



Long Term Dynamics of Crude Oil Markets

Shifting Paradigms in the Price of Oil

**Ramón Espinasa
Carlos G. Sucre**

**Inter-American
Development Bank**

Infrastructure and
Environment

Energy

TECHNICAL NOTE

No. IDB-TN-726

December 2014

Long Term Dynamics of Crude Oil Markets

**Shifting Paradigms in
the Price of Oil**

Ramón Espinasa
Carlos G. Sucre



Inter-American Development Bank

2014

Cataloging-in-Publication data provided by the
Inter-American Development Bank
Felipe Herrera Library

Cataloging-in-Publication data provided by the
Inter-American Development Bank
Felipe Herrera Library

Espinasa, Ramón.

Long term dynamics of crude oil markets: shifting paradigms in the price of oil / Ramón Espinasa, Carlos Sucre.

p. cm. — (IDB Technical Note ; 726)

1. Petroleum industry and trade—Supply and demand. 2. Petroleum products—Prices. 3. Market surveys. I. Sucre, Carlos. II. Inter-American Development Bank. Energy Division. III. Title. IV. Series. IDB-TN-726

JEL code: Q4; Q41; Q43

Keywords: Crude oil; oil price; oil markets

<http://www.iadb.org>

The opinions expressed in this publication are those of the authors and do not necessarily reflect the views of the Inter-American Development Bank, its Board of Directors, or the countries they represent.

The unauthorized commercial use of Bank documents is prohibited and may be punishable under the Bank's policies and/or applicable laws.

Copyright © 2014 Inter-American Development Bank. All rights reserved; may be freely reproduced for any non-commercial purpose.

1300 New York Avenue NW, Washington, DC

ramones@iadb.org / csucre@iadb.org

Abstract

This note provides a long term perspective on the decline in the price of crude oil taking place in the global oil market over the second half of 2014 by analyzing the fundamentals of the crude oil market and how they have changed since 1986, when the first important break of the last 30 years in the price of crude oil took place and also since 2002, when the second break in the price trend occurred. The note first provides an overview of the global petroleum demand patterns, paying particular attention to the shift in demand sources and its impact on the price of crude oil. The note then takes a close look at the changes in sources of crude oil supply that have emerged on the global scene over the past five years, with special attention given to increased output in North America as an explanatory factor behind the decline in the price of crude oil seen over the second half of 2014.

