. Unlike the rest of Europe, the UK has been comparatively late to the dieselisation process; in 2004, petrol sales where 4 billion litres greater than those of diesel, whilst annual registration of new diesel vehicles was still only one third of the total vehicle fleet. This relatively slow uptake is mostly a result of the lack of any tax advantage for diesel which, in the UK, is taxed at the same rate as petrol. However, with the advances achieved in diesel engine performance leading to improved fuel efficiency relative to petrol, combined with changes in company car personal tax policy and VED rates, consumers in recent years increasingly favoured diesel cars. 2016 saw an increase in both diesel and petrol registrations, with diesel fuelled vehicles commanding 47.7% of market share and petrol vehicles 49%. The balance is made up of LPG, other gas and electric vehicles (EVs).

3.1 Demand for Road Travel

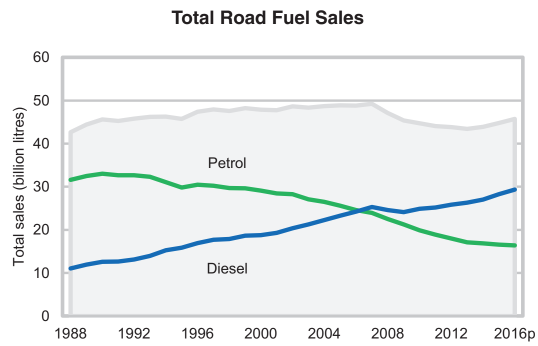


Source: DfT, Road Traffic Forecast 2015

- Road travel demand has been on an upward trend for decades and, despite a flattening in growth during the recession, demand is forecast to increase in the future
- However, due to advances in engine efficiency, this trend is not reflected in product demand
- By 2035, central demand is predicted to grow by over 50% from 1995 levels

** Latest available data*

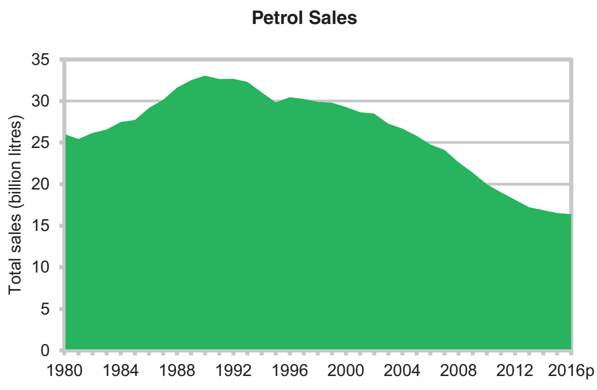
3.2 Road Fuel Sales



Source: BEIS

- Whilst total road fuel sales have remained virtually flat, demand dropped by 11% between 2007 and 2014 due to a combination of higher prices - driven by the cost of crude oil - and the economic recession
- Since then, road fuel sales have grown at an annual average rate of 2%
- In 2016, diesel demand grew by just under 4%, while petrol demand remained virtually flat compared to the previous year
- Diesel currently accounts for over 64% of total road fuel sales

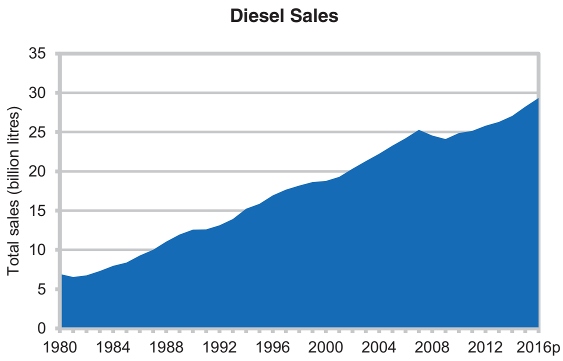
3.3 Petrol Sales



Source: BEIS

- Sales of petrol have been falling since reaching a peak of 33 billion litres - equivalent to 73% market share - in 1990
- Today, sales of petrol have fallen to 16.4 billion litres
- During the economic downturn, the average annual decline rate doubled to over 5% per annum, but it has slowed since then

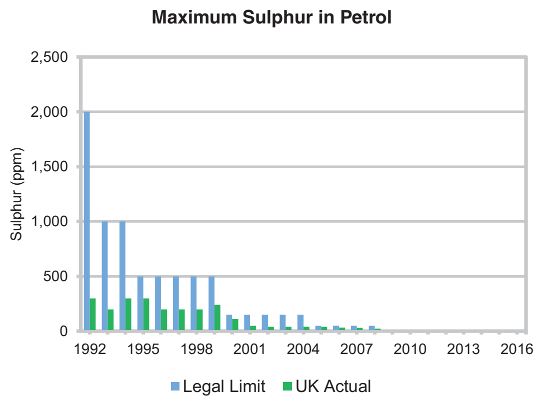
3.4 Diesel Sales



Source: BEIS

- Sales of road diesel have been increasing steadily, with demand exceeding 29 billion litres in 2016
- This is due to a marked rise in the popularity of diesel vehicles during the past decade and growth in freight transport
- Barring a short decline period in 2008 and 2009, diesel has seen an average annual growth rate of 4% in the last three decades

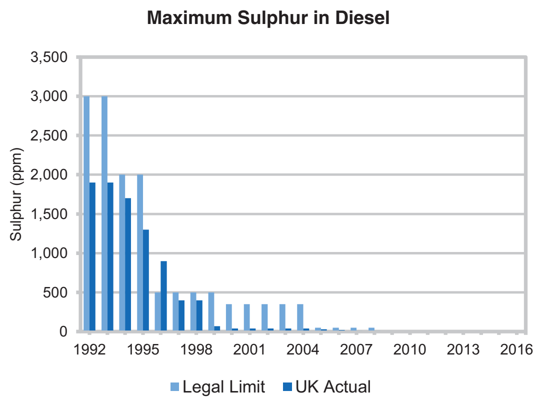
3.5 Maximum Sulphur in Petrol



Source: BSI / UKPIA

- The level of sulphur in road fuels is limited by the Fuel Quality Directive (FQD) 2009/30/EC
- Since the start of 2009, all UK petrol has been sulphur-free (10ppm or less)

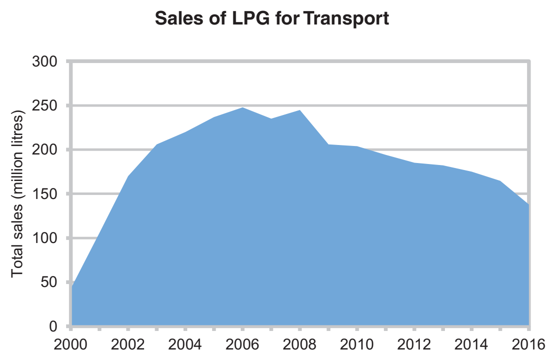
3.6 Maximum Sulphur in Diesel



Source: BSI / UKPIA

- The level of sulphur in diesel is also limited by the FQD. Since the start of 2009, all UK diesel has been sulphur-free (10ppm or less)

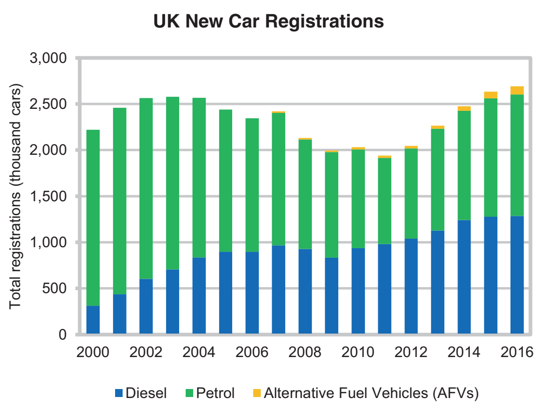
3.7 Sales of LPG for Transport



Source: HMRC

- As well as petrol and diesel, liquefied petroleum gas (LPG) is used as a road fuel in the UK
- Sales of LPG rose rapidly between 2000 and 2006 based on a favourable duty incentive, a conversion grant scheme and favourable treatment under the London Congestion Charge
- However, the removal of the grant scheme and gradual reduction in the duty differential between LPG and standard fuels has impacted the sale of LPG/petrol cars. For this reason, sales of LPG have continued to decline from a peak of 248 million litres in 2006 to 138 million litres in 2016

3.8 UK New Car Registrations



Source: SMMT

- 2016 set a new record in car registrations in the UK with a total of 2.69 million new registered vehicles, up 2.3% on the previous year
- Diesel and petrol cars continue to be by far the most popular fuel types, with diesel fuelled vehicles commanding 47.7% of market share and petrol vehicles 49%. The balance is made up of LPG, other gas and EVs

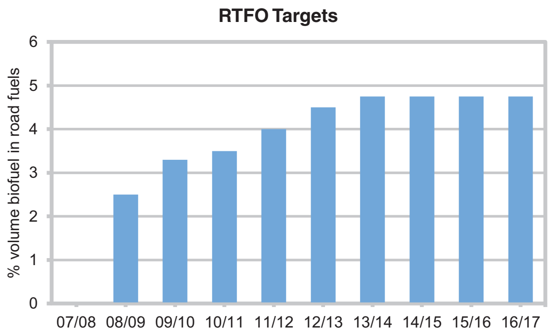
4. Biofuels

The European Biofuels Directive (2003) first set EU Member States a target of 5.75% energy used in transport by 2010. This was followed by the Renewable Energy Directive (RED) (2009/28/EC) which requires Members States to meet 10% of transport energy from renewable sources by 2020. Under the Fuel Quality Directive (FQD) 2009/30/EC fuel suppliers are required to reduce the carbon intensity of transport fuels by 6% in 2020, when compared to a 2010 baseline. In 2015, the European Commission amended both the RED and FQD to cap the volumes of biofuel produced from crops and cereals, due to concerns about indirect land use change (ILUC). These amendments are due to be transposed to UK national law during 2017.

The UK's 2007 Renewable Transport Fuels Obligation Order (RTFO) was amended in December 2011 to transpose the transport elements of the RED and allow only biofuels that meet the RED carbon and sustainability criteria to count toward the obligation. It was extended in 2013 to include fuel consumed by Non-Road Mobile Machinery (NRMM) and is due to be amended again in 2017.

About one-quarter of the UK's greenhouse gas emissions come from the transport sector and the transition to a low carbon model has been particularly challenging. An enormous amount of work has been undertaken by the downstream oil industry to ensure that the Government's targets are met under the RTFO and that fuel quality standards are maintained.

