5 International context

Key points

- Changes in domestic retail petrol prices reflect movements in international prices of refined petrol that in turn reflect changes in international prices of crude oil.
- Crude oil is a globally traded commodity. Like the prices of other commodities, prices of crude oil products are determined by the interplay of global supply and demand.
- The most appropriate crude oil benchmark for Australia is the widely used Brent crude or the regional Tapis crude benchmark.
- Western Texas Intermediate (WTI), while quoted by the media, does not presently reflect global supply and demand conditions for crude oil and is unrelated to Australian retail petrol prices.
- In 2010–11, crude oil prices continued to rise from the low levels seen during the Global Financial Crisis (GFC), driven mainly by the economic recovery from the GFC and the Libyan crisis.
- Crude oil prices are likely to remain high in the medium to long-term as:
  - demand, driven by continued high rates of growth in emerging economies, principally China and India, will grow at a faster pace than supply
  - the cost of crude exploration and production is likely to increase as existing fields continue to mature and new sources of conventional supplies become more costly to find and develop
  - conventional sources of crude supplies become more scarce and are increasingly replaced by non-conventional sources.

5.1 Introduction

Retail prices of petrol in Australia reflect movements in international prices of refined petrol. In turn, international refined petrol prices are heavily influenced by international crude oil prices. This chapter describes developments in global oil and petrol markets that impacted on domestic prices in 2010–11.

5.2 Crude oil prices

Crude oil is an actively traded international commodity. There are many types of crude oil traded in different spot markets around the world. Most crudes are differentiated in terms of their 'heaviness' and 'sweetness'. A crude is 'heavy' or 'light' depending on the extent to which it floats on water according to the American Petroleum Industry (API) gravity index crude. The sweetness of crudes is measured in terms of their sulphur content. Crudes with a sulphur content of less than 0.5 per cent are typically described as 'sweet', while those with a sulphur content of more than 0.5 per cent are said to be 'sour'.

Spot crude oil markets function like other commodity spot markets where product is bought and sold for immediate delivery at the going price.[68] Transactions take place at prices based on marker crude prices. The prices of marker crudes act as benchmarks for the broader market for crude oil products because they are traded more heavily than other crudes.

The most influential marker crudes are Brent crude, Dubai crude and West Texas Intermediate (WTI).

- **Brent crude** is also a light sweet crude deliverable at the Shetland Islands in the UK North Sea. It has been used extensively in Europe and is now increasingly used as a crude price benchmark outside Europe as well.
- **Dubai crude** is considered a sour heavy crude and is used in the Middle East.
- **WTI** is a benchmark for light sweet crude deliverable in Cushing, Oklahoma, US. It is used extensively in the North American trading region.

Malaysian Tapis crude, which is a light sweet crude, has been used as a marker crude in the South-East Asian region, particularly in Singapore.[69] Recently, however, Dated Brent has been increasingly used as a crude marker in Australia as well (see section 5.2.4 for a discussion of the diminishing importance of Tapis as a crude marker in the South-East Asian region).

5.2.1 Crude oil prices since 1980

In the long term, crude prices tend to be influenced by changes in world economic growth.

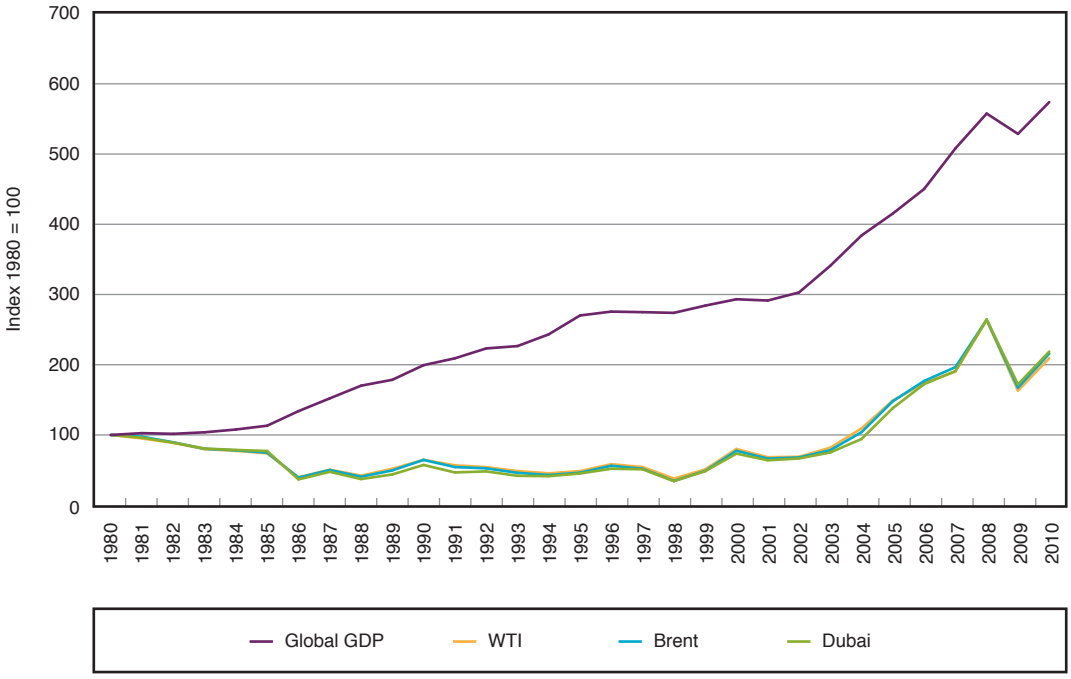
While changes in global levels of economic activity in any one year are not necessarily mirrored in changes in crude oil prices, in the long run, there appears to be a close relationship between changes in gross domestic product (GDP) levels and changes in crude prices.

Chart 5.1 shows changes in the benchmark prices of WTI, Brent and Dubai crude with changes in annual world GDP growth since 1980.

68 Spot transactions generally take place over the counter, not in exchanges. Futures crude transactions take place in futures exchanges in various regions. Physical deliveries of the most influential marker crudes underpin trading in futures exchanges.

69 See Reserve Bank of Australia, Statement of monetary policy, August 2007, box B: 'Recent developments in oil prices', at http://www.rba.gov.au/publications/smp/2007/aug/html/box-b.html, accessed 30 November 2011.

Chart 5.1 Changes in average annual benchmark prices of WTI, Brent and Dubai crudes, and in average annual world GDP: 1980 to 2010, Index 1980 = 100



Source: Crude price data from BP Statistical review of world energy, 2011, at http://www.bp.com/assets/bp_internet/globalbp/globalbp_uk_english/reports_and_publications/statistical_energy_review_2011/STAGING/local_assets/spreadsheets/statistical_review_of_world_energy_full_report_2011.xls, accessed 30 November 2011; and USEIA at http://www.eia.gov/dnav/pet/xls/PET_PRI_WCO_K_W.xls., accessed 2 August 2011. GDP data from The World Bank, GDP (current USD) at: http://api.worldbank.org/datafiles/NY.GDP.MKTP.CD_Indicator_MetaData_en_EXCEL.xls, accessed 30 November 2011.

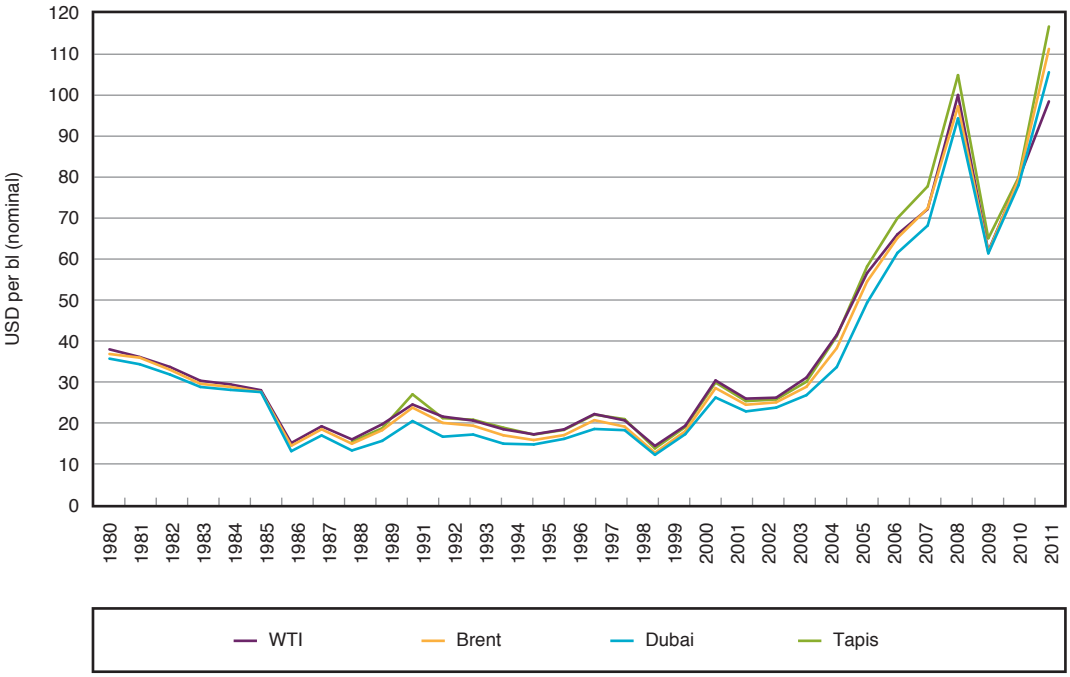
Note: Data are in nominal terms. Benchmark prices for Tapis crude are not shown as data are not available prior to 1988.

While world economic output increased strongly between 1980 and 2004 crude prices exhibited volatility, but by the end of 2004 were no higher than in 1980 (chart 5.1). Since 2004, however, crude prices appear to have tracked changes in global economic growth more closely, including the volatility associated with the Global Financial Crisis (GFC) of 2008–09.

Benchmark prices of marker crudes reflect their different chemical properties. Generally, lighter and sweeter crudes are considered higher quality and will trade at a premium relative to heavier and sourer crudes. This is mainly because they yield higher volumes of refined petrol and diesel and are therefore less costly to process on a unit basis into high-value refined petrol products such as petrol and diesel, compared with heavy crudes that are more suited for production of low-value products such as fuel oil. The lower levels of sulphur in sweeter crudes mean that they do not need as much processing to meet environmental standards.

Chart 5.2 compares average annual prices of the four major marker crudes: WTI, Brent, Dubai and Tapis from 1980 to June 2011.