JEL Codes

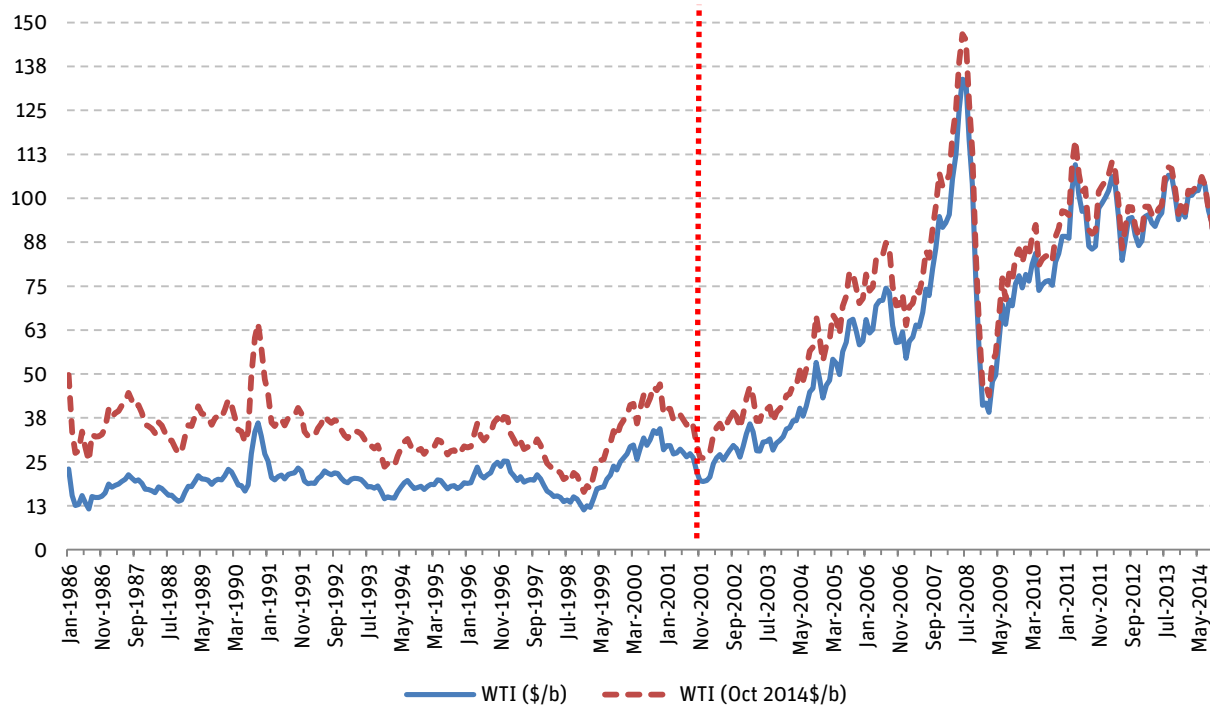
Q4; Q41; Q43

Keywords

energy supply; crude oil; oil price; oil market

Following a decade of geopolitical turmoil that led the price of crude oil to trade between US\$60 and US\$100 per barrel (\$/b) in real terms, by 1986 crude oil prices – measured here by the West Texas Intermediate (WTI) benchmark – began to settle around 20 \$/b. This period of relatively low prices lasted for 15 years and began a remarkable upward trajectory in 2002. Between January 2002 and June 2008, the real price of WTI more than quintupled, from 28 \$/b to 147 \$/b.

Figure 1 | West Texas Intermediate (WTI) crude oil price, real (Oct 2014 \$) and nominal



Source: Energy Information Administration

Although the price of crude did fall to around 40 \$/b in the aftermath of the financial crisis from its July 2008 record high level, between January 2002 and December 2012 the price of crude oil increased nearly four times from 27 to 91 \$/b. Other commodities such as metals & minerals, food, and non-energy commodities have shown a similar pattern since 2002 as their price level has increased by a factor of 2 to 4.

More recently, however, a new pattern may be emerging for the price of crude oil.

In June 2014, West Texas Intermediate sold at 106 \$/b. At the close of markets on August 29, 2014, WTI was selling for 97 \$/b. This whopping drop of 10 dollars per barrel in just two months was only the beginning of an emphatic fall in the price of crude oil for all of its benchmark products. By the end of September, commodity markets priced WTI at 91 \$/b and this price kept falling all through October until reaching 80.5 \$/b on October 31.

Over the first two weeks of November 2014, markets broke through the 80 \$/b threshold and closed at 74 \$/b on November 13, 2014. Over the last half of the month, the decline continued and a barrel of crude oil sold for 64 \$/b on the last day of trading in November 2014 and traded around 65 \$/d over the first week of December 2014.