4.1 RTFO Targets

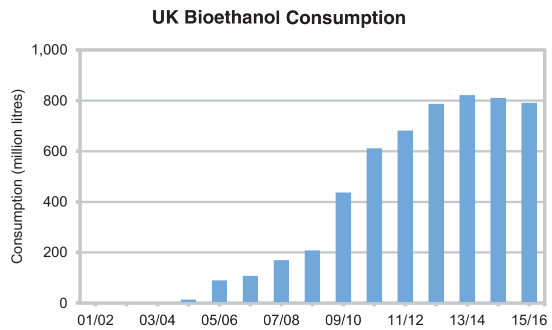


**from 2014 April, 4.75% petrol, diesel and NRMM*

Source: HMT

- The RTFO was introduced in April 2008, with an original target of 5% biofuel content (by volume) in road fuels by 2010/11
- This was revised due to sustainability concerns. The targets for the biofuel content of road fuels were 4.5% for 2012/13, and 4.75% for 2013/14 and 2014/15
- From April 2013, the RTFO included NRMM in the obligation
- For the year commencing in April 2017, the target remains at 4.75% volume
- The DfT consulted on the future RTFO obligation level (closed in February 2017), and will announce the trajectory to 2020 later in the year

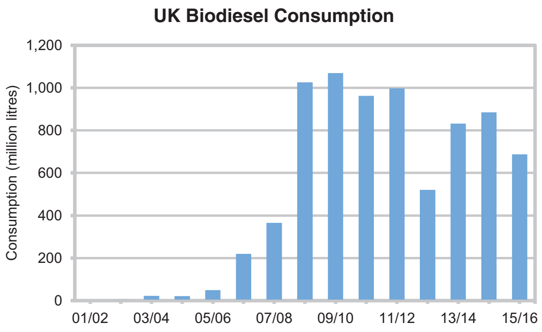
4.2 UK Bioethanol Consumption



Source: HMRC

- Between January 2005 and March 2010, the Government introduced a 20 pence per litre duty reduction on bioethanol
- The duty differential of 20 pence per litre was removed in 2010
- In 2015/16, UK bioethanol consumption stood at a little under 800 million litres, which represents around 4.6% of all petrol sales by volume
- There are other renewable petrol fuels which obligated companies use to meet their targets, such as methanol
- The buyout price in the RTFO is set at 30 pence per litre

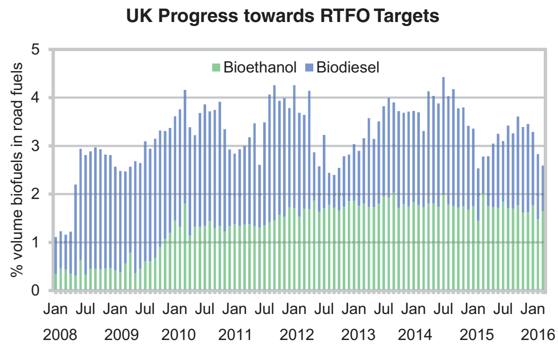
4.3 UK Biodiesel Consumption



Source: HMRC

- Between July 2002 and March 2010, the Government introduced a 20 pence per litre duty reduction on biodiesel
- The duty differential of 20 pence per litre was removed in 2010
- In 2012/13, UK biodiesel consumption fell to around 520 million litres from previous year's 992 million litres as a result of fuels derived from waste oil being used to fulfil the RTFO obligation, which in fact account for twice the value of regular biofuels
- Consumption increased again in 2013/14 and 2014/15, but fell again in 2015/16 to 687 million litres, representing around 2.3% of total diesel sales by volume
- The buyout price in the RTFO is set at 30 pence per litre

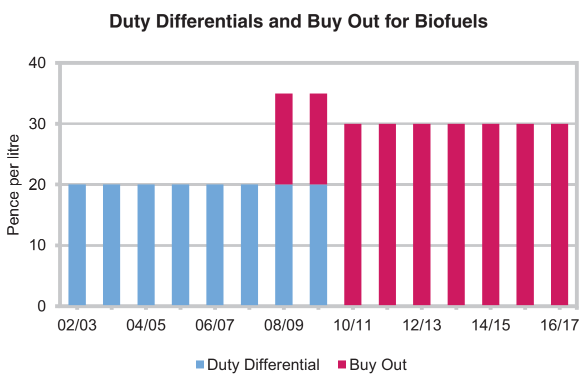
4.4 UK Progress towards RTFO Targets



Source: HMRC

- The UK added 2.6% volume of biofuels during the first year of the RTFO (2008/09), exceeding the RTFO target of 2.5%
- In the 2nd year of the RTFO (2009/10), the UK again met its target of 3.25% of biofuels
- In the 2011/2012 period, biofuel use increased to 3.7% of total road transport but fell below 3% in year 4 as a result of fuels derived from waste now double counting.
- In the last accounting period (April 2015 – March 2016), volumes were again reaching an average of 3.17% volume when averaged over the petrol and diesel fuel volume

4.5 Duty and Buy Out for Biofuels

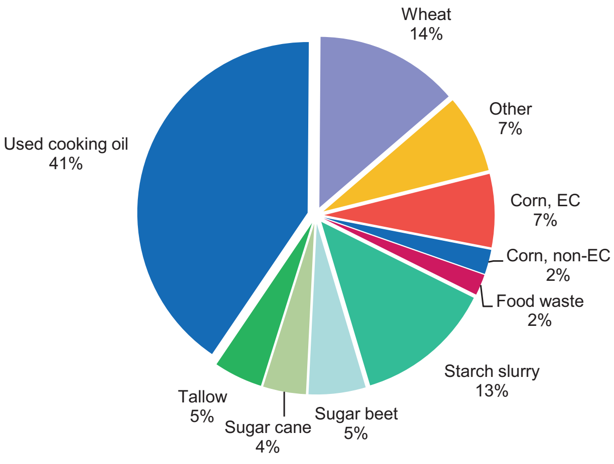


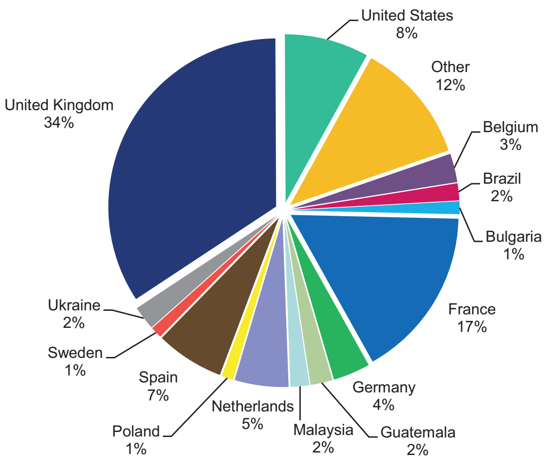
Source: HMT

- A duty differential of 20 pence per litre had been in place for biodiesel since 2002 and for bioethanol since 2005
- In addition, a 'buy out' price for the RTFO was introduced at 15 pence per litre in 2008/09, giving a combined incentive of 35 pence per litre
- The duty differential was removed in 2010*, with the buy out price at 30 pence per litre
- The buy out price is an alternative compliance mechanism in case the fuel supplier is unable to add the full volume of biofuel, required by the RTFO, to the final blend