Chart 5.2 Average annual benchmark prices of WTI, Brent, Dubai and Tapis crudes: 1980 to 2011



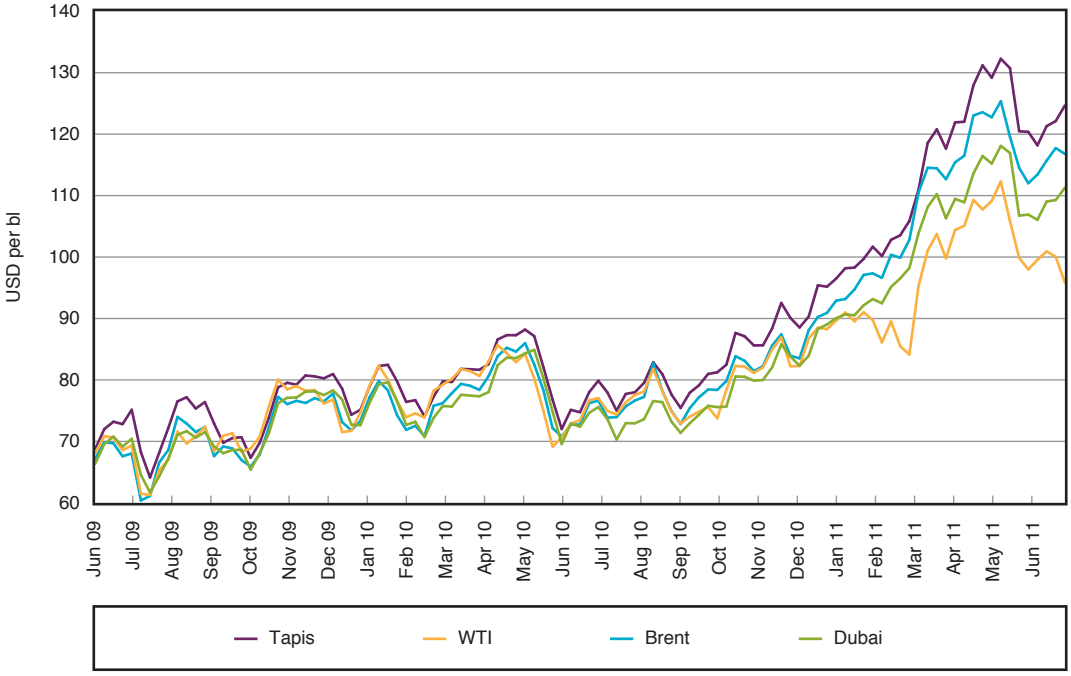
Source: Crude price data from BP Statistical review of world energy, 2011, at http://www.bp.com/assets/bp_internet/globalbp/globalbp_uk_english/reports_and_publications/statistical_energy_review_2011/STAGING/local_assets/spreadsheets/statistical_review_of_world_energy_full_report_2011.xls, accessed 30 November 2011; and US Energy Information Administration at http://www.eia.gov/dnav/pet/xls/PET_PRI_WCO_K_W.xls, accessed 2 August 2011.

Chart 5.2 shows that since 1980, prices of the major marker crudes have followed each other closely. In the long run, variations in prices of the different marker crudes will generally reflect differences in quality. Tapis has generally traded at a premium relative to other crudes because it is the lightest and sweetest among these four marker crudes. Dubai crude has tended to trade at a discount with respect to the other three marker crudes because it is the heaviest and most sour crude of the four marker crudes. As WTI is slightly lighter and sweeter than Brent, all else equal, it has generally traded at a slight premium to Brent.

5.2.2 Crude oil prices in the short term

Chart 5.3 provides a comparison of average weekly prices for the four marker crudes since June 2009. From this chart more significant price variations can be observed.

Chart 5.3 Average weekly benchmark prices of WTI, Brent, Dubai and Tapis crudes: June 2009 to June 2011



Source: Crude price data from US Energy Information Administration at http://www.eia.gov/dnav/pet/xls/PET_PRI_WCO_K_W.xls, accessed 2 August 2011, and at http://www.eia.gov/dnav/pet/xls/SPT_S1_W.xls, accessed 30 November 2011.

It is apparent from chart 5.3 that the relationship between the key international benchmarks for crude oil prices has changed recently. Since mid-2010, there appears to be a widening differential between the marker crudes.

5.2.3 Price relativity between marker crudes

Since June 2010, WTI has traded at an increasingly larger discount to Brent and Tapis, and since January 2011, at a discount also to Dubai crude prices. Furthermore, the discount relative to Brent has been significant, averaging about USD 5 per barrel (bl) since June 2010 and in the range of USD 10–15/bl in 2011.

It is generally accepted that oil markets are sufficiently developed and efficient to ensure that price variations that do not reflect quality differentials are quickly arbitraged away, even in the very short term.

In view of this, it is not surprising that the widening and persistent differential between WTI and other marker crudes has attracted attention. Reasons that may explain this recent price divergence include:

- High stock levels of crude oil in the United States (US). The US Department of Energy reported record high inventories in Cushing of 41.8 million barrels in March 2011.[70] This was due to strong crude oil production in the US and increased flows from Canada through two new pipelines. The build-up of stocks has put downward pressure on WTI prices.
- Cushing is an inland distribution centre and there are significant physical barriers to exporting crude. This renders arbitrage more difficult—Brent can be delivered against WTI contracts but WTI is not deliverable against Brent contracts.

The immediate outlook for the differential between WTI and the other marker crudes is likely to depend on a number of factors, including the prospects for US refineries to increase production and exports of refined petrol.

5.2.4 Increasing use of Brent in Asia region

With WTI being affected by the significant build-up of inventories near the delivery trading centre of Cushing, WTI prices are seen as out of step with broader market fundamentals and not indicative of global supply and demand conditions. For these reasons, WTI is losing support as a key marker crude and as a benchmark for pricing purposes.

Instead, Brent is attracting interest as a leading benchmark for crude oil prices. Brent is used as the principal benchmark for setting prices in transactions for crude outside North America, and increasingly outside Europe as well. According to Platts, which provides quotes for most of the world's key marker crudes, 'more than 60% of the world's internationally traded crude oil is priced against Dated Brent'.[71]

The International Energy Agency (IEA) has reported that Brent has replaced WTI as its preferred pricing instrument for assessing fuel markets, citing volatility in the differential between WTI and other international marker crudes.[72]

Brent is increasingly being used also in Asia, where Tapis crude has been the traditional marker used for setting crude oil prices. There is a growing awareness that the fundamentals driving Tapis prices are unrepresentative of the fundamentals for the broader market for crudes used in the region. Production from Malaysia's reservoirs of light sweet crude is declining.[73] As this means a smaller number of cargoes available for trading, objective price setting becomes more problematic. Inevitably, prices determined on the basis of fewer trades are less reliable indicators of fundamental supply and demand factors for the benchmark crude, and for other crudes.

Petronas, the national oil company of Malaysia which developed the Tapis oil fields, has announced that from 1 June 2011 crude prices would be based on Dated Brent rather than Tapis crude prices, reportedly because of volatility in the Tapis benchmark.[74]

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70 See US Energy Information Agency, at http://www.eia.gov/dnav/pet/pet_stoc_wstk_dcu_YCUOK_m.htm, accessed 11 August 2011.

71 Platts defines the term Dated Brent as 'the physical cargo price for North Sea Brent light crude which has been allocated a specific forward loading date'. See Platts, 'Dated Brent: the pricing benchmark for Asia-Pacific sweet crude oil', May 2011, p. 2, at http://www.aip.com.au/pricing/crude.htm, accessed 30 November 2011. Platts, a division of the McGraw–Hill Companies Inc.

72 See International Energy Agency, *Medium-term oil and gas markets 2011 report*, p. 24 © OECD/IEA International Energy Agency.

73 See Platts, Market issues: oil. 'Dated Brent: the pricing benchmark for Asia-Pacific sweet crude oil', May 2011, p. 3. Platts, a Division of The McGraw-Hill Companies, Inc.

74 See Reuters, 'Malaysia to change crude price benchmark to Dated Brent from June 1', 4 April 2001, at http://www.reuters.com/article/2011/04/04/malaysia-crude-price-idUSL3E7F406S20110404, accessed 30 November 2011.

In Australia, information collected by the ACCC from monitored companies indicates an increasing proportion of crude import cargoes being priced on the basis of Dated Brent, rather than Tapis. Caltex Australia, one of the refiner-marketers monitored by the ACCC, has announced that due to 'comparative substantial volatility' in Tapis crude prices, from 1 January 2011 it was replacing Tapis with Dated Brent as the basis for pricing purchases of crude.[75] The Australian Institute of Petroleum now publishes benchmark prices for both Tapis and Dated Brent.[76]

Recognising that Tapis may be losing its significance as a crude marker and as a benchmark for pricing crude oil in the Asia-Pacific region, the ACCC has included dated Brent to the list of international benchmark prices it monitors.

5.2.5 Recent movements in crude oil prices

Crude oil prices increased significantly during 2010–11 (see charts 5.2 and 5.3). Brent crude increased from a low of around USD 75/bl in July 2010 to over USD 120/bl in May 2011. By late June 2011 prices eased off slightly to around USD 110/bl.

The major influences on crude prices in recent years have been the GFC of 2008–09 and the subsequent (un-uniform) recovery of the world economy. The significant swings in crude prices evident in charts 5.2 and 5.3 reflect not only the nature and extent of the GFC but also the speed and strength of the ensuing economic rebound. Global demand for oil recovered much more quickly than had been anticipated in the immediate aftermath of the GFC. According to the IMF, annual growth in world demand for oil during 2010 was twice as strong as had been predicted at the start the year and the strongest since 2004.[77]

The supply response during 2010–11 has been mixed. The combined effects of reductions in spare capacity among member countries of the Organisation of Petroleum Exporting Countries (OPEC), production increases (mostly from non-OPEC countries), and running down of inventories were not sufficient to accommodate the increase in demand. OPEC's response was adversely affected by the reduction in supplies from Libya.

5.2.6 Future crude oil prices

Clearly, the prospects for crude prices in the short to medium term will depend on the interplay between the supply response to the world's energy requirements and the extent to which demand can continue to remain buoyant, particularly in view of current high energy prices.

In the 20 years prior to 2004, the prices of the four major marker crudes averaged under USD 25/bl. Since 2004, it appears that prices have moved into a higher range with prices averaging around USD 77/bl in the seven years to June 2011.

A discussion of relevant fundamental demand and supply factors likely to impact world oil prices follows in sections 5.3 and 5.4. An assessment of the likely course of future crude prices is presented in section 5.7.

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75 Caltex Australia, Understanding our financial results, 2011; at http://www.caltex.com.au/investorcentre/pages/understandingourfinancialresults.aspx, accessed 30 November 2011.