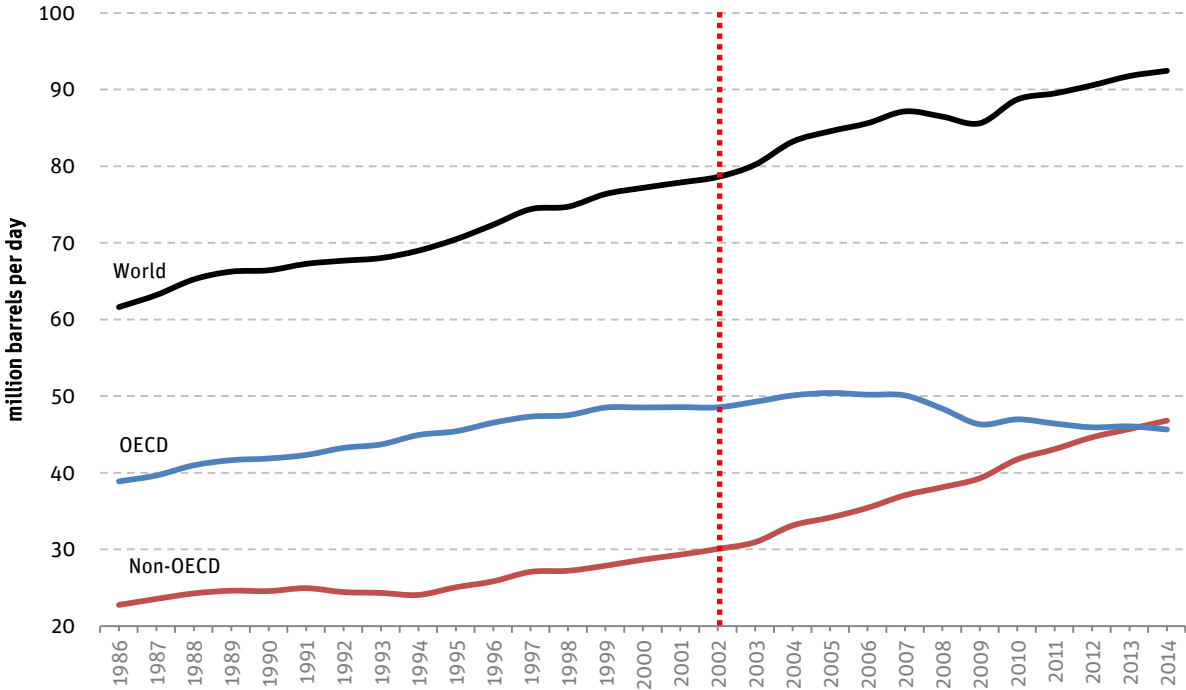
Very clearly this recent and sustained drop strongly diverges from the pattern followed by the price of crude oil since 2002. This note attempts to provide a fundamental explanation behind this decline of nearly 40% since June 2014 by analyzing recent changes in the global patterns of demand and supply of petroleum, following the commodities super cycle that began in 2002.

Demand Push

In global terms, crude oil demand stands at just above 90 million barrels per day (Mbd), having increased by 30 Mbd since 1986. This global figure can be broken down into two large components around country clusters: those belonging to the Organization for Economic Co-operation and Development (OECD) and those not belonging to that organization (Non-OECD). The former includes the so-called developed countries, the United States, most of Western Europe, Japan, Australia, Canada, and Mexico among others. Among the non-OECD countries are Russia, China, Brazil, India, the Middle East and most of Asia, Africa and Latin America.

At the beginning of the high price trend in 2002, the OECD demanded 49 Mbd per day while Non-OECD nations consumed 30 Mbd. Between 2002 and 2014,¹ OECD demand actually declined by 0.5% per year and by 2013 the most developed nations in the world were demanding 46 Mbd – a full 3 Mbd less than their 2002 level, as shown in Figure 2.

Figure 2 | Global Petroleum Consumption



Source: International Energy Agency

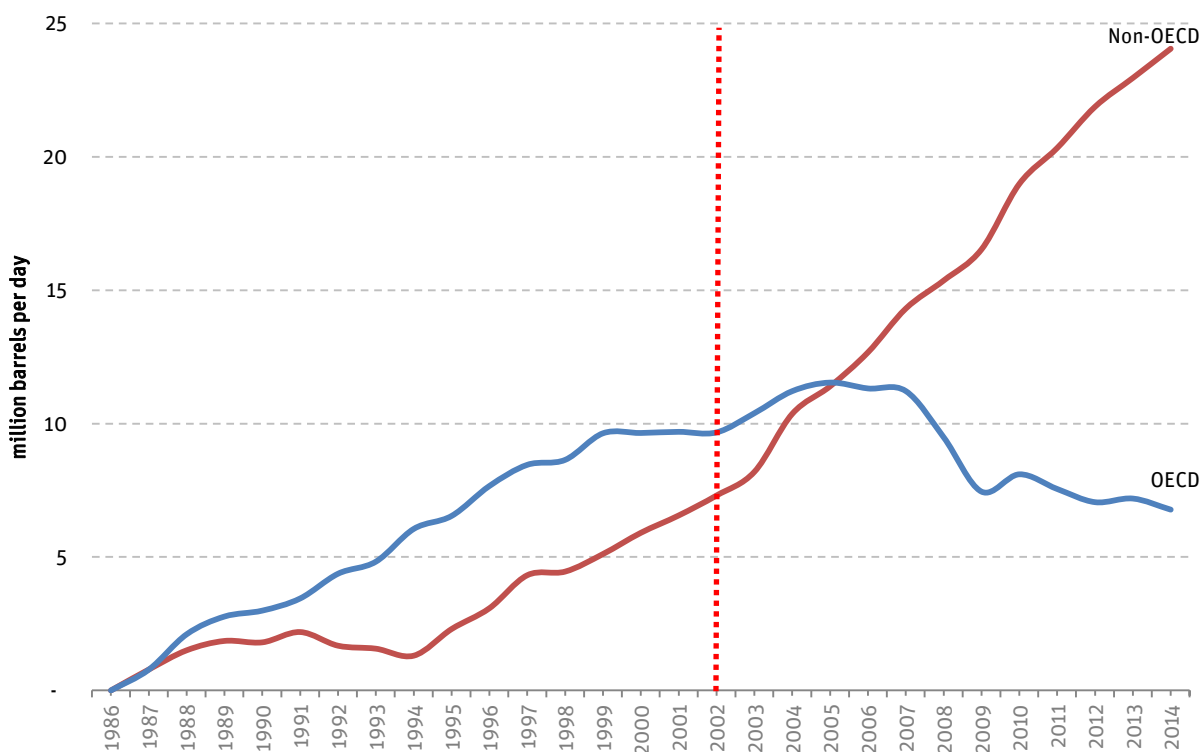
In stark contrast, between 2002 and 2014 non-OECD demand rose by 4% per year and stood at 47 Mbd by 2014, a figure 50% higher than its 2002 level. This tremendous increase in non-OECD