** Except for cooking oil where the duty differential of 20 pence per litre remained until April 2012*

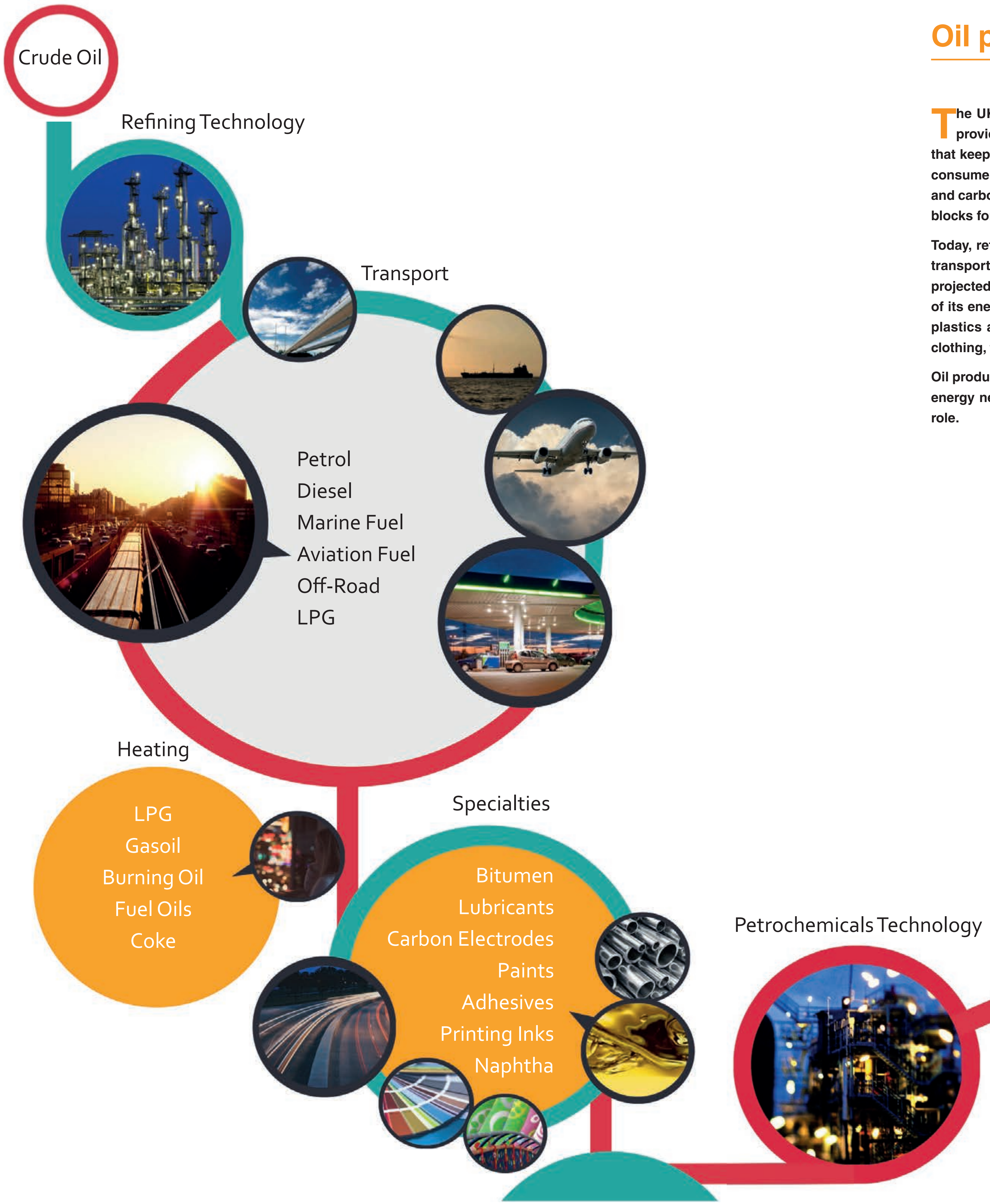
4.6 Sources of Biofuels used in the UK

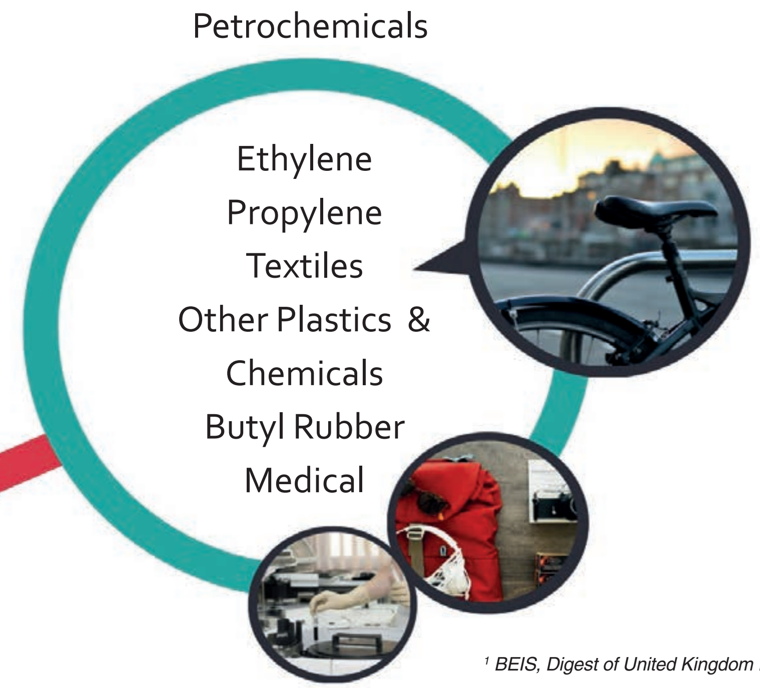




Source: DfT (covering period 15th April 2016 - 14th April 2017)

- Around one-third of biofuels used in the UK are domestically produced
- The second single largest source of biofuels is from France
- Ethanol is mostly sourced from sugar beet, wheat and sugarcane
- Biodiesel is mostly sourced from used cooking oil





Oil products power our lives and fuel innovation

The UK downstream oil sector plays a pivotal role in powering our mobility, fuelling our economic engine and providing value to our everyday lives by supplying the transportation fuels that keep us moving, the heating fuels that keep us warm and the feedstocks that other industries rely on to manufacture hundreds of thousands of other consumer products. From lubricants, petrochemicals and heating fuels, to road and construction, paints and solvents, and carbon electrodes for the aluminium sector, the downstream oil industry is responsible for providing the building blocks for the many products that are fundamental to the way we live today and for future innovations.

Today, refined oil products provide for more than one-third of the UK's primary energy needs[1], power 96%[2] of our transportation and supply close to 70%[3] of the raw material for the chemical industry. To 2035 and beyond, this is projected to change very little. The transportation sector in the UK will still rely on petroleum products for about 90%[4] of its energy needs and the chemical sector will continue to rely on petrochemical feedstocks for the production of plastics and polymers used in everything from medical equipment and pharmaceutical products, cosmetics and clothing, to computers, wind turbines and solar panels.

Oil products touch our daily lives in countless ways and the downstream oil sector's ability to continue powering our energy needs and fuelling our future rests upon an energy and industrial strategy that recognises its fundamental role.

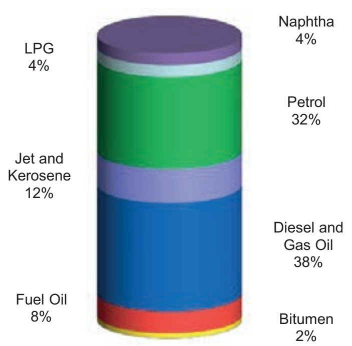
[1] *BEIS, Digest of United Kingdom Energy Statistics (DUKES), 2016*
[2] *Ibid.*
[3] *Cefic, 2016*
[4] *BEIS, Updated energy and emissions projections (including aviation), 2016*

Centrefold

5. Other Products

A wide range of products are produced from crude oil, ranging from transport and domestic/industrial fuels to chemical feedstocks. Over time, refinery configurations have developed to increase the quantities of high value transport fuels that can be produced. In contrast, the domestic/industrial markets for other fuels have altered markedly over the last twenty years as sales of fuel oil and gas oil have reduced, being displaced in power generation and industrial applications by natural gas.

5.1 Refining Production

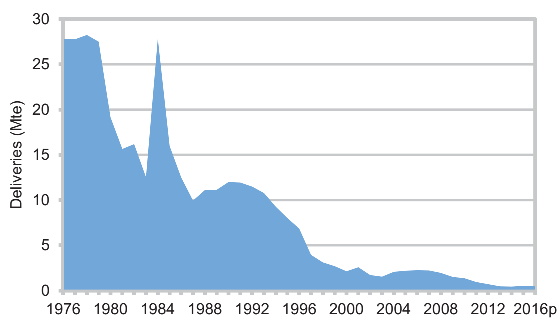


Provisional data for 2016. Excludes refinery fuel use and losses

Source: BEIS

- Refineries produce naphtha, LPG, road fuels, kerosene, jet fuel, heating oil, diesel, gas oil, fuel oil, bitumen and other products such as chemical feedstocks
- The current trend of production is away from heating fuels (fuel and gas oils) and towards transport fuels (petrol, diesel and jet fuel)

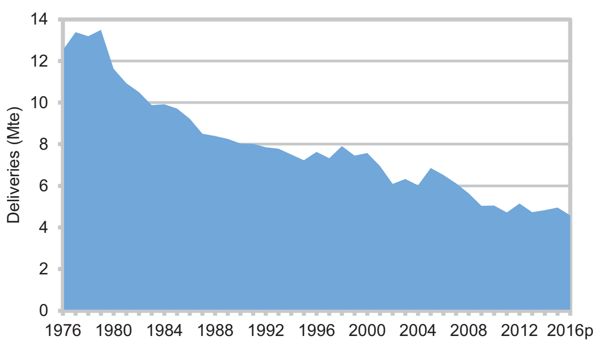
5.2 Fuel Oil Deliveries



Source: BEIS

- The market for fuel oil has reduced significantly since the 1970s – rising only briefly in 1984 due to the miners strike
- The decline in demand is mainly due to a switch to other fuels, such as natural gas, by electricity generators

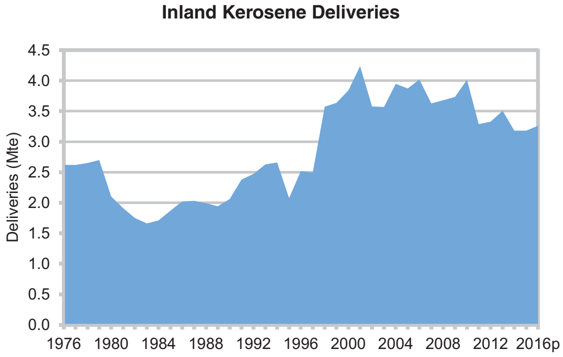
5.3 Gas Oil Deliveries



Source: BEIS

- The UK demand for gas oil has fallen since the 1970s to about 5 million tonnes
- The reduction in demand is mainly due to fuel switching to natural gas for power generation
- Since 2011, all gas oil delivered for Non Road Mobile Machinery (NRMM) is sulphur-free (10ppm or less). Fuel for heating use and stationary engines remains at 1000ppm sulphur maximum

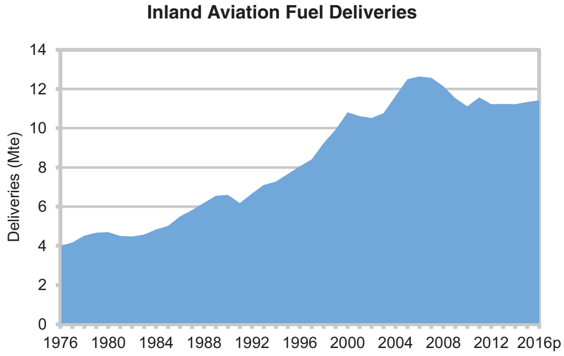
5.4 Kerosene Deliveries



Source: BEIS

- Kerosene (also called burning oil) is used as fuel for domestic and industrial heating, and sales are typically higher during the winter
- Inland sales of kerosene have been declining in recent years
- Deliveries in 2016 rose slightly from the previous year but remain at just over 3 million tonnes
- Since 2008, the maximum allowable sulphur level in kerosene is limited to 1000ppm

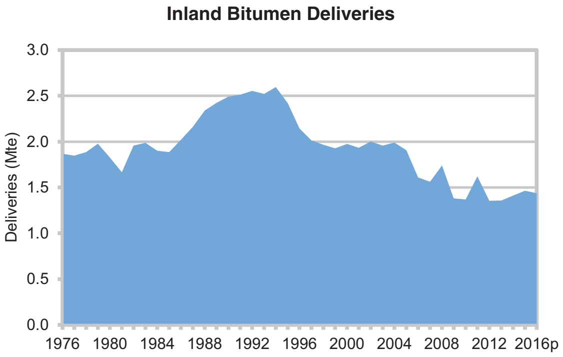
5.5 Aviation Fuel Deliveries



Source: BEIS

- Aviation turbine kerosene is used in jet engines
- Sales of AVTUR rose steadily since the 1970s but remain 11% down on the 2006 peak
- Demand has been consistent in recent years between 11 and 11.5 million tonnes
- This is mainly due to increased engine efficiencies, which have meant that less fuel has been needed

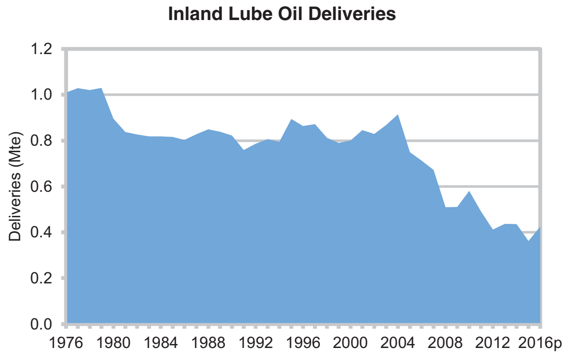
5.6 Bitumen Deliveries



Source: BEIS

- Demand for bitumen has declined to 1.4 million tonnes/pa
- Bitumen is produced from some of the heaviest fractions of crude oil and is mainly used for road surfacing and roofing

5.7 Lube Oil Deliveries



Source: BEIS

- Sales of lubes and greases have more than halved since the 1970s to around 0.4 million tonnes/pa
- Improved engines require fewer oil changes and the use of synthetic lubricating oils has also contributed to this reduction
- The increased use of biodiesel could see oil drain intervals reducing and demand for lubes increasing

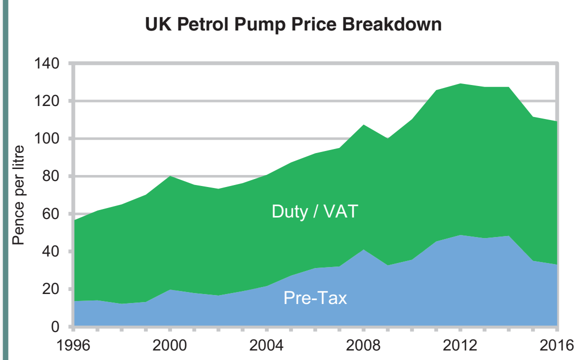
6. Petrol Prices

As a result of the UK's competitive road fuels retail market and efficient distribution facilities, the pre-tax price of major brand petrol in the UK is consistently amongst the lowest in Europe. However, despite this competition, the price paid by consumers at the pump is one of the highest in Europe, due to the higher levels of duty applied by the Government. The retail/ex-refinery price spread on average has been around 7 pence per litre on petrol for most of the last decade.