76 See Australian Institute of Petroleum, at http://www.aip.com.au/pricing/marketwatch.htm, accessed 30 November 2011.

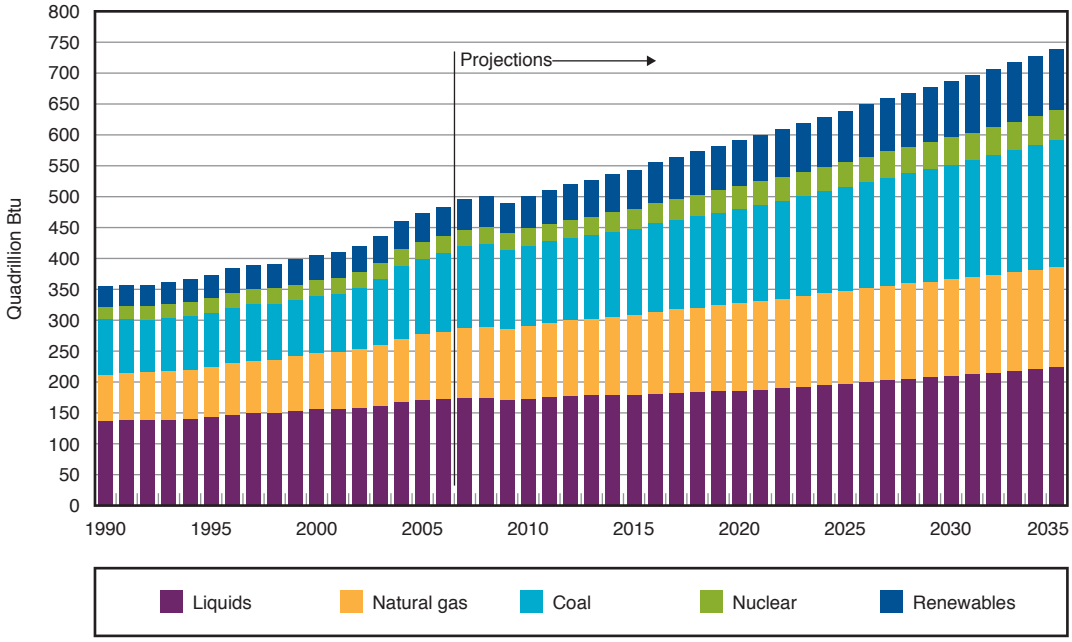
77 See International Monetary Fund, *World economic outlook*, April 2011, p. 92, at http://www.imf.org/external/pubs/ft/weo/2011/01/index.htm, accessed 30 November 2011.

5.3 Crude oil demand

For decades, crude oil has been the world's largest source of energy and is projected to remain so in the medium term. Presently, oil provides about 33 per cent of the world's total energy requirements followed by coal and natural gas, which supply 28 and 23 per cent of total energy needs, respectively.[78]

Chart 5.4 shows annual consumption data for the four primary sources of energy (oil, natural gas, coal and nuclear) and renewable energy sources.

Chart 5.4 Annual world energy consumption, by fuel type: 1990 to 2035



Source: US Energy Information Administration, *International energy outlook*, 2010, at http://www.eia.gov/oiaf/ieo/excel/figure_16data.xls, accessed 30 November 2011.

Note: Liquid fuels include other petroleum-derived fuels and non-petroleum derived liquid fuels, such as ethanol and biodiesel, coal-to-liquids, and gas-to-liquids, petroleum coke, natural gas liquids, crude oil consumed as fuel, and liquid hydrogen (US Energy Information Administration, *International energy outlook*, 2010, p. 23). Renewable energy sources are geothermal, hydropower, solar and wind.

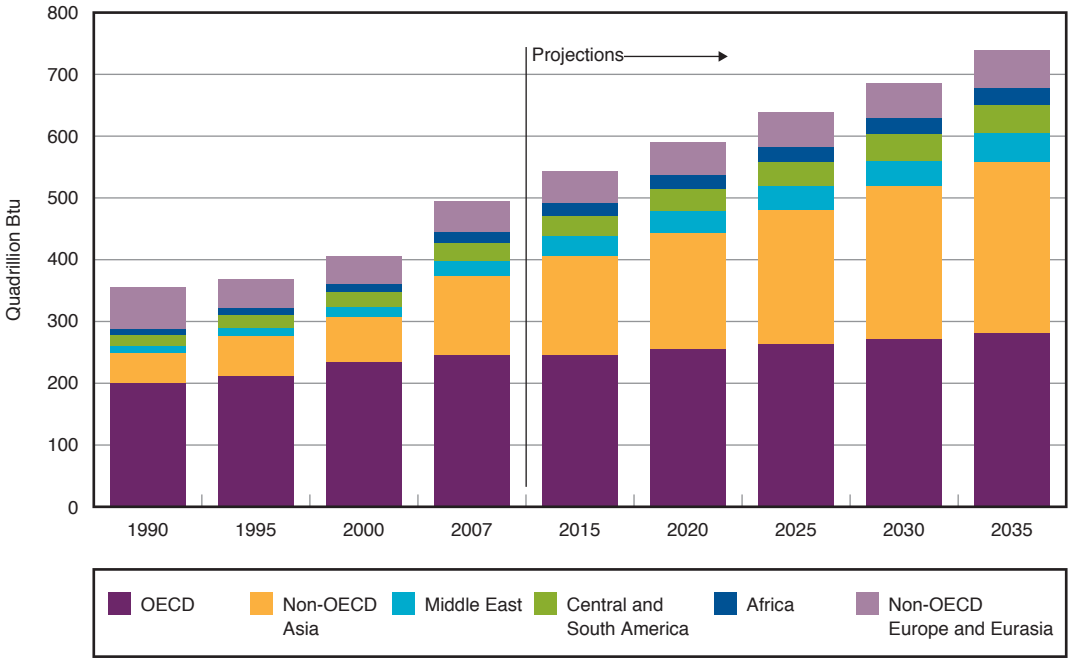
By 2035, the US Energy Information Administration (US EIA) projects that while the relative importance of oil as an energy source will diminish, and that of coal, renewable energy and, to a lesser extent, nuclear energy, will rise, oil will continue to be the world's largest source of energy.

78 See International Monetary Fund, *World economic outlook*, April 2011, pp. 32–3, at http://www.imf.org/external/pubs/ft/weo/2011/01/index.htm, accessed 30 November 2011.

In the future, it is likely that demand for energy will continue to be closely related to the level of economic activity. World economic activity is forecast to remain reasonably robust in the short to medium term. According to the US EIA, world GDP will grow by an average annual rate of 3.2 per cent up to 2035, with countries from the Organisation for Economic Co-operation and Development (OECD) growing by 2.5 per cent and non-OCED countries by 4.4 per cent per annum.[79]

Generally, the economies of non-OECD countries are forecast to grow at higher rates than those of developed countries in the OECD.[80] This will affect energy demand patterns. The growth in energy use in non-OECD countries in the last 20 years is expected to continue in the medium term. Indeed, non-OECD countries, and Asian countries in particular, are estimated to account for the bulk of the expected growth in energy consumption up to 2035 (chart 5.5).

Chart 5.5 Energy consumption in OECD and non-OECD countries: 1990–2035



Source: US Energy Information Administration, *International energy outlook*, 2010, p. 10.
Also, http://www.eia.gov/oiaf/ieo/excel/figure_15data.xls and http://www.eia.gov/oiaf/ieo/excel/figure_13data.xls, accessed 30 November 2011.

Among Asian countries, China and India are among the largest consumers of energy and are estimated to account for the bulk of the projected increase in energy consumption in the medium term. Since 1990, their combined share of world energy use doubled to 20 per cent of global energy demand.[81]

79 US Energy Information Administration, *International energy outlook*, 2010, table A3, p. 148. International Energy Agency, *Medium-term oil and gas markets 2011 report*, p. 36. International Monetary Fund, *World Economic Outlook*, April 2011, table A1, p. 181.

80 Ibid.

81 US Energy Information Administration, *International energy outlook*, 2010, p. 10.

The energy consumption profile of countries varies according to, among other things, their level of economic development.[82] Countries in the OECD have mature petrol consumption markets where demand is affected by continual efficiency gains, higher fuel taxes, behavioural changes, structural declines in fuel consumption and a greater disposition to coordinated action on environmental issues. On the other hand, demand in developing and emerging countries is responsive to higher incomes and, in some countries, relatively insensitive to price increases due to government subsidies and a lack of alternative energy sources.

Based on results of econometric analysis of world oil consumption demand, the IMF observes that:

> *The growing importance of emerging market economies appears to have reduced world oil demand price elasticity … and increased income elasticity.*[83]

This means that in the global stage incomes will be more important determinants of demand than prices. The economic engine of developing countries becomes increasingly oil-intensive as their economic development gathers pace. Developing and emerging economies increase their total demand for energy in line with their growing income levels.[84] In contrast, the dependency of developed economies on oil tends not to increase dramatically with increases in GDP. Also, developed economies rely more on oil and less on coal to satisfy their energy requirements than developing and emerging economies.

In addition, as income levels increase in developing and emerging economies, consumption of oil increases more than proportionately to other forms of energy. The IEA considers that 'oil demand takes off exponentially when income per capita reaches around USD 3000 per capita (in year 2000 dollars) and begins to taper off after passing the USD 20 000 mark'.[85]

This is demonstrated in chart 5.6, which shows average daily oil consumption by the US and China since 1990, projected to 2035.

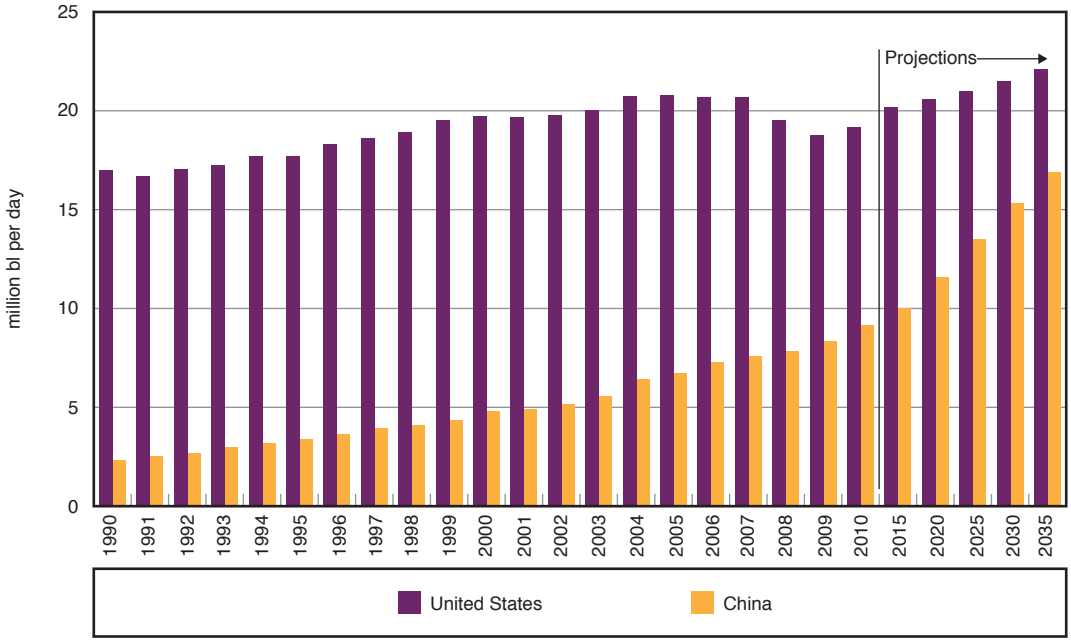
82 See International Monetary Fund, *World economic outlook*, April 2011, pp. 92–7.

83 Ibid., p. 95.

84 The International Monetary Fund claims that the 'income elasticity of energy demand is close to unity', *World economic outlook*, April 2011, p. 93.

85 International Energy Agency, *Medium-term oil and gas markets 2011 report*, pp. 38, 60 ©OECD/IEA International Energy Agency, p. 38.

Chart 5.6 Oil consumption in US and China: 1990 to 2035



Source: US Energy Information Administration, *International energy outlook*, 2010, table A5, p. 150. Also, http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=5&pid=5&aid=2&cid=CG6,CG5,&syid=1990&eyid=2010&unit=TBPD, accessed 30 November 2011.