¹ Figures for 2014 throughout this documents are estimates made by the International Energy Agency from official data

demand is understood to be the main driver² behind the rapid and dramatic increase in the price of crude oil – and most other commodities – during the first decade of the twenty-first century³ as described above.

Measured relative to 1986, Non-OECD countries contributed more than two thirds of the increase in global oil demand of 30 Mbd with these countries increasing their demand by 24 Mbd and OECD countries growing by only 7 Mbd, as seen in Figure 3. This difference is particularly noticeable from 2002, when OECD demand plateaued and began to decline in response to escalating crude oil prices while Non-OECD countries sharply increased consumption. The increase in prices was due to a demand-side push caused by sharp and sustained economic growth in the developing world during the first decade of this century.

Figure 3 | Change in Global Petroleum Consumption Relative to 1986



Source: International Energy Agency

Particularly important to explaining the upward pressure of non-OECD demand on the price of crude oil is the growth in consumption since 2002 of Asian nations outside of the OECD, strongly tied to high levels of economic growth over that span.⁴ Breaking down non-OECD demand into Asian and non-Asian components we note that the driver of non-OECD demand is growth in Asian demand.⁵

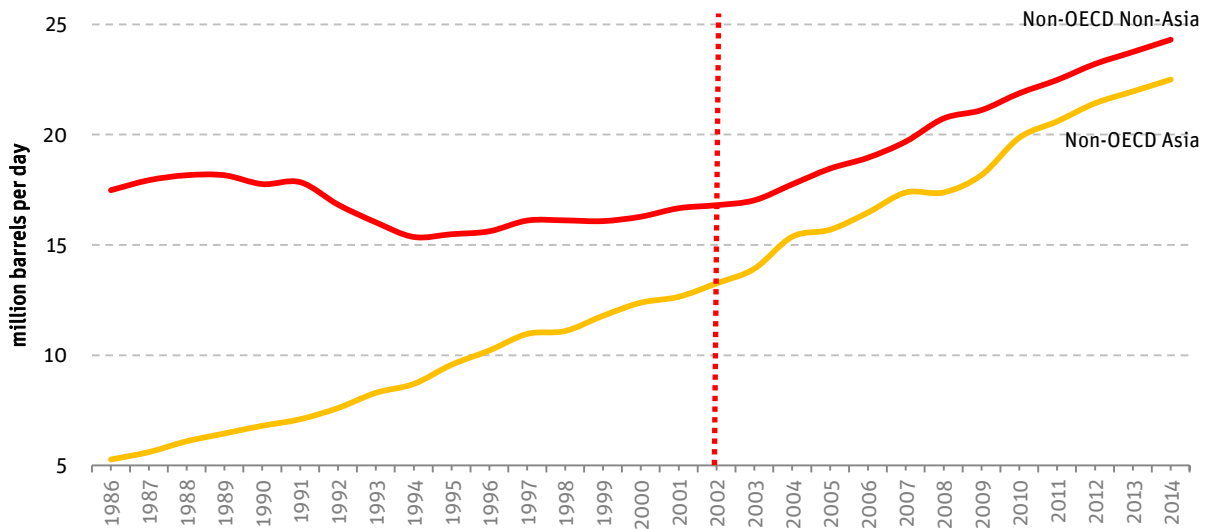
² Nigel Pain, Isabell Koske and Marte Sollie, “Globalisation and OECD Consumer Price Inflation,” *OECD Economic Studies*: 44 (2008), available at <http://www.oecd.org/eco/42503918.pdf>