It should also be noted that data hides variations between remote rural regions and urban areas, in part due to higher transportation costs. The government sought to address this by setting up a pilot scheme to provide a 5 pence per litre fuel rebate for very remote areas. The scheme launched on 1st March 2012 with more than 90 businesses in the Inner & Outer Hebrides, Northern Isles, Islands in the Clyde and Isles of Scilly taking part.

The Rural Fuel Rebate was approved by the European Union in March 2015 - with effect from 31st May 2015 - for 17 of the UK's most rural areas with the highest fuel prices.

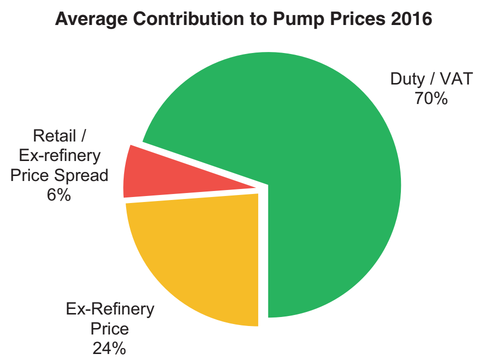
6.1 Petrol Pump Price



** The price of petrol is in money of the day*
Source: Wood Mackenzie

- The price of petrol at the pump has steadily increased over the last 20 years with the exception of some spikes and a most recent fall: a result of crude oil prices falling sharply since mid-2014. Crude oil prices increased slightly in 2016 but remained below 2015 averages
- Consistent growth until late 2013 was due in part to the general rise in crude prices, reflecting increased global demand and regular increases in duty from 2006 up until 2011
- Owing to the fall in crude oil price and duty freeze, petrol pump prices declined on average by 5% in 2016 compared to the previous year

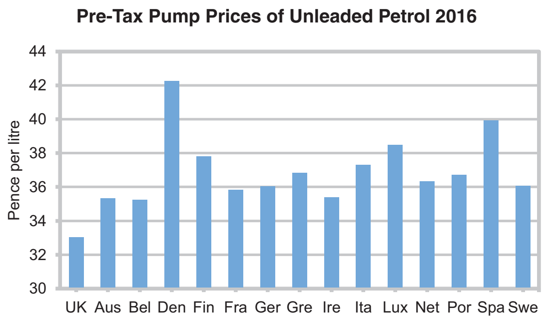
6.2 Average Contribution to Pump Prices



Source: Wood Mackenzie

- Duty and VAT are the main components of the pump price of petrol in the UK, making up 70% of the total
- VAT increased to 20% in January 2011 after a temporary cut to 15% in 2008 and increase to 17.5% in 2010
- Duty was charged at 57.95 pence in 2016
- The average retail/ex-refinery price spread for 2016 was around 7 pence per litre

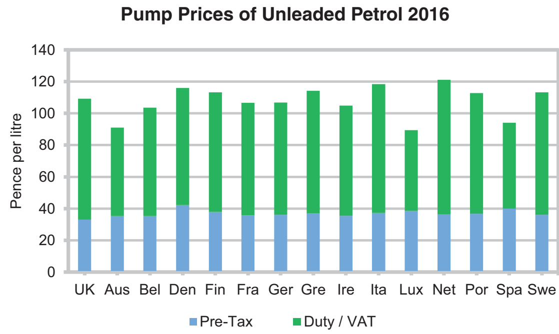
6.3 European Pre-Tax Pump Prices



Source: Wood Mackenzie / BEIS

- In 2016 the UK pre-tax price of major brands of unleaded petrol was again one of the lowest in Europe at 33.04 pence per litre, whilst the average of the 15 major EU countries was 37 pence by comparison
- The low pre-tax price is a result of strong competition among retailers and an efficient fuel distribution network

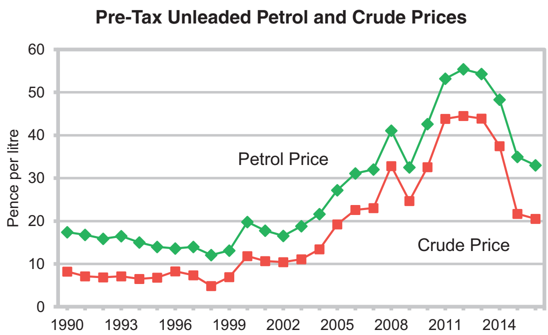
6.4 European Pump Prices



Source: Wood Mackenzie / BEIS

- Whilst the UK pre-tax price of major brands of unleaded petrol was again the lowest compared to 15 major EU countries, the price paid at the pump by UK consumers was considerably higher due to the levels of fuel duty. Duty and VAT, on average, in 2016 amounted to a little over 76 pence per litre

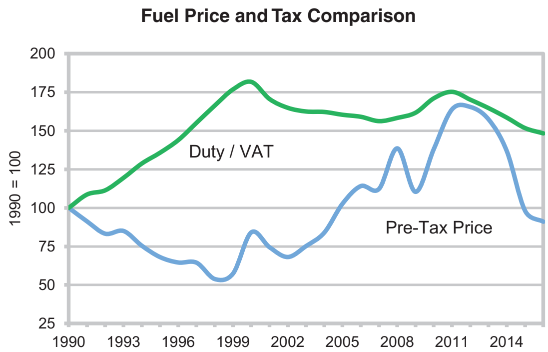
6.5 Pre-Tax Unleaded Petrol and Crude Prices



Source: Wood Mackenzie

- The pre-tax price of petrol is related to the cost of crude oil
- The effect of crude prices on the final pump price is lessened by the high levels of fuel duty
- The £/$ exchange has a significant influence on fuel prices

6.6 Fuel Price and Tax Comparison



Source: Wood Mackenzie / ONS

- The pre-tax price of petrol increased from 2005 to 2014 relative to 1990 levels, having remained below RPI adjusted 1990 prices until 2005. However, it decreased sharply in 2015 and in 2016 it fell below RPI adjusted 1990 prices
- Duty and VAT steadily increased relative to 1990 levels throughout the '90s, until they were effectively frozen following protests in September 2000
- They have recently risen again and continue to show a greater increase over the past 19 years than the pre-tax price. 2010 saw the largest growth since 1999
- Since 2013, duty was effectively frozen, with VAT only increasing the tax curve, while pre-tax prices have been declining due to falling crude prices since mid-2014

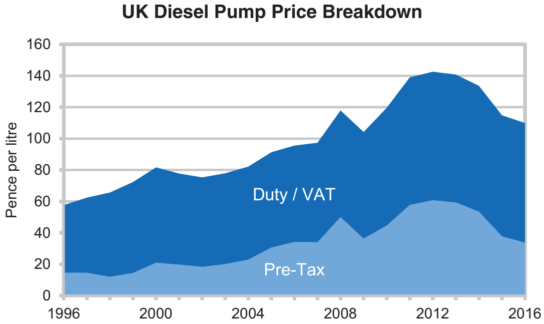
7. Diesel Prices

The UK road fuels retail market is highly competitive and distribution facilities are efficient; consequently, the pre-tax price of major brand diesel in the UK is consistently amongst the lowest in Europe. Despite this competition, diesel prices at the pump remain the highest in Europe, with a much larger share of the price taken up by tax compared to other European markets.

The UK, unlike other European markets, does not tax diesel at a lower rate than petrol. This results in diesel prices being slightly higher compared to petrol – primarily driven by UK supply/demand pressures. Nonetheless, as briefly discussed in Chapter 3, diesel demand has continued to gain market share since the late '90s, partly as a result of the fuel efficiency advantage of diesel engines over petrol.

However, with improvements in petrol engine efficiency continuing to catch up with that of diesel, forecasting the current 'dieselisation' trend long-term is difficult, particularly as the growing drive for a reduction in carbon emissions from transport will increasingly result in tax levels becoming more aligned with vehicle carbon emission levels, and most likely lead to a marginal increase in the attraction of smaller capacity petrol fuelled vehicles. For these reasons, along with emerging air quality arguments, analysts contend that the growth in diesel's market share will slowly cease and reach a peak in 2017, followed by a gradual reversal in trend.

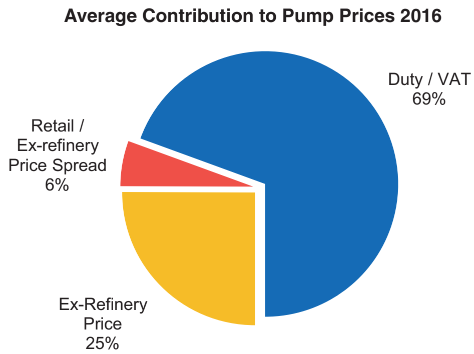
7.1 Diesel Pump Price



**The price of diesel is in money of the day*
Source: Wood Mackenzie

- The price of diesel at the pump has steadily increased over the last 20 years, with the exception of some spikes in 2008 and 2011 (as a direct consequence of crude oil prices reaching record levels and duty/VAT increasing sharply) and a most recent fall. The recent fall in diesel pump prices is due to crude oil prices declining sharply since mid-2014. Crude oil prices increased slightly in 2016 but remained below 2015 averages
- Diesel prices had grown at quite a considerable rate, averaging over 11% between the end of 2009 and 2012 due to rising crude oil prices and supply/demand pressure
- In 2016 diesel pump prices declined on average 4% compared to 2015

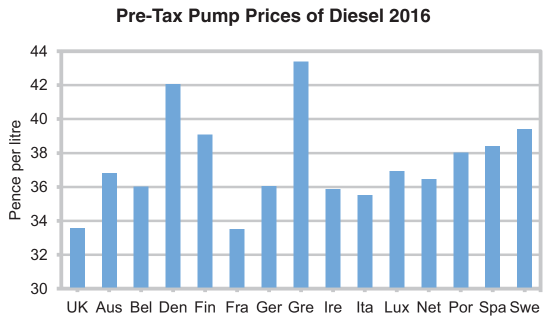
7.2 Average Contribution to Pump Prices



Source: Wood Mackenzie

- In 2016 duty and VAT represented 69% of the pump price of diesel in the UK
- The retail/ex-refinery price spread was a little over 6 pence per litre
- From this, the oil company and retailer must cover all site, distribution and storage expenses