Note: Includes liquid fuels and other petroleum-derived fuels and non-petroleum derived liquid fuels, such as ethanol and biodiesel, coal-to-liquids, and gas-to-liquids, petroleum coke, natural gas liquids, crude oil consumed as fuel, and liquid hydrogen.[86]

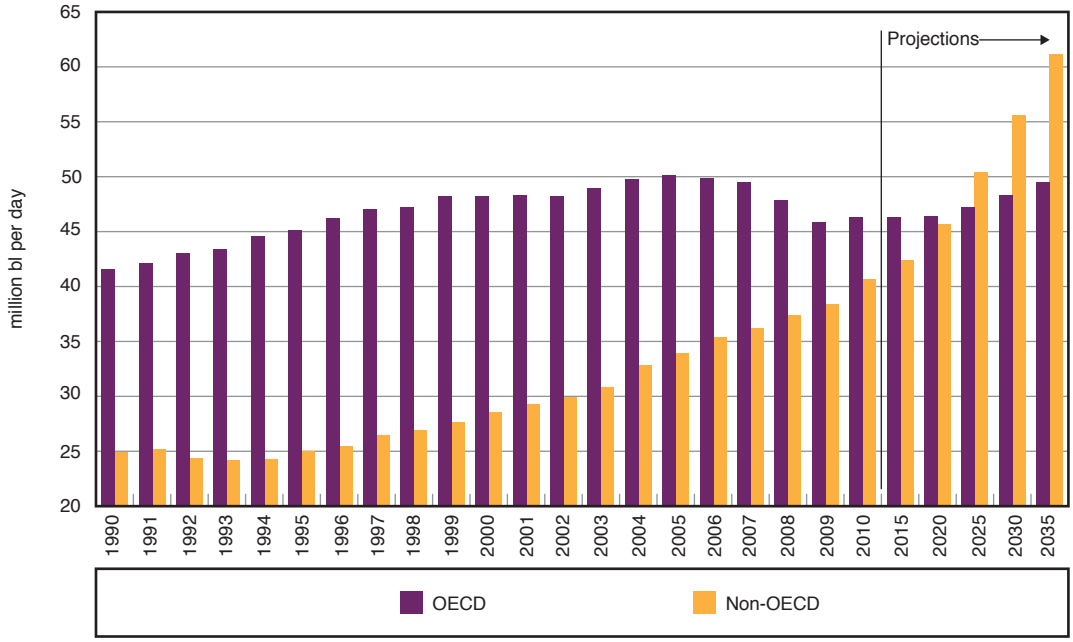
Chart 5.6 demonstrates the contrast between the growth in demand for oil in the US and in China since 1990 and projected growth to 2035 and highlights the magnitude of the impact on global demand for oil that the Chinse economy could have in the next few decades.

The strong growth in demand for oil in China (and to a lesser extent in India) underpins much of the growth evident among developing and emerging countries. Just under half of the total growth in non-OECD demand will come from China. Compared with 2001, China's oil demand is expected to double by 2015 and treble by 2030.[87] This is demonstrated in chart 5.7, which shows oil demand in OECD and non-OECD countries from 1990 to 2035.

86 US Energy Information Administration, *International energy outlook*, 2010, p. 23.

87 Ibid.

Chart 5.7 Oil consumption in OECD and non-OECD: 1990 to 2035



Source: US Energy Information Administration, *International energy outlook*, 2010, table A5, p. 150. Also, http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=5&pid=5&aid=2&cid=CG6,CG5,&syid=1990&eyid=2010&unit=TBPD, accessed 30 November 2011.

Note: Includes liquid fuels and other petroleum-derived fuels and non-petroleum derived liquid fuels, such as ethanol and biodiesel, coal-to-liquids, and gas-to-liquids, petroleum coke, natural gas liquids, crude oil consumed as fuel, and liquid hydrogen.[88]

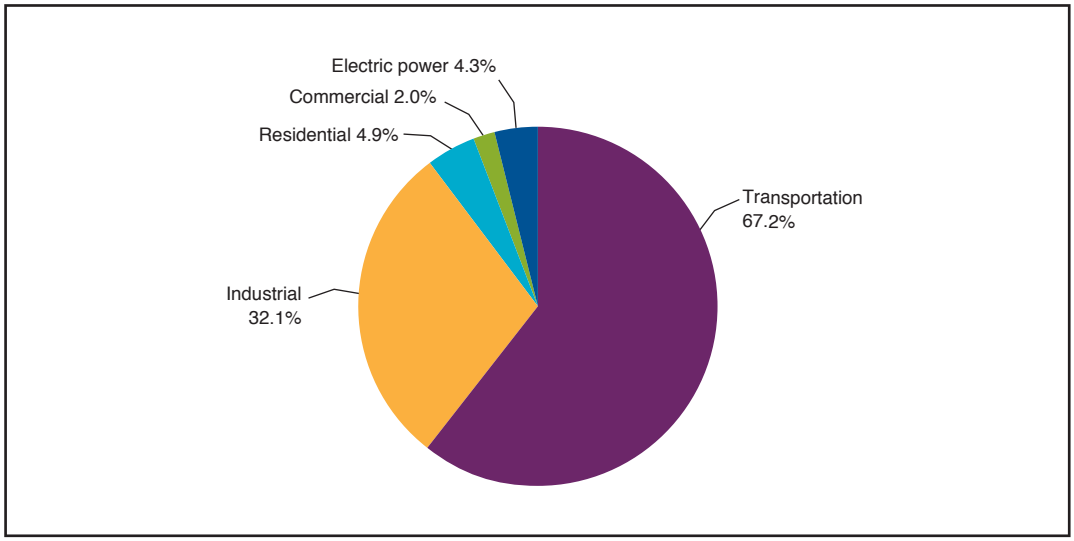
From 2010 to 2020, non-OECD countries are expected to account for almost all the growth in world demand for oil, and as chart 5.9 shows, the demand for oil by non-OECD countries is expected to surpass total OECD demand around 2020.

While there are difficulties with reporting and collecting data on sectoral sources of demand, it appears that the transport sector will continue to be the major driver of global oil use. The US EIA estimates that by 2035, transport will account for more than two-thirds of total oil use and for more than 80 per cent of the increase in oil consumption since 2007 (chart 5.8).[89]

88 US Energy Information Administration, *International energy outlook*, 2010, table A5, p. 150. Also, http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=5&pid=5&aid=2&cid=CG6,CG5,&syid=1990&eyid=2010&unit=TBPD., accessed 30 November 2011.

89 Ibid.

Chart 5.8 World oil consumption by sector: 2035



Source: US Energy Information Administration, *International energy outlook*, at http://www.eia.gov/oiaf/ieo/excel/figure_26data.xls, accessed 30 November 2011.

Demand for diesel is projected to be the principal source of growth in demand for crude oil. The IEA expects diesel to account for around 40 per cent of total forecast growth and for 30 per cent of total world demand by 2016.[90] According to the IEA around 90 per cent of the growth in demand for diesel is likely to be concentrated in countries outside the OECD.[91]

5.4 Crude oil supply

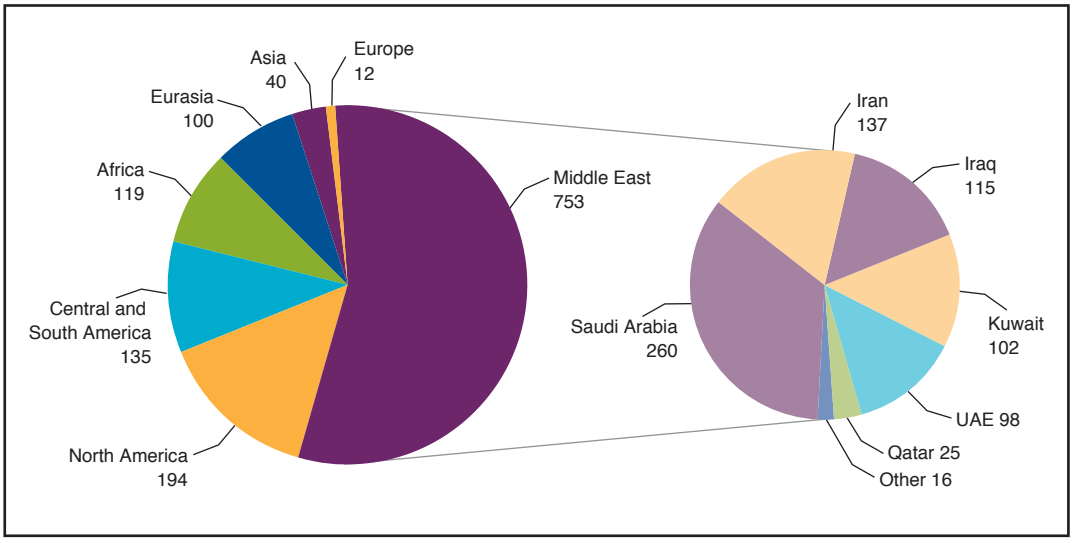
5.4.1 Proved reserves

Most of the world's proved reserves of crude oil are in the Middle East where 753 billion barrels out of a total 1353 billion barrels of proved reserves are located. Chart 5.9 provides data on the global distribution of proved reserves as at January 2010.

90 International Energy Agency, *Medium-term oil and gas markets 2011 Report*, pp. 40–1, 60 © OECD/IEA International Energy Agency

91 Ibid.

Chart 5.9 Proved crude oil reserves, billions of barrels: 2010



Source: US Energy Information Administration, *International energy*, figure 35 and table 5, p. 37; based on data reported by the *Oil and gas journal* from estimates provided to the US Securities and Exchange Commission.

Note: Proved reserves are defined by the US EIA as 'estimated quantities that analysis of geologic and engineering data demonstrates with reasonable certainty are recoverable under existing economic and operating conditions': US Energy Information Administration, *International energy*, p. 37.