³ Lutz Killian and Bruce Hicks, “Did Unexpectedly Strong Economic Growth Cause the Oil Price Shock of 2003–2008?” *Journal of Forecasting*: 32-5 (2013): 385–94, doi/10.1002/for.v32.5/.

⁴ Pain, Koske, Sollie (2008)

⁵ International Energy Agency, “Background Paper for the 14th International Energy Forum Ministerial Meeting Moscow 15-16 May 2014,” *International Energy Forum*, 2014. Available at: <https://www.ief.org/resources/files/events/ief14/ief14-iea-background-paper.pdf>

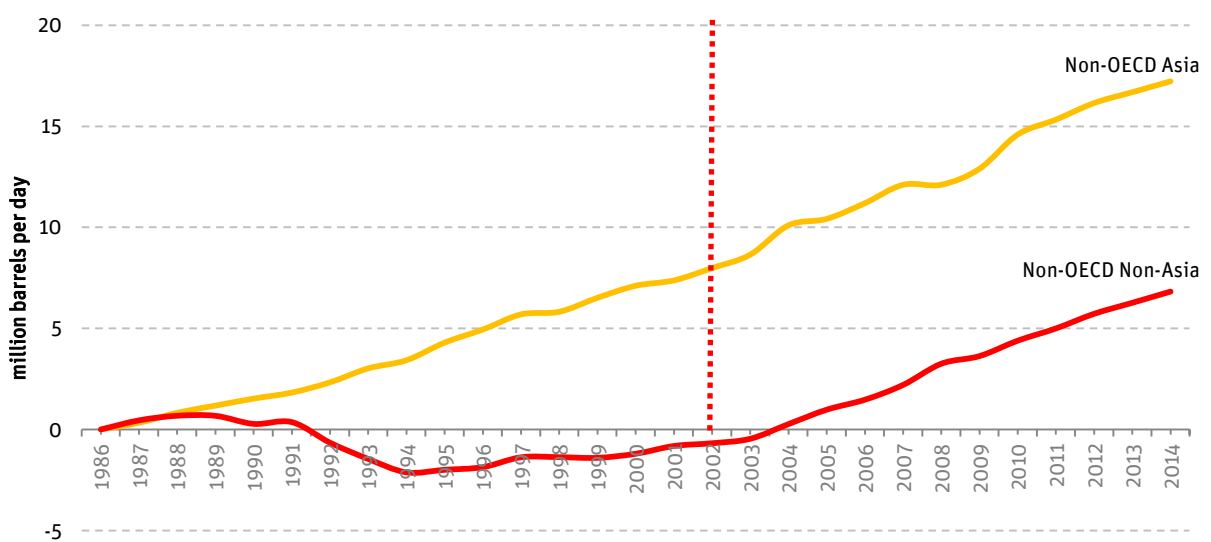
Figure 4 | Non-OECD Petroleum Consumption



Source: International Energy Agency

When the price of crude oil began its low-level period in 1986, petroleum demand by Asian countries that did not belong to the OECD represented only 23% of demand from non-OECD nations. Since then, Asian non-OECD demand has increased by a whopping 17 Mbd and these countries now account for 48% of total non-OECD demand. Over the same span, demand by non-OECD countries outside of Asia only increased by 7 Mbd and fell from 77% in 1986 to 52% of total non-OECD demand. This can be seen in Figures 4 and 5.