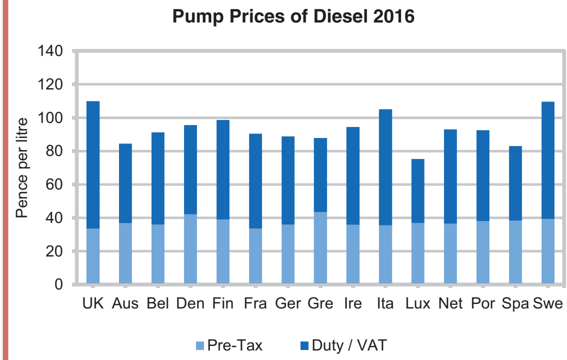
7.3 European Pre-Tax Pump Prices



Source: Wood Mackenzie / BEIS

- In 2016, the UK once again had one of the lowest pre-tax diesel prices in the EU; about 4 pence lower compared to the average
- The low UK pre-tax price is a result of strong competition amongst retailers and an efficient fuel distribution network

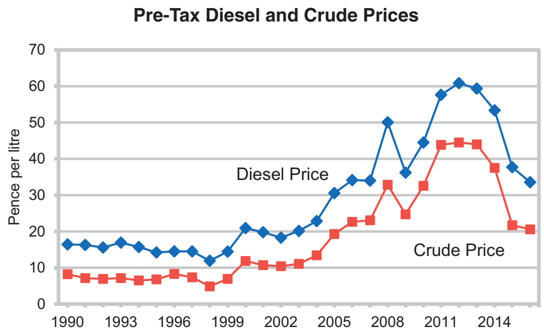
7.4 European Pump Prices



Source: Wood Mackenzie / BEIS

- The final pump price of major brand diesel in the UK was the highest compared to other major European countries in 2016, reflecting the high level of duty paid on fuel in the UK
- The UK is the only major European country to apply the same duty rate to diesel and petrol
- The rate of duty on diesel is lower than that on petrol in all European countries except for the UK and Switzerland

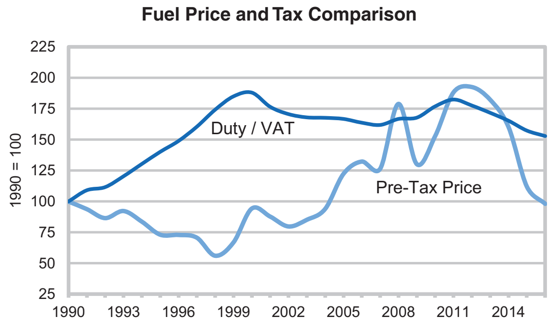
7.5 Pre-Tax Diesel and Crude Prices



Source: Wood Mackenzie

- The pre-tax price of diesel is closely related to the price of crude oil
- The £/$ exchange is a key factor in determining fuel prices

7.6 Fuel Price and Tax Comparison



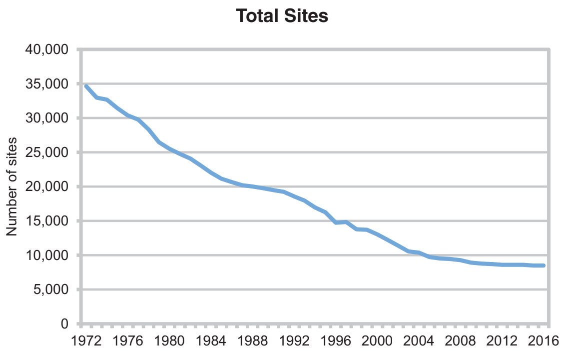
Source: Wood Mackenzie / ONS

- The pre-tax price of diesel increased relative to 1990 levels in 2004. In 2016, it fell slightly below RPI adjusted 1990 prices
- 2009, 2015 and 2016 saw large price drops, owing to falling crude oil prices
- Duty and VAT have steadily increased relative to 1990 levels throughout the '90s, until they were effectively frozen in September 2000 and again in 2012
- Duty was again increased from December 2006 through to the end of 2011, whilst VAT was briefly lowered to 15% in 2009 but increased to 20% in 2011; this explains the slightly higher gradient in duty and VAT from 2006, as shown in the chart

8. Filling Station Statistics

Over the last forty years, the number of filling stations in the UK has reduced from over 30,000 in 1970 to 8,476 at the end of 2016. In the last twenty years, on average around 300 filling stations have closed each year due to strong competition between fuel retailers and the increasing costs of compliance with environmental regulation. This has favoured large service stations with lower overheads per litre sold. As a result, many smaller filling stations have become economically unviable. However, closure rates have tapered off in the last three years and the long-term trend of declining numbers of forecourts in the UK appears to have stabilised. In contrast, the steady increase in the number of large supermarket sites continues. In 2016, hypermarkets accounted for over 45% of total market share by volume, despite only owning 18% of all petrol stations in the UK. Oil companies accounted for about 18% market share by volume with ownership of 15% of all petrol stations.

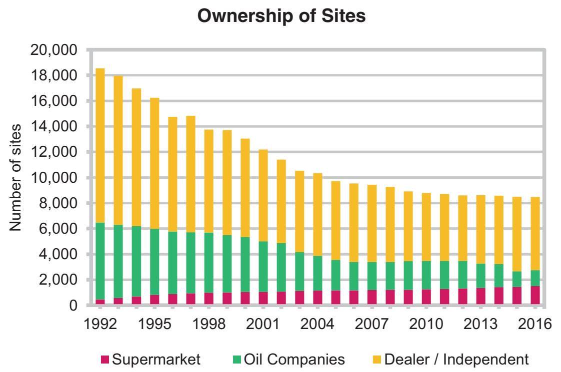
8.1 Number of Sites



Source: Source: Energy Institute until 2005; Catalist onwards

- At the end of 2016 there were 8,476 filling stations in the UK
- The number of filling stations is now less than a third than in the 1970s
- Over the past twenty years, the number of sites has been falling at an average rate of 300 per year. However, the long-term trend of declining numbers of forecourts in the UK appears to have stabilised in the past two to three years

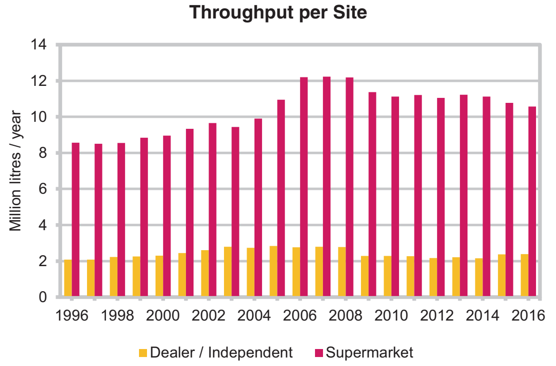
8.2 Ownership of Sites



Source: Energy Institute until 2005; Catalist onwards

- Many filling stations owned and operated by both oil companies and independent retailers have closed due to fierce competition and low profits
- The number of supermarket sites has been increasing at a steady rate of 3% p/y
- Independent sites still account for the majority of petrol stations, at around 67% of the total number, but just over 38% of sales volume
- In the last few years several oil majors have exited the UK retail market

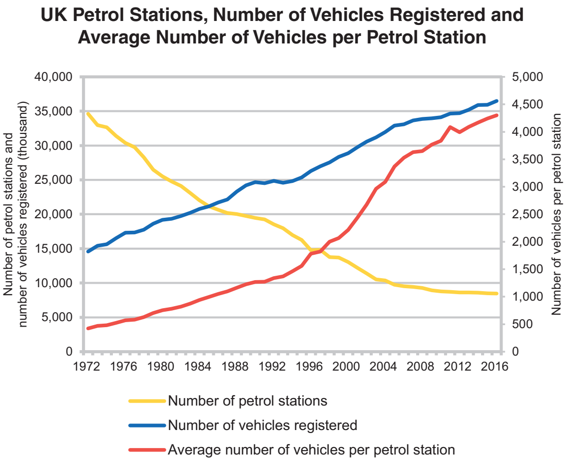
8.3 Throughput per Site



Source: Catalist

- The average throughput of all filling stations has risen over the years to a little over 6 million litres per year. However, there is a huge disparity in throughput between independent and supermarket sites
- The average supermarket site's throughput is currently around 10.5 million litres per year whilst independent sites average just over 2.4 million litres

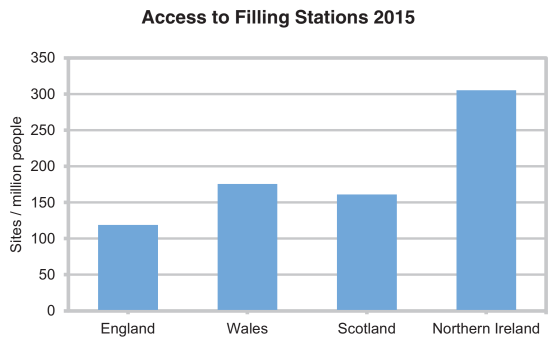
8.4 Average Number of Vehicles per Filling Station



Source: Catalist / Energy Institute

- The number of vehicles registered in the UK has been growing steadily. With the number of forecourts decreasing, there are more vehicles per filling station today than ever before

8.5 Access to Filling Stations



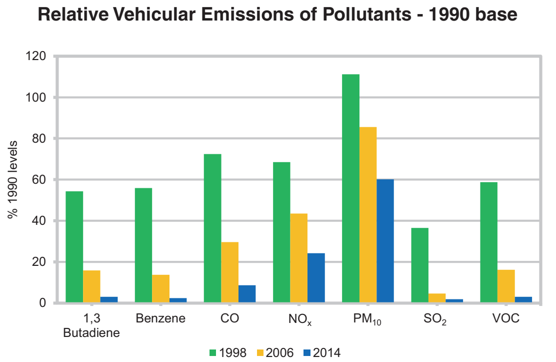
Source: ONS / Catalist

- The number of filling stations per capita is highest in Northern Ireland with around 305 filling stations per million relative to England with 119 per million
- Over the last few years, the number of filling stations has continued to decrease in all regions, albeit at a slower rate than in the past
- See UKPIA briefing paper – *'Fuel Supply to Rural Filling Stations*' for more information

9. Air Quality

Since 1990 road fuels and vehicles have become significantly cleaner, resulting in much lower exhaust emissions despite a continued increase in traffic levels.