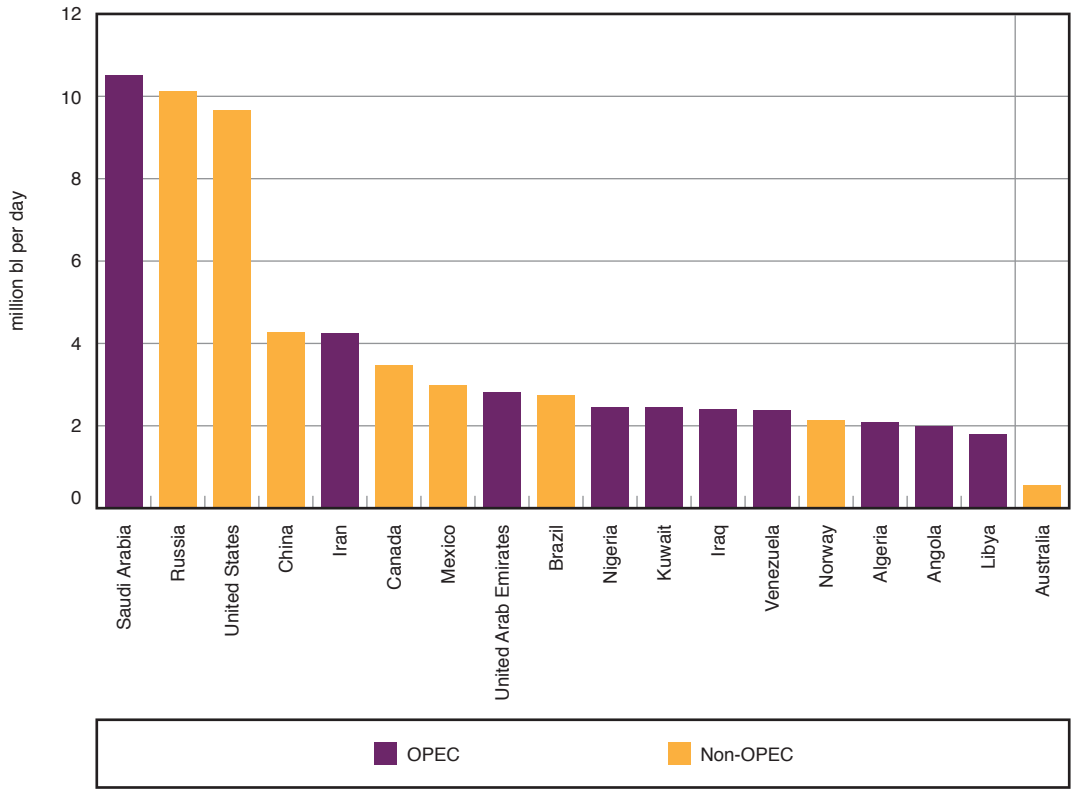
According to the US EIA, Saudi Arabia holds the world's largest pool of proved oil reserves with around 260 billion barrels of oil. The North America region holds the second largest pool of crude with 194 billion of proved reserves. Of these, 175 billion barrels are in Canada, mostly in the form of tar sand deposits. Venezuela's reserves hold 99 billion barrels of oil (mostly in its Orinoco heavy oil belt), the sixth largest pool of reserves in the world.[92]

5.4.2 Major producers and exporters

The world's major crude oil producing countries include countries that consume most of their supplies and those whose supplies exceed their internal consumption needs and thus are able to export crude. In 2010, Saudi Arabia was the world's largest producer and exporter of crude oil. Large crude oil producers that consume most of their supplies include the US and China. Chart 5.10 presents production data for 2010 for the largest producers of crude and for Australia.

92 Estimates of proved oil reserves may vary, sometimes considerably depending on assessments of what constitutes recoverable oil. For example, the latest BP Statistical review reports that as at the end of 2010, Venezuela had proved oil reserves of 211.2 billion barrels. See BP Statistical review of world energy, June 2011, p. 6.

Chart 5.10 Major crude oil producers and Australia: 2010

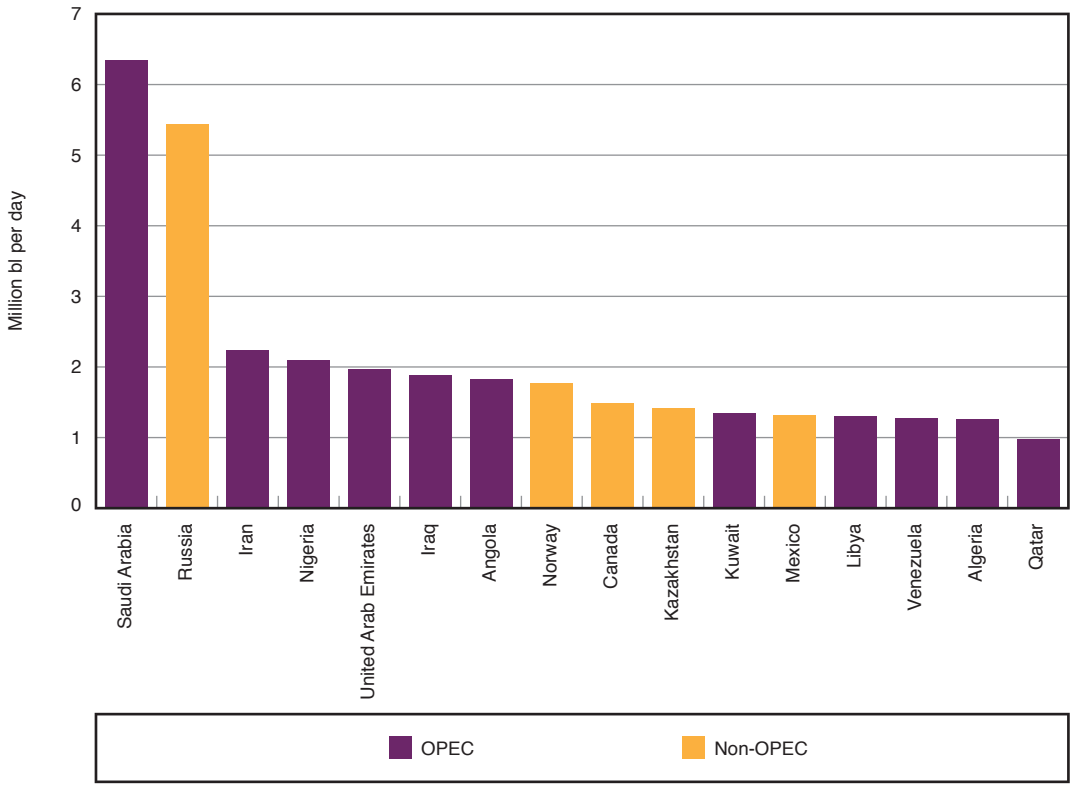


Source: US Energy Information Administration, *International energy*, tables G1 and G2, also at http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=5&pid=53&aid=1&cid=regions,ww,r1,r2,r4,CG6,CG5,CG9,&syid=1990&eyid=2010&unit=TBPD, accessed 30 November 2011.

Chart 5.10 shows that in 2010, Saudi Arabia was the world's largest producer of crude oil with a production of 10.5 million barrels per day (mbpd). Russia was the second largest producer with a production of 10.1 mbpd, slightly ahead of the US (9.7 mbpd) and China (4.3 mbpd). Australia was ranked 32nd, with an output of 550 000 barrels per day.

Chart 5.11 shows export data for major exporters for 2009. Saudi Arabia and Russia are also the world's largest exporters of crude with exports in 2009 of 6.4 mbpd and 5.4 mbpd respectively. The next largest exporter in 2009 was Iran with 2.2 mbpd.

Chart 5.11 Major crude oil exporters: 2009



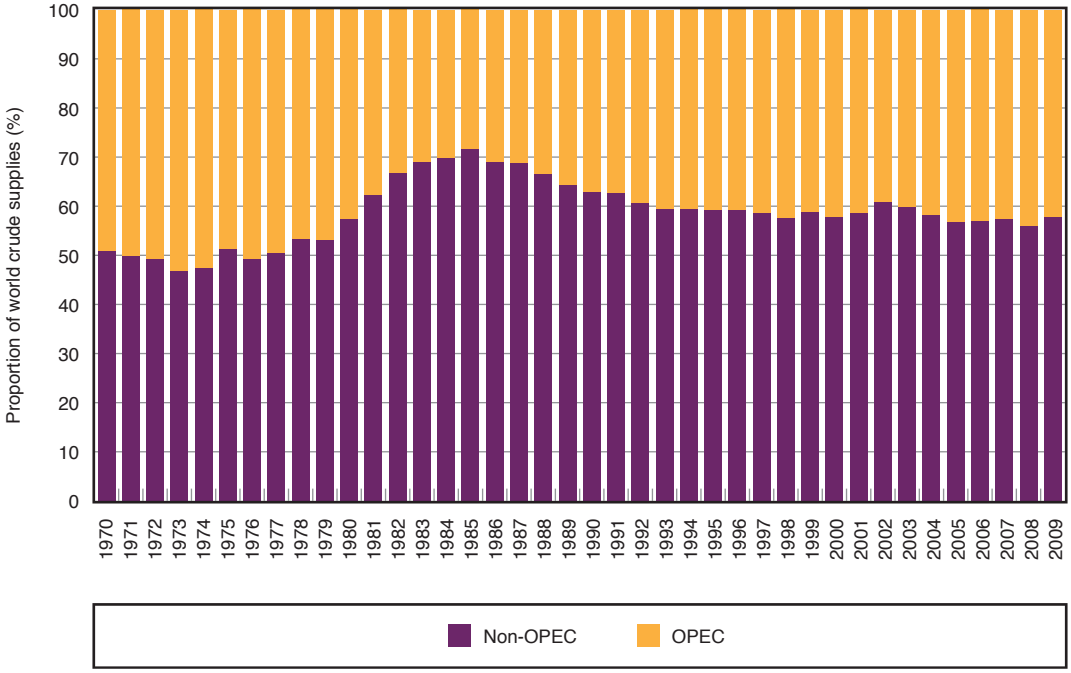
Source: US Energy Information Administration, *International energy*, at http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=5&pid=57&aid=4&cid=regions&syid=2005&eyid=2009&unit=TBPD, accessed 30 November 2011.

Most of the large exporters of crude are members of OPEC, an intergovernmental cartel of some of the largest producers of crude oil in the world. OPEC has twelve member countries: Algeria, Angola, Ecuador, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates and Venezuela. OPEC's stated objective is to 'coordinate and unify the petroleum policies of member countries and ensure the stabilization of oil markets in order to secure an efficient, economic and regular supply of petroleum to consumers, a steady income to producers and a fair return on capital to those investing in the petroleum industry'.[93]

In 2009, supplies of crude from OPEC member countries accounted for around 42 per cent of global crude supplies (chart 5.12).

93 OPEC Mission Statement, at www.opec.org, accessed 30 November 2011.

Chart 5.12 Proportion of global crude oil production, OPEC and non-OPEC countries: 1970 to 2009



Source: US Energy Information Administration, *International energy*, at http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=5&pid=54&aid=4, 30 November 2011.

The contribution of OPEC member countries to total world crude supplies has varied over time. Since 1970, OPEC's contribution to global supplies has ranged from 25 per cent in 1986 to 55 per cent in 1973. This is consistent with the perception of OPEC as a swing producer that aims to vary output to maximise revenues at given world prices subject to global demand and supply conditions.

According to IEA forecasts, by 2016 OPEC countries will contribute about 60 per cent of the growth in global crude production capacity of 6.8 mbpd.[94] Iraq, Angola and United Arab Emirates will account for most of this growth while a lack of investment in new production capacity is likely to adversely affect supplies from Iran. The civil war in Libya is likely to affect its production prospects for the next few years; the IEA's baseline scenario for Libya is that pre-war production levels will not be recovered before 2014.[95] Given the decline of mature fields in Mexico and the North Sea, the majority of growth in non-OPEC supplies up to 2016 will come from Canada, the US, Brazil and Russia.

In the longer term, the US EIA estimates that by 2035 Brazil, Canada and the US will achieve significant gains in production levels. Brazil is forecast to increase production by 4.9 mbpd, the largest increase among non-OPEC countries.[96]

94 International Energy Agency, *Medium-term oil and gas markets 2011 report*, p. 60 © OECD/IEA International Energy Agency.