Figure 5 | Change in Non-OECD Petroleum Consumption Relative to 1986



Source: International Energy Agency

It is clear then that while OECD demand has remained stagnant for most of the last decade and its consumption of oil has actually fallen since the turn of the century, economic growth fuelling increased oil demand in non-OECD nations have led to a sustained upward trajectory in the price of

crude oil.⁶ It is important to note – however – that since 2012 and 2014, the rate of growth of non-OECD demand has fallen from 4% to 2.4% while OECD demand has remained flat. World oil demand is slowing down as a consequence.

Recent demand slowdown

The detailed analysis of demand dynamics since 1986 can be seen in Table I. It is most important to notice the deceleration of the rate of annual rate of growth of demand across the board in the last two years, 2012-14, as compared to the average annual rate of growth of demand for the period 2002-12.

Furthermore, recent economic growth estimates by the International Monetary Fund (IMF) indicate that the slowdown in oil demand may be part of a larger pattern of lower economic growth throughout most large economies. In its October 2014⁷ estimates for 2015, the IMF revised downward the growth prospects it had first issued in April 2014 for most of the world's largest economies.

The world economy as a whole is now expected to grow at 2.6% in 2015, when in April 2014 the forecast was to expand by 3%. This announcement precipitated the collapse of world oil prices during the fall annual IMF-WB meetings, when the announcement was made.

Table 1 | Petroleum Consumption

million barrels per day	1986	2002	2012	2013	Est. 2014	% World Demand	Growth 2002-14	CAGR 2002-12	CAGR 2012-14
World	61.6	78.6	90.5	91.8	92.4	100%	18%	1.4%	1.0%
Non-OECD	22.8	30.1	44.6	45.7	46.8	51%	56%	4.0%	2.4%
OECD	38.9	48.5	45.9	46.1	45.6	49%	-6%	-0.6%	-0.3%
Non-OECD Non-Asia	17.5	16.8	23.2	23.7	24.3	26%	45%	3.3%	2.3%
Non-OECD Asia	5.3	13.3	21.4	22.0	22.5	24%	70%	4.9%	2.5%
USA	16.6	20.1	18.8	19.3	19.3	21%	-4%	-0.7%	1.3%
China	2.0	5.1	9.8	10.1	10.3	11%	102%	6.7%	2.7%
Japan	4.5	5.3	4.7	4.5	4.3	5%	-19%	-1.2%	-4.3%
India	1.0	2.4	3.8	3.8	3.9	4%	61%	4.5%	1.5%
Russia	-	2.7	3.4	3.5	3.6	4%	34%	2.4%	2.9%

Source: International Energy Agency

Demand has had a clear effect on the price of crude oil over the past decade,⁸ fueled by growth in demand in emerging markets and particularly in the developing economies of Asia. Slower growth – therefore – of demand for crude oil is understood to have a tampering effect on the price for that commodity. Yet, it is our contention that most of the explanation for the sustained drop in prices over the last two years, and particularly in the last four months, is to be found on the dynamics of the supply side of the market.

⁶ Kilian & Hicks (2013)

⁷ International Monetary Fund, "World Economic Outlook: Legacies, Clouds, Uncertainties," *International Monetary Fund* (October 2014). Available at <http://www.imf.org/external/pubs/ft/weo/2014/02/pdf/text.pdf>

⁸ International Energy Agency (2014)

Shifting supply and the price surge

While global oil demand is analyzed via its OECD and non-OECD components, the production of oil⁹ is broken down into three groups: the Organization of Petroleum Exporting Countries (OPEC), the OECD, and countries belonging to neither OPEC nor the OECD. This last group is important as it includes Russia, China, Brazil, Kazakhstan, and Colombia, all of which are major producers.