9.1 Vehicular Emissions

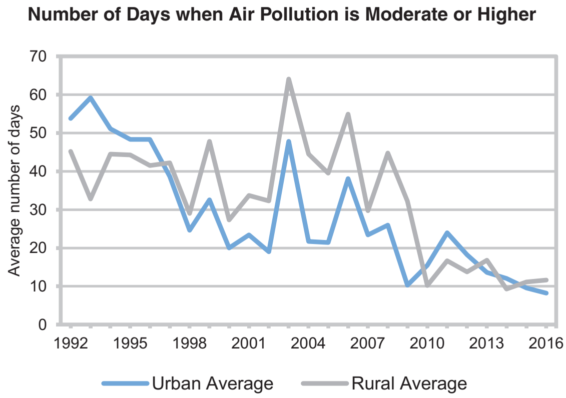


Source: DEFRA

- Emissions of all exhaust gas pollutants have been significantly reduced from 1990 levels
- The largest reduction has been made for SO_2 through the introduction of zero sulphur petrol and diesel (the move to zero sulphur fuels for off-road machinery vehicles was introduced in 2011)

** 2014 was the latest available data at time of print*

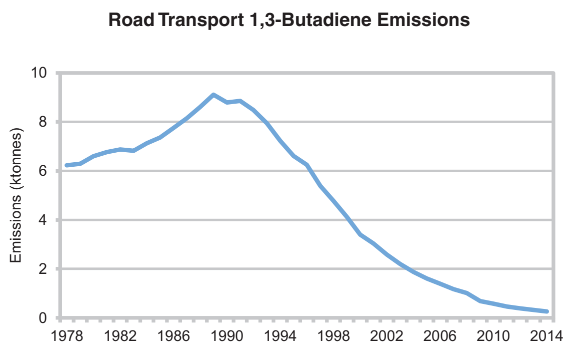
9.2 Air Pollution



Source: DEFRA

- Air pollution in urban areas has fluctuated over time but there has been a general long term decline in high air pollution days at both urban and rural monitoring sites
- Days of moderate or higher air pollution for urban areas have shown a clear downward trend
- The variability of weather from year to year plays an important role; for example, the hot summers of 2003 and 2006 resulted in high pollution levels mainly caused by ozone, some associated with trans-boundary sources. The comparatively cooler summers in 2007, 2010 and 2012 ensured air pollution reverted to low levels

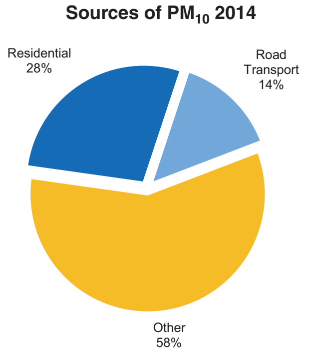
9.3 Road Transport 1,3- Butadiene Emissions



Source: DEFRA

- Emissions of 1,3-butadiene have reduced by 97% since 1990

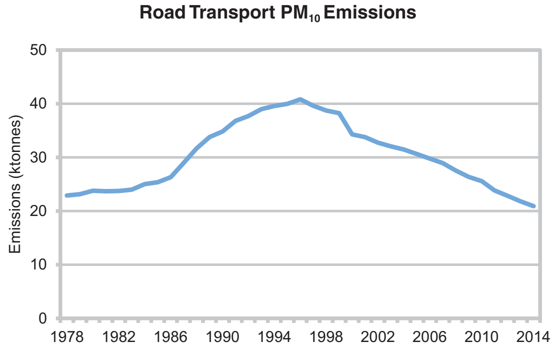
9.4 Sources of PM_{10}



Source: DEFRA

- In 2014, road transport accounted for 14% of the UK's primary emissions of particulate matter, 3% lower compared to the previous year
- The residential sector accounted for 28% of emissions. About 58% of particular matter emissions were produced by other sources, including industry and power generation

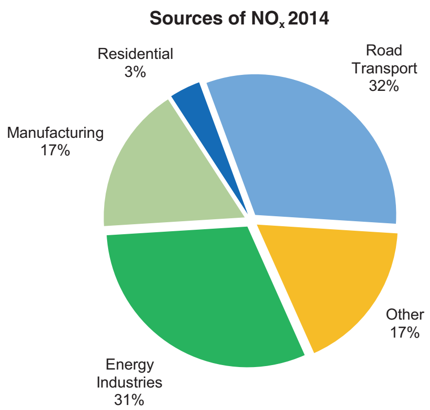
9.5 Road Transport PM_{10} Emissions



Source: DEFRA

- Emissions of particulate matter (PM_{10}) from road transport peaked in 1996 at 40 thousand tonnes
- They have since declined by almost half, due to tighter standards for vehicular emissions and the move to sulphur-free road fuels
- PM_{10} emissions include combustion from road fuels, non-exhaust emissions from tyres, break wear and road abrasion

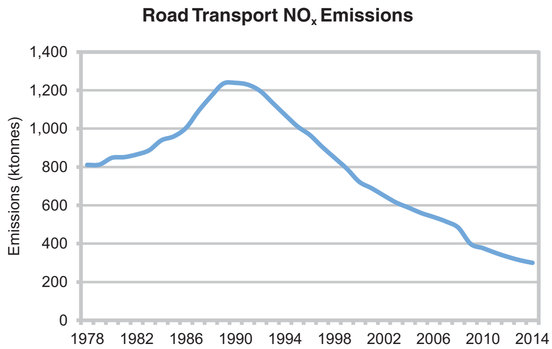
9.6 Sources of NO_x



Source: DEFRA

- Nitrogen oxides (NO_x) are mainly formed as a by-product from the combustion of fuel
- Less than one third of UK's total NO_x emissions in 2014 was from road transport
- Tighter EU exhaust emission standards will reduce vehicle NO_x emissions further

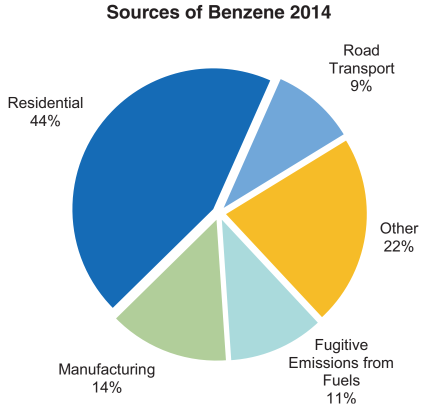
9.7 Road Transport NO_x Emissions



Source: DEFRA

- Nitrogen oxides are acidifying and eutrophying gases and give rise to ground-level ozone
- Road transport NO_x emissions have fallen by around 76% from their peak in 1990 to around 300k tonnes in 2014
- Tighter EU exhaust emission standards will reduce vehicle NO_x emissions further

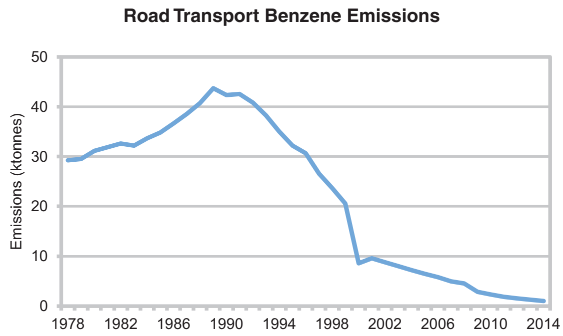
9.8 Sources of Benzene



Source: DEFRA

- In 2014, road transport was responsible for 9% of the UK's benzene emissions
- Stage II Vapour Recovery ensures the recovery of petrol vapour that would otherwise be emitted to the air during the refuelling of vehicles at filling stations
- Benzene is naturally present in crude oil and is also formed during refining
- Most benzene is removed to comply with specifications

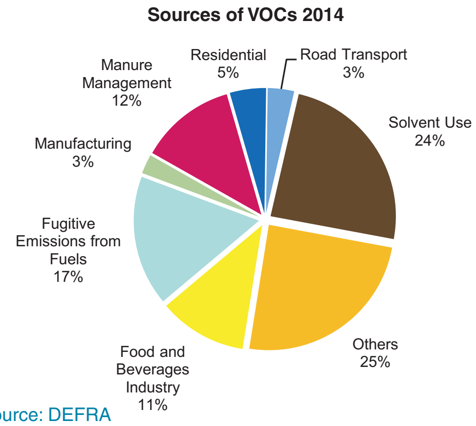
9.9 Road Transport Benzene Emissions



Source: DEFRA

- Emissions of benzene from road transport have reduced by 98% since 1990 due to the introduction of exhaust after-treatment technology enabled by unleaded petrol
- In 2000 emissions of benzene were further reduced following the lowering of the benzene and aromatics limits in petrol

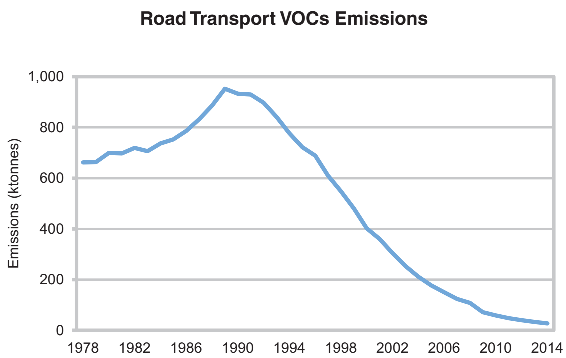
9.10 Sources of VOCs



Source: DEFRA

- In 2014, road transport was responsible for 3% of the UK's volatile organic compound emissions, a 19% decrease in real volume compared to the previous year

9.11 Road Transport VOCs Emissions

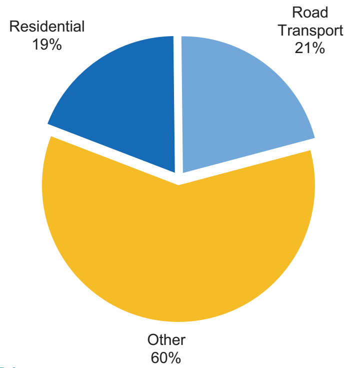


Source: DEFRA

- Road transport emissions of VOCs have dramatically reduced since their peak in 1990, falling by over 99%

9.12 Sources of CO

Sources of CO 2014



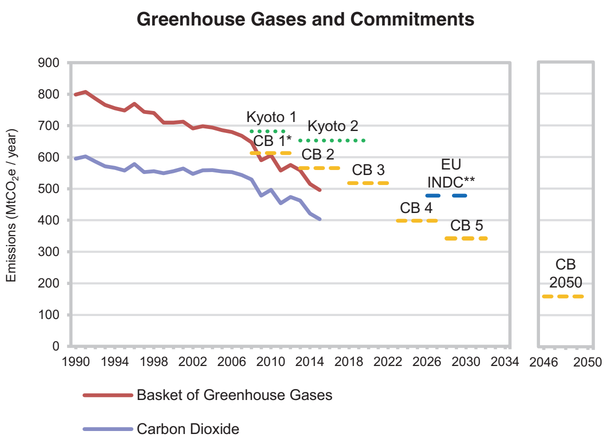
Source: DEFRA

- Carbon monoxide is formed from the incomplete combustion of fuel
- In 2014 road transport was responsible for 21% of the UK's carbon monoxide emissions – down about 10% in real volume from the previous year
- The residential sector was responsible for 19% of emissions
- Other sources include power stations, aviation, metal production and waste incinerators

10. Greenhouse Gases

A key UK Government commitment is to reduce emissions of greenhouse gases by 80% by 2050 relative to 1990 levels. The main greenhouse gas is carbon dioxide, CO_2. Emissions of CO_2 from road transport have reduced significantly when compared to the overall increasing mileage. In 2016, the average CO_2 emissions of new cars was around 35% lower compared to 17 years ago, reflecting improvements in vehicle efficiency enabled in part by cleaner fuels.