95 Ibid., p. 18.

96 US Energy Information Administration, *International energy outlook, 2010*, table G1, p. 249; also, http://www.eia.gov/oiaf/ieo/excel/ieopoltab_1.xls, accessed 30 November 2011. Includes conventional liquids (crude oil, lease condensate, natural gas liquids and refinery gain) and unconventional liquids (biofuels, oil sands, extra heavy oil, coal-to-liquids, gas-to-liquids and shale oil).

Growth in Brazil will come from higher production levels in existing deep-water fields and recently discovered large sub-salt fields in the Campos and Santos offshore basins. The largest of the recently discovered fields, Tupi, lies beneath several kilometres of salt strata about 2000 metres below the Atlantic sea level. The size and contents of the sub-salt area off Brazil's south-west coast is still to be fully assessed. According to the US IEA, the sub-salt discoveries in Brazil may point to 'the presence of other large fields in the same formation'.[97]

The other major contributors to long-term growth in world oil production among non-OPEC countries are expected to be the US and Canada.[98] The US is likely to benefit from more efficient oil recovery in existing deep-water fields and new output from recently discovered fields in the Gulf of Mexico. Greater shale oil production from onshore fields will also enhance the US's crude oil supplies in the long term.[99] In Canada, the bulk of the growth in oil supplies is likely to come from unconventional sources, mainly oil sands. Brazil and Iraq are projected to experience the most significant increases in their respective shares in world production. Countries that are likely to experience notable reductions in their share of world output in the long run include countries where mature fields continue to decline, namely, OECD Europe (North Sea) and Mexico. Iran, Libya and Venezuela are also expected to account for smaller proportions of world output by 2035.

5.4.3 Conventional and unconventional sources of crude oil supplies

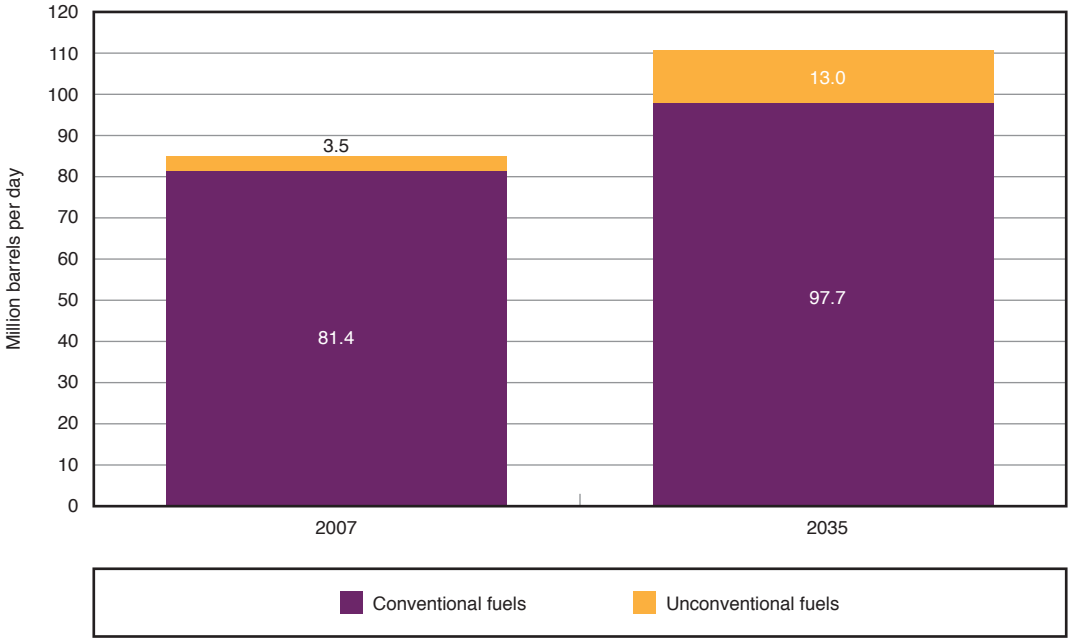
Conventional crude oil will continue to be the primary source of liquid fuels in the next 25 years. However, unconventional liquids are expected to grow more than proportionately to conventional liquids. Chart 5.13 provides data on world supplies of conventional and unconventional liquid fuels for 2007 and 2035.

97 US Energy Information Administration, *International energy outlook, 2010*, p. 30. Recent estimates suggest that Tupi may hold 120 billions barrel of oil. For example, see 'Brazil oil fields may hold more than twice estimates', at http://www.bloomberg.com/news/2011-01-19/brazil-oil-fields-may-hold-more-than-twice-estimated-reserves.html, accessed 30 November 2011.

98 US Energy Information Administration, *International energy outlook, 2010*, table G1, p. 249. Also, http://www.eia.gov/oiaf/ieo/excel/ieopoltab_1.xls, accessed 30 November 2011.

99 International Energy Agency, *Medium-term oil and gas markets 2011 report*, p. 69 © OECD/IEA International Energy Agency.

Chart 5.13 World liquid fuels production, conventional and unconventional: 2007 and 2035



Source: US Energy Information Administration, *International energy outlook*, 2010, table 3, p. 24.

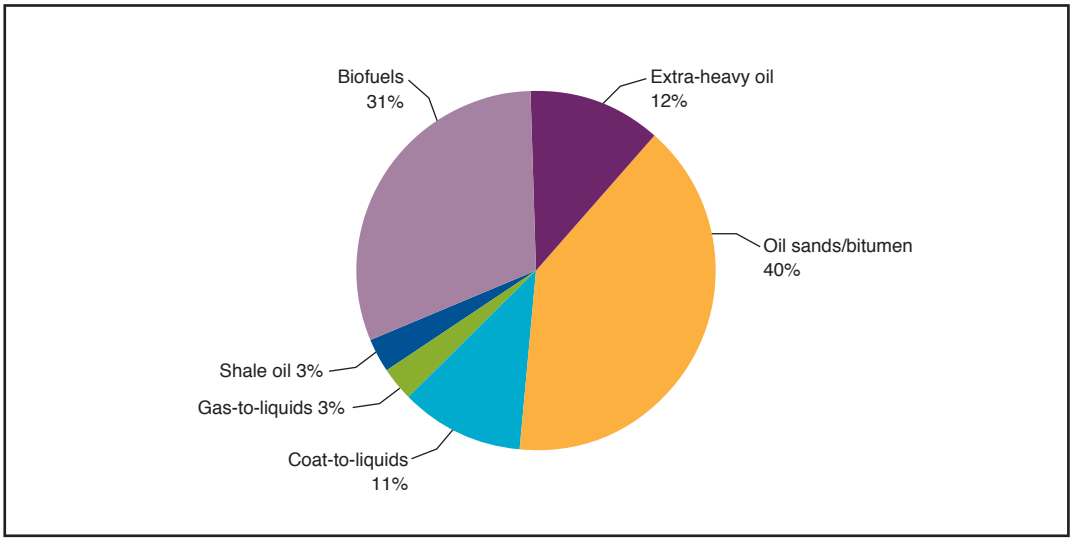
Note: Conventional liquids include crude oil, lease condensate, natural gas liquids and refinery gain. Unconventional liquids include biofuels, oil sands, extra heavy oil, coal-to-liquids, gas-to-liquids and shale oil.

Chart 5.13 shows that unconventional liquid fuels' contribution to total world liquid fuel supplies will grow from 3.5 mbpd in 2007 to 13.0 mbpd in 2035 and will account for about 37 per cent of the increase in total supplies over that period.

By 2035, the most important source of unconventional fuels will be oil sands (chart 5.14). These are sand deposits which contain (among other things) oil in solid or semi solid state. The mixture is heavy and viscous (bituminous and tar like) and must be heated in order to extract the oil from the sand deposits.[100]

100 The world's largest sources of oil sands are in Canada and Venezuela. Canada is considerably more advanced than Venezuela in its development of oil sand deposits.

Chart 5.14 Unconventional liquid fuels, by type of fuel: 2035



Source: US Energy Information Administration, *International energy outlook*, 2010, table 3, p. 24.

Note: Conventional liquids include crude oil, lease condensate, natural gas liquids and refinery gain. Unconventional liquids include biofuels, oil sands, extra heavy oil, coal-to-liquids, gas-to-liquids and shale oil.

Data in chart 5.14 indicates that after oil sands, the next largest source of unconventional fuels in 2035 is expected to be biofuels which will account for 31 per cent of all unconventional fuel supplies. Other important sources of unconventional fuels will be extra-heavy oil (12 per cent of total unconventional fuels) and coal-to-liquids (11 per cent of total unconventional fuels). These estimates indicate that in future the supply of conventional fuels will not keep pace with the world's requirements and will need to be increasingly supplemented with fuels produced from unconventional sources.

5.4.4 Strategic management of supplies

The ability of the global market to deal with unforeseen supply disruptions, such as those caused by severe weather events or geopolitical turmoil, by bringing additional supplies onto the market at short notice, depends on the extent to which supplies can be increased quickly or stocks released.

The ability of major suppliers to do this depends on the size of holdings of strategically held stocks, and their willingness to release them, and/or the potential to tap into spare crude production capacity.

The IEA is an energy forum established in 1974 to establish emergency supply security measures. Members of the IEA consist of OECD countries (including Australia) as well as some non-OECD countries. On 23 June 2011, member countries decided to release 60 million barrels of oil from their strategic reserves.[101] This was in response to supply disruptions at Libya's production facilities. This was the third time the IEA had released supplies of crude from its member countries' holdings of strategic supplies. Previously supplies had been released in the lead up to the Gulf War in 1991 and in the aftermath of Hurricane Katrina in 2005.

101 See International Energy Agency, *Medium-term oil and gas markets 2011*, p. 76. © OECD/IEA International Energy Agency.

Member countries of the IEA are required to hold oil stocks equivalent to at least 90 days of net imports. This is done in a variety of ways. In some countries, governments own stocks of oil. In other countries, governments require industry to hold a certain amount of compulsory stocks. Some countries are net exporters of oil or their market processes are such that they do not rely on formal arrangements. When governments release crude oil from their holdings of strategic stocks, these are typically released onto the market by a tender process. Some time may elapse before the crude is available for delivery into pipeline or ship.

Other countries deal with emergency disruptions differently. Member countries of OPEC, who are subject to production quotas, usually rely on the buffer provided by spare production capacity to meet unexpected demand–supply imbalances. OPEC's spare capacity enables member countries to act as the world's swing producer and take advantage of favourable market situations at relatively short notice.

There are varying estimates of OPEC's current spare capacity. The most recent estimate by OPEC is at around 4.5 mbpd.[102] According to the IEA, total OPEC capacity in 2011 is likely to be the lowest in four years even after Saudi Arabia's substantial investments in new capacity in 2009–10, mainly due to the loss of Libya's productive capacity. The IEA estimates that in 2011 average spare capacity may be around 3.15 mbpd.[103] The IMF, on the other hand, estimates OPEC's spare capacity at around 6 mbpd.[104] The IEA observes that most of OPEC's spare capacity is held by Saudi Arabia and that Iraq will provide about 70 per cent of OPEC's planned capacity expansion up to 2016.[105]

5.5 Refining capacity

Australia accounts for less than 1 per cent of the world's refining capacity.[106] As a net importer of fuel products, Australia's ability to meet its domestic requirements depends on the supplies of refined petrol in the region. According to the 2011 BP Statistical review, since 2000 the bulk of additions to the world's refining capacity have occurred in the Asia-Pacific region (chart 5.15).