10.1 Greenhouse Gases and Commitments



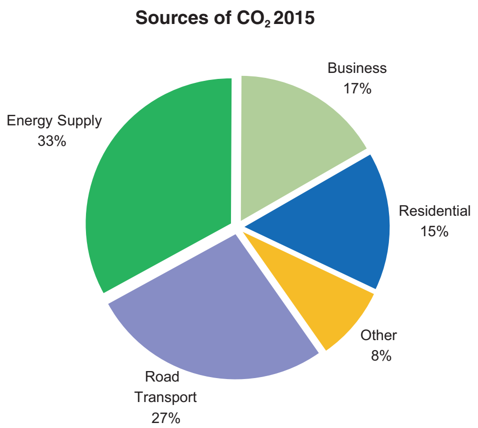
*CB - UK Carbon Budget

**EU INDC - EU Intended Nationally Determined Contribution

Source: BEIS

- The UK met the targets identified under the Kyoto protocol in 1999 – 13 years ahead of the target year – delivering a 12.5% reduction in greenhouse gases compared to 1990
- Under the Climate Change Act 2008 the Government is required to set five yearly carbon budgets, twelve years in advance, from 2008 to 2050. The aim is to reduce greenhouse gas emissions by at least 80% by 2050 compared to 1990 levels
- The first three carbon budgets were set in May 2009 and require emissions to be reduced by at least 34% below base year levels in 2020
- Latest emissions data (2015) measure UK's carbon footprint at 404 million tonnes per year, and basket of greenhouse gases at 495.7 million tonnes
- Emissions recorded in 2015 are about 32% lower relative to carbon dioxide levels in 1990, and about 38% lower relative to basket of greenhouse gases in 1990

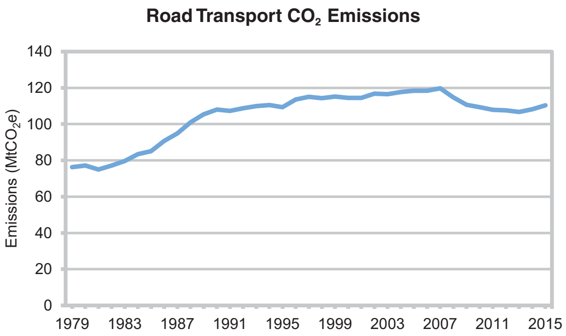
10.2 Sources of CO_2



Source: BEIS

- Road transport produces approximately 27% of the UK's CO_2 emissions – around 110 million tonnes
- The energy supply industry, along with the residential and business sectors are also major sources of CO_2

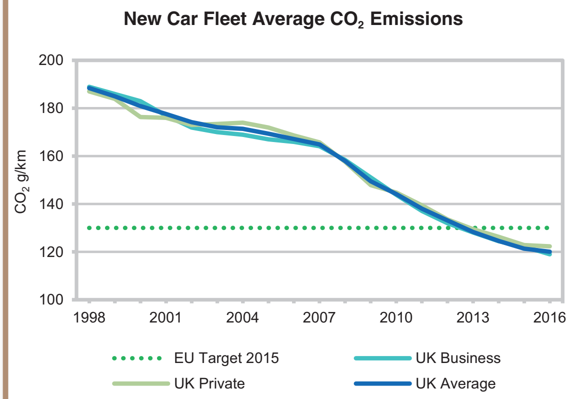
10.3 Road Transport CO_2 Emissions



Source: BEIS

- CO_2 road transport emissions increased slightly in 2015 compared to the previous year, but remain well below the 2007 peak
- Since 1990, emissions from road transport have risen at a much lower rate than vehicle mileage
- This can be attributed to the use of more efficient vehicle technologies enabled by cleaner fuels, and an increased proportion of diesel vehicles
- The Renewable Energy Directive (RED) mandates that 10% of transport energy is to be from renewable sources, whilst the Fuel Quality Directive (FQD), mandates a reduction in CO_2 emissions by 6%, all to be completed by 2020

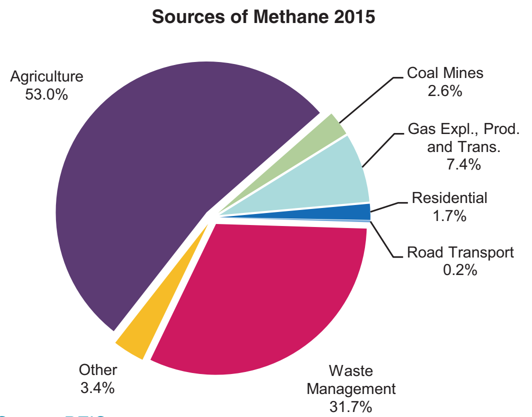
10.4 CO_2 from New Cars



Source: SMMT / European Commission

- UK average new car CO_2 emissions have fallen every year on record, and in 2016 the UK average level of CO_2 emissions was 120.1g/km
- Future emissions of CO_2 from road transport will continue to be lowered by further improvements in vehicle efficiency

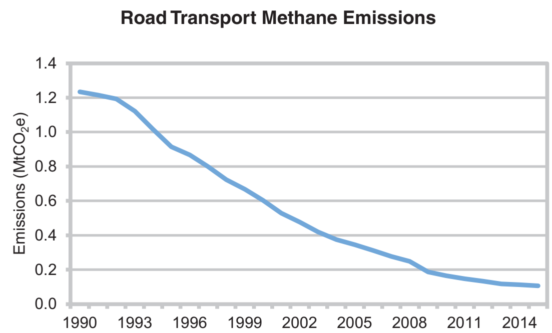
10.5 Sources of Methane



Source: BEIS

- Road transport is a minor contributor to methane emissions, producing around 0.2% of the UK total in 2015
- The main contributing sector is agriculture which accounted for over half of methane emissions

10.6 Road Transport Methane Emissions



Source: BEIS

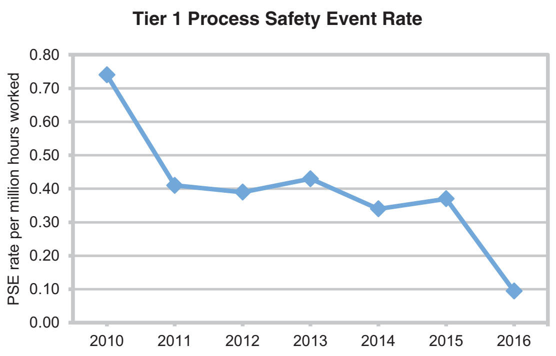
- Road transport methane emissions have reduced by 91% since 1990

11. Process Safety

This section is produced as part of the key objectives of UKPIA's commitment to process safety, and in response to the challenges set by the Buncefield Major Incident Investigation Board regarding sector level reporting for key process safety performance indicators.

To ensure consistency in reporting these indicators as an industry sector, UKPIA members have adopted the American Petroleum Institute's (API) Recommended Practice (RP) 754, 'Process Safety Performance Indicators for the Refining and Petrochemical Industries'. It is on the indicators classified as Tier 1, Tier 2 and Tier 3 that this section is based.

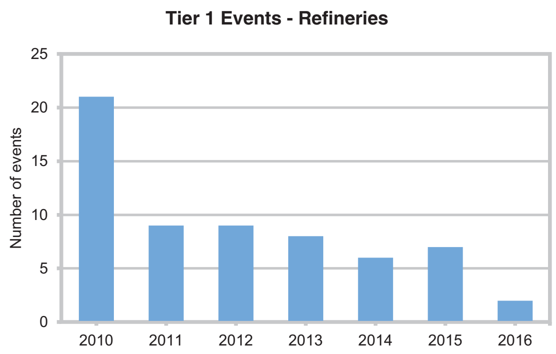
11.1 Tier 1 PSE Rate



Source: UKPIA

- The Tier 1 PSE Rate provides an indication of the number of Tier 1 Process Safety Events (PSE) that have occurred against the total number of hours worked, this is normalised per million hours

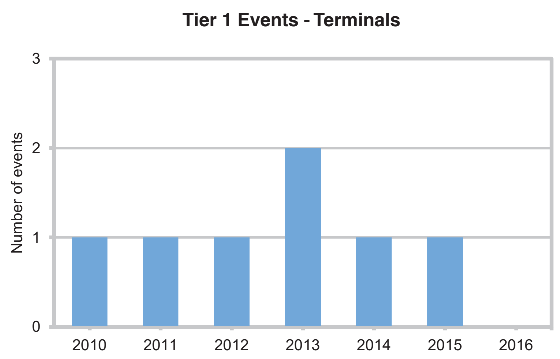
11.2 Tier 1 Events - Refineries



Source: UKPIA

- The number of Tier 1 events reported at refineries in a 12 month period

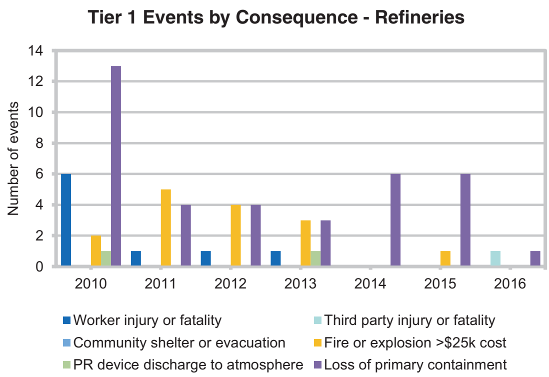
11.3 Tier 1 Events - Terminals



Source: UKPIA

- The number of Tier 1 events reported at terminals in a 12 month period
- In 2016, no Tier 1 terminal event was reported