102 See OPEC Secretary General, HE Abdalla S El-Badri, 'Asian energy outlook up to 2030', speech to the Fourth Asian Roundtable: Sustainable Growth and Energy Interdependence, Kuwait, 18 April 2011, at http://www.opec.org/opec_web/en/press_room/2036.htm, accessed 30 November 2011.

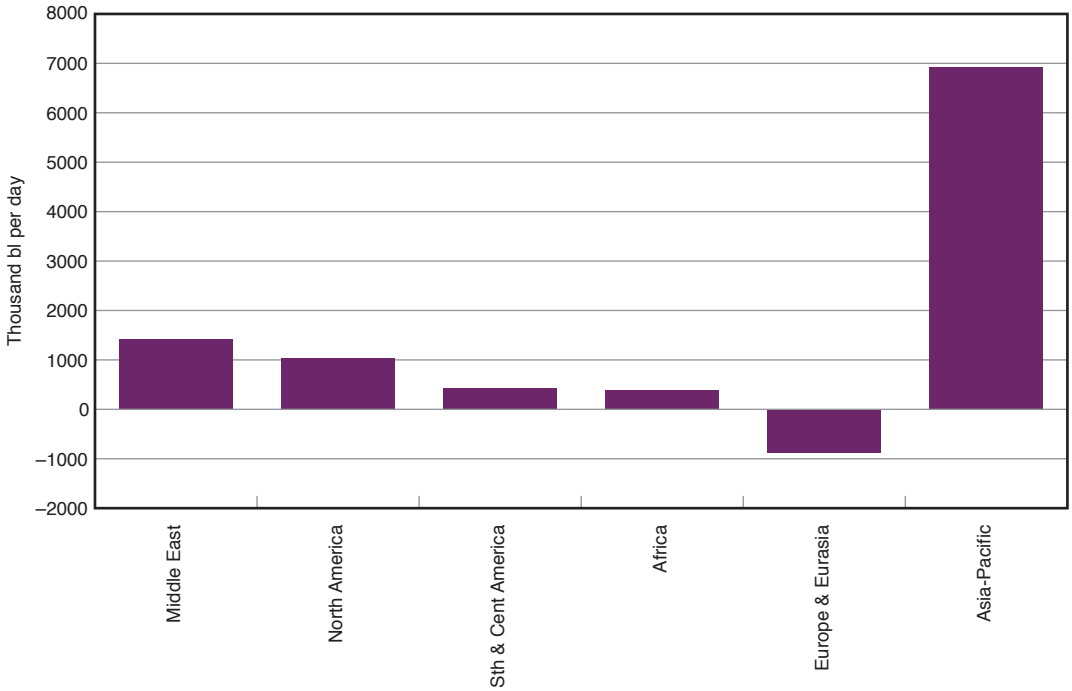
103 See International Energy Agency, press release, at http://www.iea.org/press/pressdetail.asp?PRESS_REL_ID=418, accessed 30 November 2011.

104 See International Monetary Fund, *World economic outlook*, April 2011, p. 99, at http://www.imf.org/external/pubs/ft/weo/2011/01/index.htm, accessed 30 November 2011.

105 See International Energy Agency, *Medium-term oil and gas markets 2011*, p. 76. © OECD/IEA International Energy Agency.

106 See BP, Statistical review of world energy, June 2011; historical data, at http://www.bp.com/sectionbodycopy.do?categoryId=7500&contentId=7068481, accessed 30 November 2011.

Chart 5.15 Growth in world refining capacity, by region: 2000 to 2010

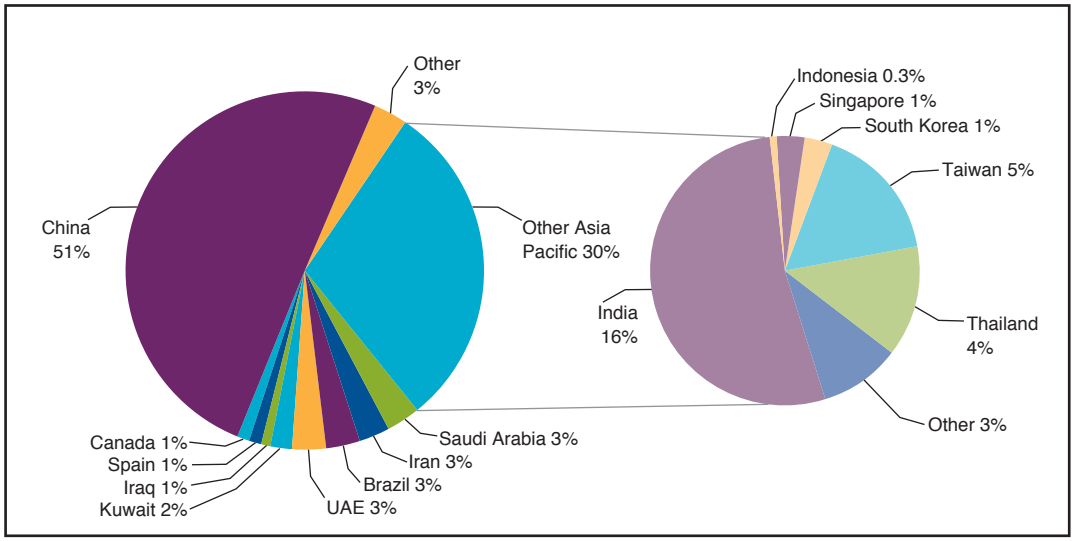


Source: BP, *Statistical review of world energy*, June 2011, p. 16, also at http://www.bp.com/sectiongenericarticle800.do?categoryId=9037130&contentId=7068669, accessed 30 November 2011.

Chart 5.15 shows that from 2000 to 2010 refining capacity in the Asia-Pacific region increased by almost 7 mbpd, about 74 per cent of the total increase in the world's refining capacity.

The majority of the growth in refining capacity in Asia-Pacific is accounted for by China, a net importer of refined petrol. Data in chart 5.16 shows that China has accounted for about 51 per cent of the growth in the world's refining capacity since 2000.

Chart 5.16 Growth in world refining capacity, by country: 2000 to 2010

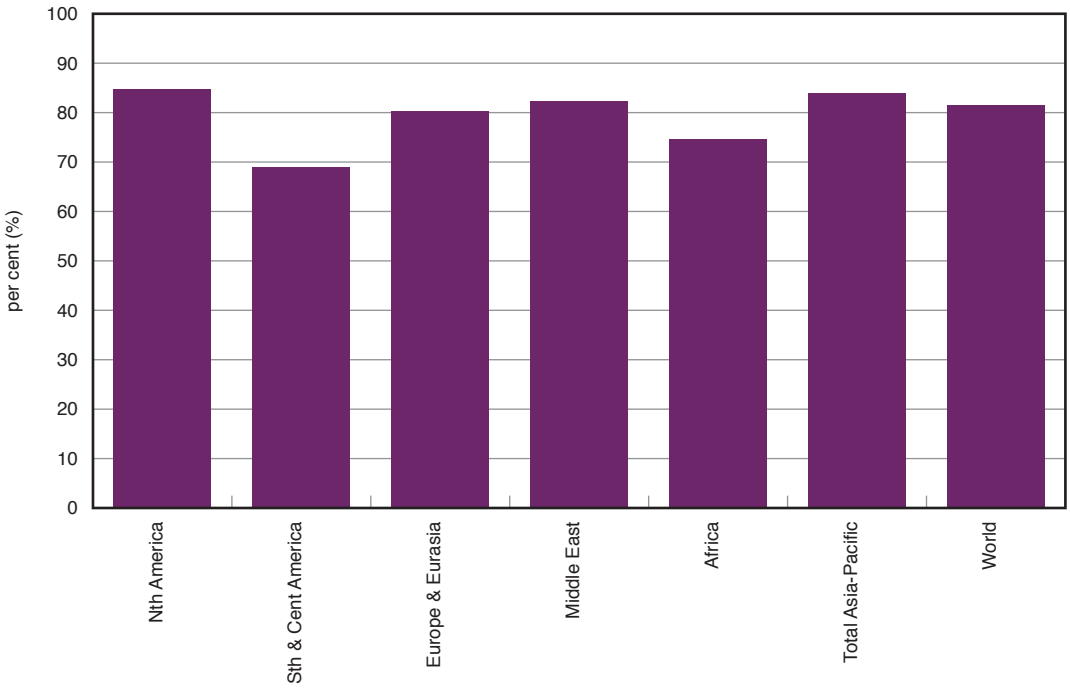


Source: BP, *Statistical review of world energy*, June 2011, p. 16, also at http://www.bp.com/sectiongenericarticle800.do?categoryId=9037130&contentId=7068669, accessed 30 November 2011.

Excluding China, the rest of the Asia-Pacific region (consisting mostly of countries that are net exporters of refined petrol) contributed around 30 per cent of total growth in refining capacity. India's refining sector accounted for about 16 per cent of the increase in the world's refining capacity and more than half of the growth among countries in the Asia-Pacific region, excluding China.

Refinery utilisation in 2010 was, on average, below capacity in most regions in the world, suggesting that there was scope, in the short term, for additional exports of refined petrol. Chart 5.17 presents data on refinery capacity utilisation rates by region for 2010.

Chart 5.17 Refining capacity utilisation rates, by region: 2010



Source: BP, *Statistical review of world energy*, June 2011, p. 16, also at http://www.bp.com/sectiongenericarticle800.do?categoryId=9037130&contentId=7068669, accessed 30 November 2011.

Average refinery capacity utilisation rates vary across regions in the world. Refineries in Central and South America operated at around 69 per cent capacity during 2010 while the average utilisation rate in North America was around 85 per cent.[107] The average utilisation rate in the Asia-Pacific region was 84 per cent.

By 2016, world crude distillation capacity is forecast to increase by 9.6 mbpd.[108] China is expected to account for around 34 per cent of the total increase while capacity in refineries in the rest of Asia will increase by 1.3 mbpd, or around 13 per cent of the total increase in capacity. The IEA reports that India is expected to increase refinery capacity by more than one mbd by 2016.[109] Since the commissioning of the Reliance refinery at Jamnagar in 2009, India has established itself as an exporter of high-quality product.

107 BP, *Statistical review of world energy*, June 2011, p. 16;
also at http://www.bp.com/sectiongenericarticle800.do?categoryId=9037130&contentId=7068669, accessed 30 November 2011.

108 International Energy Agency, *Medium-term oil and gas markets 2011 report*, table 5, p. 137. ©OECD/IEA International Energy Agency.

109 International Energy Agency, *Medium-term oil and gas markets 2011 report*, p. 108. © OECD/IEA International Energy Agency.

5.6 Potential limits to production of crude oil: peak oil

The cost of producing crude oil is a major influence on the prices of crude and petroleum products. Production costs vary depending on the source of supplies. How quickly existing sources of supply will have to be replaced by more costly non-conventional sources is at the heart of the so-called 'peak oil' issue.

The impact of the exhaustion of current supplies on costs, and therefore the price of crude oil and petrol prices, will depend to a large degree on how quickly existing oil reservoirs will be depleted and replaced by more costly sources of crude. There is much conjecture on the issue of how quickly current conventional sources of supply are being depleted. In essence, this issue is about whether or not the world is presently approaching, or has even approached, what is known as 'peak oil' production.

There appears to be some confusion about the concept of peak oil. Reaching peak oil does not mean running out of oil. Peak oil refers to the rate of production, not the level of production. Concerns about peak oil are centred on the issue of when crude oil production rates reach a maximum, not when the world runs out of crude oil. The world will not run out of crude after passing 'peak oil'; it is just that the rate at which it is produced will start declining, causing prices to rise.

The debate about peak oil stems from the fact that crude oil is a non-renewable resource with finite supply constraints. Furthermore, the level of economically extractable oil in any given reservoir is something less than the total available volumes. This is typically referred to as the level of crude oil 'reserves'. Oil from an individual reservoir can be extracted at an increasing rate up to a maximum point after which oil is produced at a declining rate. According to the theory the production rate for an individual reservoir roughly follows a bell-shaped curve with the maximum production rate typically happening after about half the reserves have been recovered.[110]

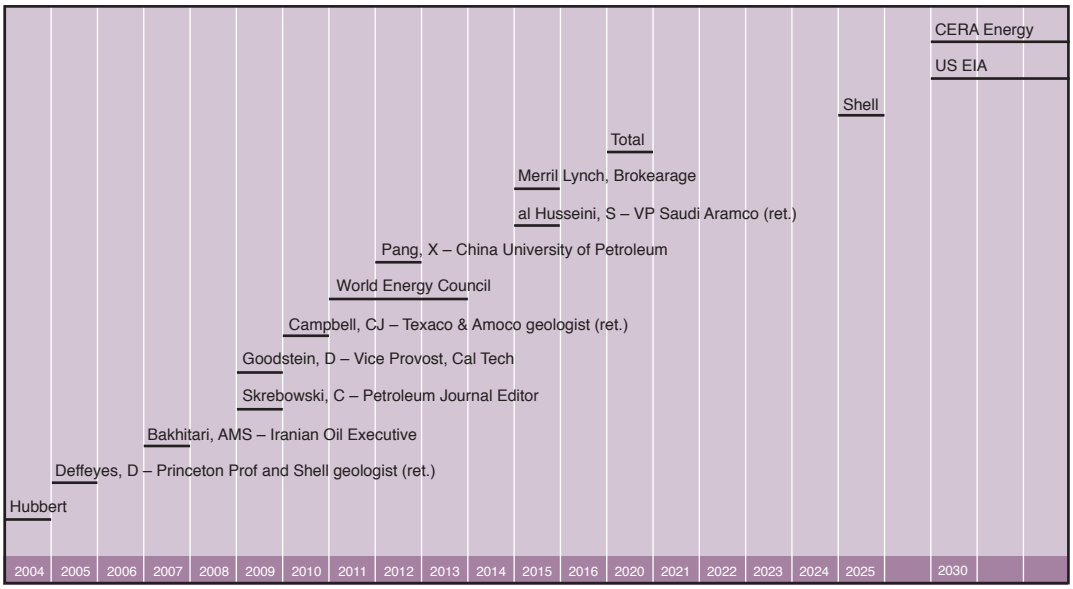
Peak oil has been reached for many oil fields and countries, including the US. World peak oil is the point at which the rate of production from the world's combined reserves of crude starts to decline. There are many difficulties associated with establishing the point of peak oil. One is that geological estimates of oil reserves are often based on judgment and are subject to considerable error. Furthermore, as noted in a 2007 study published recently by the British Department of Energy and Climate Change 'in the literature of peak oil, the use of different data and a lack of standardised definitions and methodologies leads to significant disagreement about even the basic empirical facts'.[111]

110 Known as the Hubbert curve after MK Hubbert, a geophysicist who while working for Shell in 1956 proposed that the rate of production over time from a crude oil field would follow a bell-shaped curve. See MK Hubbert, 'Nuclear energy and fossil fuels', presented to the American Petroleum Institute, March 1956, at http://www.oilcrisis.com/hubbert/, accessed 30 November 2011.

111 See *The guardian*, 'UK ministers ignored "peak oil" warnings, report shows', 15 June 2011, at http://www.guardian.co.uk/environment/2011/jun/15/peak-oil-warning, accessed 30 November 2011. See also 2007 report by the then British Department of Business Enterprise and Regulatory Reform, at http://www.decc.gov.uk/publications/basket.aspx?filetype=4&filepath=What+we+do%2fGlobal+climate+change+and+energy%2fInternational+energy%2fenergy+security%2f1790-decc-report-2009-oil-decline.pptx&minwidth=true#basket, accessed 30 November 2011.

Not surprisingly, the IEA noted in 2010 that 'the size of ultimately recoverable resources of both conventional and unconventional oil is a major source of uncertainty for the long-term outlook for world oil production'.[112] Reflecting this, a recent summary of estimates of when peak oil may occur shows that there is a wide range of possible scenarios considered by industry forecasters (see Figure 5.1).

Figure 5.1 Peak oil forecasts



Source: Based on 'Peaking of world oil production: recent forecasts', RL Hirsch, Senior Energy Program Advisor (Science Applications International Corporation), April 2007, at http://www.worldoil.com/April-2007-Peaking-of-world-oil-production-Recent-forecasts.html, accessed 30 November 2011.

Note: Forecast year of peak oil is underlined in table. According to RL Hirsch: ExxonMobil sees no sign of peak oil, BP considers that it is impossible to predict, while OPEC denies the theory of peak oil.

Notwithstanding the absence of consensus about the mechanics and the precise timing of peak oil, it seems clear that as oil is a non-renewable resource, eventually global production will decline. Increasingly, pronouncements from the major energy agencies suggest that the rate of global production may be approaching peak levels in the next two decades.

The IEA, for example, has estimated that by 2035 about 75 per cent of crude oil production from existing fields will have passed its peak.[113] According to the IEA, this represents around '50 mbpd, which is equivalent to about four times the production capacity of Saudi Arabia, the world's largest oil producer'.[114]

112 International Energy Agency, *World energy outlook 2010*, Executive summary, p. 6, at http://www.worldenergyoutlook.org/, accessed 30 November 2011.

113 Nobuo Tanaka, IEA 'Oil in the global energy mix: climate policies can drive an early peak in oil demand', 13 April 2011, at http://www.iea.org/index_info.asp?id=1928, accessed 30 November 2011.

114 Ibid.

The implications of such scenarios are apparent: unless there is substantial production of crude oil from newly discovered fields and unconventional sources to compensate for the projected decline in existing fields, then demand will continue to outstrip supply of conventional crude oil and prices will continue to rise.

Indeed, prices are likely to rise in the future even if production from newly discovered fields and unconventional sources make up for the loss of production in mature existing fields. As noted in the previous section, existing fields are the cheapest sources of crude oil. Production from new more remote oil reservoirs and from unconventional sources is likely be more costly and viable only at higher prices.

5.7 Prospects for crude oil prices

The volatility seen in crude oil prices in the last few years suggests that predicting future prices remains an extremely difficult task. As discussed in the previous section, prices are the outcome of a complex interaction of many factors impacting on both demand and supply, including:

- responsiveness of demand to changes in prices and income levels
- the rate of decline of existing crude oil fields
- the cost of discovering and exploiting new fields
- technological changes that improve recovery rates at existing fields and exploitation of more remote fields
- prices of alternative fuels and energy sources
- 'above ground' or geopolitical factors.

An additional layer of uncertainty stems from an increase in possible speculative activity. According to OPEC, increasingly prices also seem to be influenced by the activities of global commodity traders. OPEC claims that in recent years there has been a 'rapid increase in the participation of non-commercial traders' such as investment banks and funds that look to make profits from movements in oil prices rather than from conventional investments.[115]

In terms of market fundamentals, the supply and demand scenarios considered in this chapter suggest that in the short to medium term, growth in demand may outstrip supplies of conventional crude oil and that the costs of supply are likely to increase as the marginal sources of supply become more costly. The most likely future price path is one with an upward bias.

The IEA's short- to medium-term forecast indicates that by 2016, global demand for oil will grow 7.2 mbpd while total supply capacity will expand 6.8 mbpd, suggesting a widening supply shortfall.[116] According to the IMF, growth in global production capacity is likely to remain modest with the main buffer being provided by OPEC's spare capacity.[117] With supply being constrained in the short run, there may be limited scope to accommodate demand surprises.

115 OPEC, *World oil outlook 2010*, p. 24, at http://www.opec.org/opec_web/en/publications/340.htm, accessed 30 November 2011.

116 International Energy Agency, *Medium-term oil and gas markets 2011 report*, pp. 37, 60, ©OECD/IEA International Energy Agency.

117 See International Monetary Fund, *World economic outlook*, April 2011, p. 99, at http://www.imf.org/external/pubs/ft/weo/2011/01/index.htm, accessed 30 November 2011.

Whether world demand can continue growing at the pace seen in recent years if crude prices remain at current high levels is a matter of conjecture. As the US EIA observes, 'the impacts of world prices on energy demand are a considerable source of uncertainty …'.[118] The IEA further comments that 'although … rising income per capita will remain a far more central driver of global oil demand growth than prices, another spike in international prices may jeopardise the ongoing global economic recovery'.[119]

A number of baseline forecasts, that is, scenarios that exclude demand and supply shocks, indicate that, in the short to medium term, it is likely that the outcome from the dynamics of the interplay between supply and demand is at least a continuation of recent high price levels. For example:

- In Australia, the Australian Bureau of Agricultural and Resource Economics projects average WTI prices of around USD 90–95/bl up to 2016.[120]
- The IEA forecasts average import prices of around USD 101/bl in 2016 based on Brent futures.[121]
- The US EIA projects WTI prices of USD 100/bl by 2017.[122]
- The IMF warns that while its base case rests on the assumption that the tension between demand and supply is likely to be 'resolved with oil prices around current high levels',[123] 'on balance risks to prices remain on the upside …'.[124]

The evidence considered in this chapter indicates that the global crude oil market may have shifted to a new paradigm. Demand will continue to be driven by strong growth in emerging economies while supply will be affected by depletion of existing cheap sources of crude and increasing reliance on more costly conventional and non-conventional sources. In this new paradigm, it would be extremely unlikely for oil prices to sustainably fall back to the prices seen in the period 1985–2005 when oil averaged less than $25 a barrel.

118 US Energy Information Administration, *International energy outlook*, 2010, p. 25.

119 International Energy Agency, *Medium-term oil and gas markets 2011 report*, p. 43, ©OECD/IEA International Energy Agency.

120 See ABARE, *Australian commodities*, vol. 18 no. 1, March quarter 2011, p. 137.

121 International Energy Agency, *Medium-term oil and gas markets 2011 report*, pp. 23–4, ©OECD/IEA International Energy Agency.

122 US Energy Information Administration, *International energy outlook*, 2010, pp. 25–7.

123 See International Monetary Fund, *World economic outlook*, April 2011, p. 89, at http://www.imf.org/external/pubs/ft/weo/2011/01/index.htm, accessed 30 November 2011.

124 See International Monetary Fund, *World economic outlook*, April 2011, p. 35, at http://www.imf.org/external/pubs/ft/weo/2011/01/index.htm, accessed 30 November 2011.