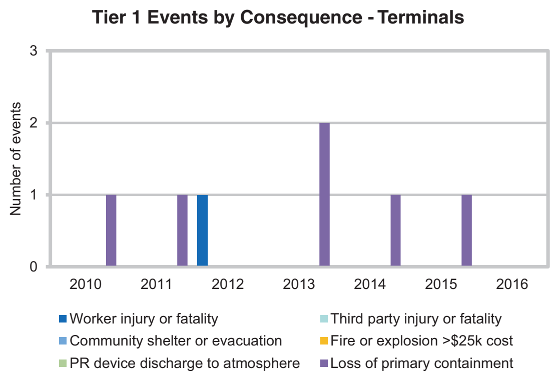
11.4 Tier 1 Events by Consequence - Refineries



Source: UKPIA

- The consequences of Tier 1 events at refineries for a 12 month period. Note that there may be more than one consequence per Tier 1 event

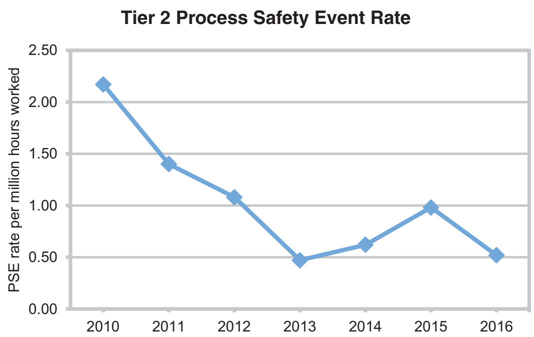
11.5 Tier 1 Events by Consequence - Terminals



Source: UKPIA

- The consequences of Tier 1 events at terminals for a 12 month period. Note that there may be more than one consequence per Tier 1 event

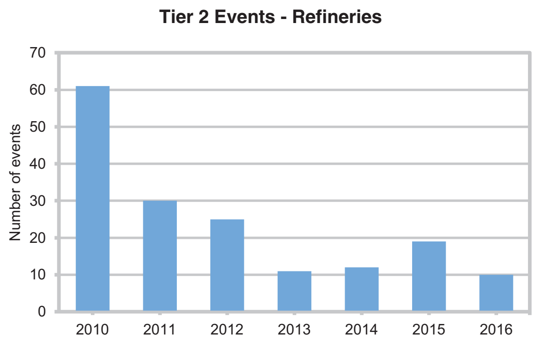
11.6 Tier 2 PSE Rate



Source: UKPIA

- The Tier 2 PSE Rate provides an indication of the number of Tier 2 Process Safety Events (PSE) that have occurred against the total number of hours worked, this is normalised per million hours

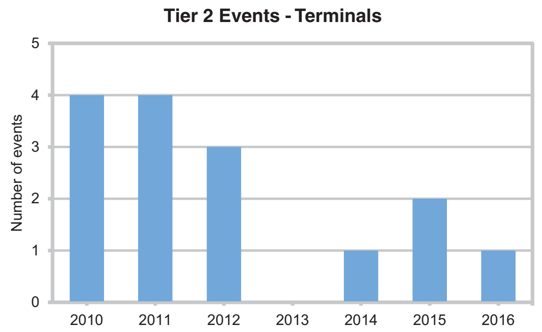
11.7 Tier 2 Events - Refineries



Source: UKPIA

- The number of Tier 2 events reported at refineries in a 12 month period
- The average number of reported events has decreased by almost 84% over the last six years

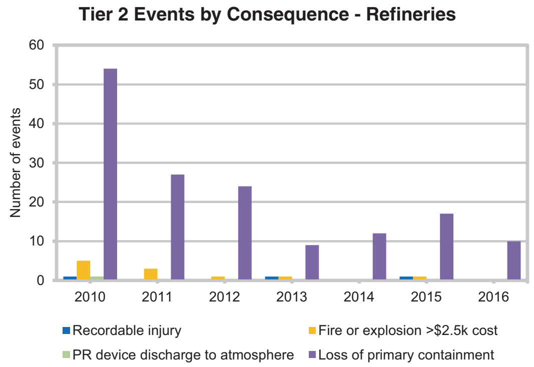
11.8 Tier 2 Events - Terminals



Source: UKPIA

- The number of Tier 2 events reported at terminals in a 12 month period

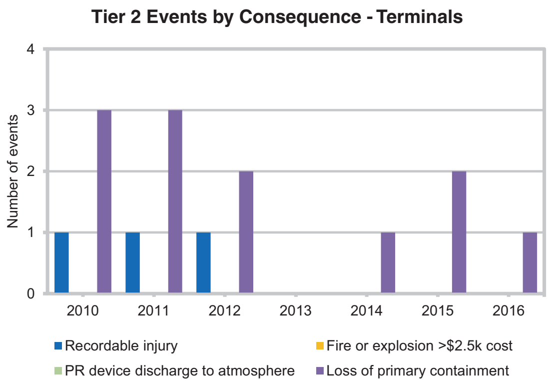
11.9 Tier 2 Events by Consequence - Refineries



Source: UKPIA

- The consequences of Tier 2 events at refineries for a 12 month period. Note that there may be more than one consequence per Tier 2 event

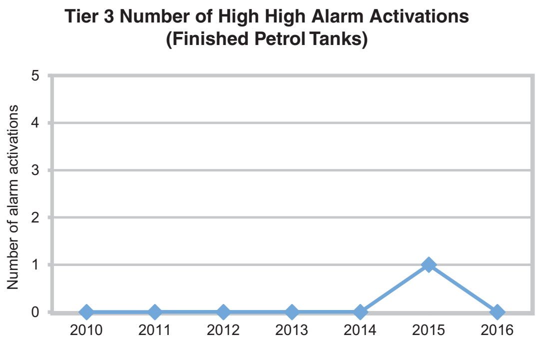
11.10 Tier 2 Events by Consequence - Terminals



Source: UKPIA

- The consequences of Tier 2 events at terminals for a 12 month period. Note that there may be more than one consequence per Tier 2 event

11.11 Tier 3 Number of High High Alarm Activations on PSLG Scope Finished Petrol Tanks



Notes:
1. Excludes spurious trips and activations due to planned alarm testing
2. The definition of PSLG scope finished petrol tanks can be found in the final PSLG report, paragraph 24

Source: UKPIA

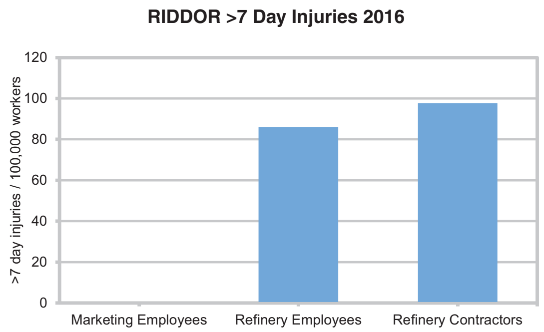
- High High alarm activation provides an indication of the number of times a safety related (or instrumented) system has been activated on finished petrol tanks which fall under the scope of the PSLG report

12. Occupational Health and Safety

The Refining and Marketing sector remains one of the safest manufacturing industries in the UK, with proportionately fewer injuries occurring than in the manufacturing sector as a whole.

Due to changes in reporting of RIDDOR (reporting of injuries, disease and dangerous occurrences regulations), data provided in this chapter have been reconfigured and restarted. Reporting requirements mostly remained unchanged. However, the requirement for an employer to record accidents that result in the incapacitation of a worker (inability to work) changed from 'for more than 3 days' to 7 days.

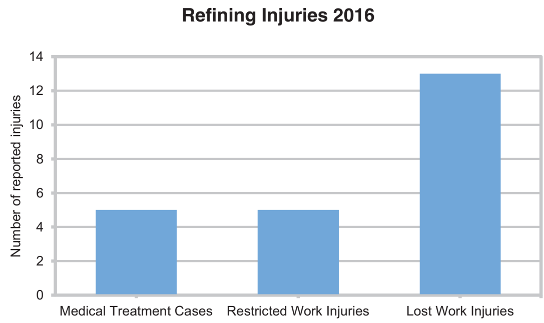
12.1 RIDDOR >7 day Injuries by Category of Worker



Source: UKPIA

- RIDDOR >7 day shows the frequency of injuries in three downstream categories: marketing employees, refinery employees and refinery contractors

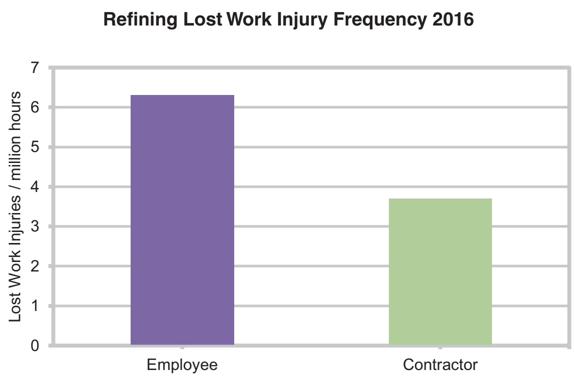
12.2 Refining Injuries



Source: UKPIA

- Refining Injuries are reported according to impact severity of injury

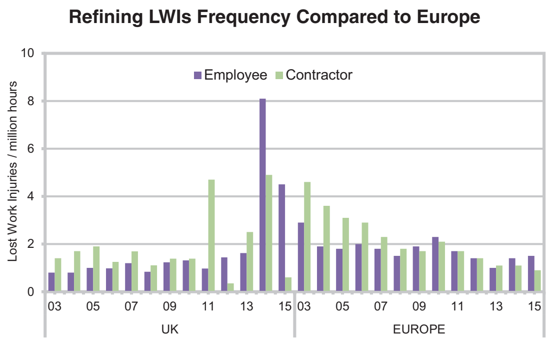
12.3 Refining Lost Work Injury Frequency



Source: UKPIA

- Refining Lost Work Injury Frequency compares lost work incidents relative to millions of hours of work between refinery contractors and employees

12.4 Refining Lost Work Injuries Frequency compared to Europe

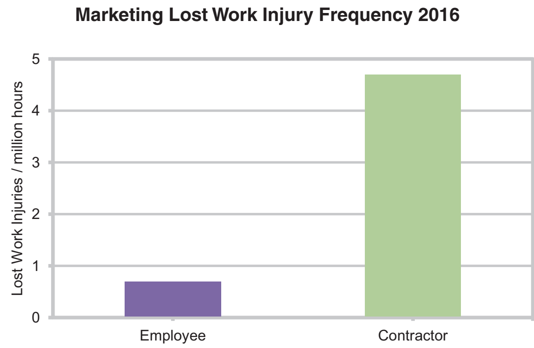


Source: UKPIA / CONCAWE

- This graph, generated using RIDDOR data, compares UKPIA with European safety data (CONCAWE)

Note: Concawe (Conservation of Clean Air and Water in Europe) is the European oil industry technical body focussed on environment, health and safety.

12.5 Marketing Lost Work Injury Frequency



Source: UKPIA

- The Lost Work Injury Frequency for the marketing division of the downstream oil sector compares injuries of contractors and employees.

NOTES

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