Table 2 | Global Production of Oil (Crude, Natural Gas Liquids, and Non-Conventional Oils)

million barrels per day	1986	2002	2012	2013	1H 2014	% World Supply	Growth 2002-1H2014	CAGR 2002-12	CAGR 2012 -1H2014
World	61.9	77.3	90.8	91.3	92.4	100%	20%	1.6%	0.9%
OPEC	19.9	28.8	37.5	36.7	36.4	39%	26%	2.7%	-1.5%
Non-OPEC / Non-OECD	22.3	24.6	29.5	29.5	29.7	32%	21%	1.8%	0.3%
OECD	19.7	21.7	19.8	20.9	22.2	24%	2%	-0.9%	5.9%

Source: International Energy Agency

The three groups divide up global production of crude oil, natural gas liquids and unconventional oils, defined by the International Energy Agency in the following way: OPEC produced 37 Mbd in 2013, while OECD output reached 21 Mbd, around 56% of OPEC's supply. Countries belonging to neither organization, non-OPEC non-OECD, produced 30 Mbd in 2013.

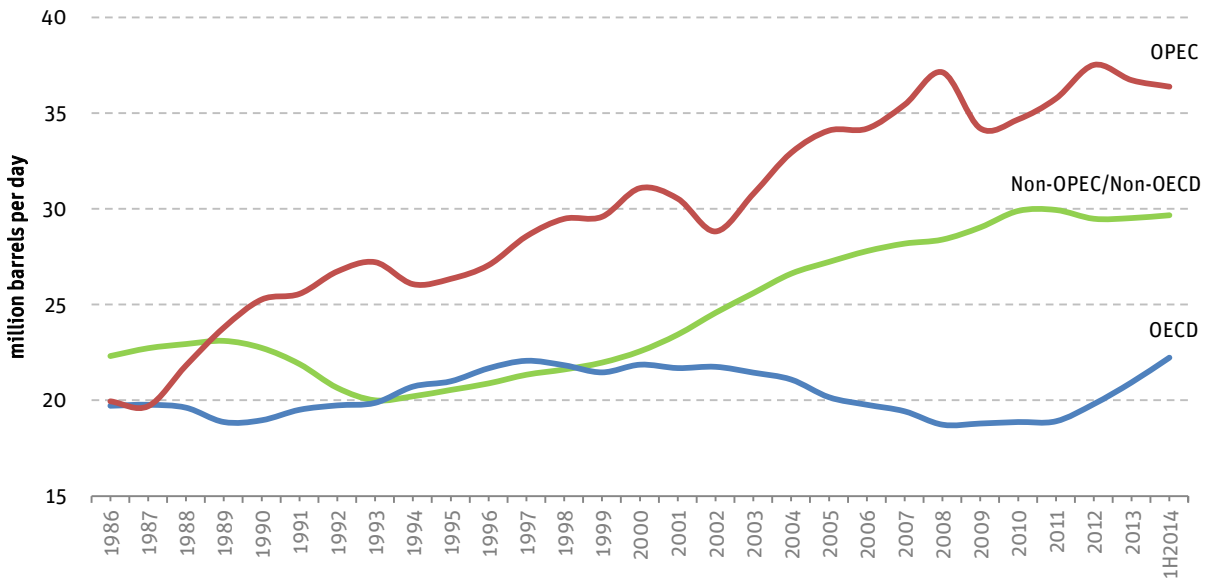
Preliminary figures for the first half of 2014 (1H2014) show that OPEC and Non-OECD/Non-OPEC output has remained practically unchanged at 36.4 and 29.7 Mbd respectively while OECD countries have added around 2.4 Mbd to the market from their 2012 level. Table 2 shows the sharp acceleration in OECD supply in the last two years compared to the previous ten as well the contraction in OPEC supply and the stagnation in Non-OPEC/Non-OECD supply.

In 1986, OPEC and OECD countries produced nearly identical levels of oil: 20 million barrels per day. Over that time, however, both groupings responded to the dynamics of the global market in starkly different fashions.

As the largest producer in 1986, Non-OPEC/Non-OECD countries – led by the Soviet Union – collapsed following the breakup of the USSR, OPEC countries began expanding production at a rapid pace in order to gain market share under the low-price structure that had set in place in the market since 1986. Since 1986, OPEC production increased by a whopping 17 Mbd to 36 Mbd. It is important to note that the first sharp increase in OPEC supply after 1986 was swift and steady making use of spare capacity shut down to defend to no avail the high prices of the early 1980s. This can be seen in Figures 6 and 7.

⁹ Note that the global supply section of this document refers to the production of crude oil, natural gas liquids and non-conventional oils. Detailed sections on country production will refer to crude oil exclusively.

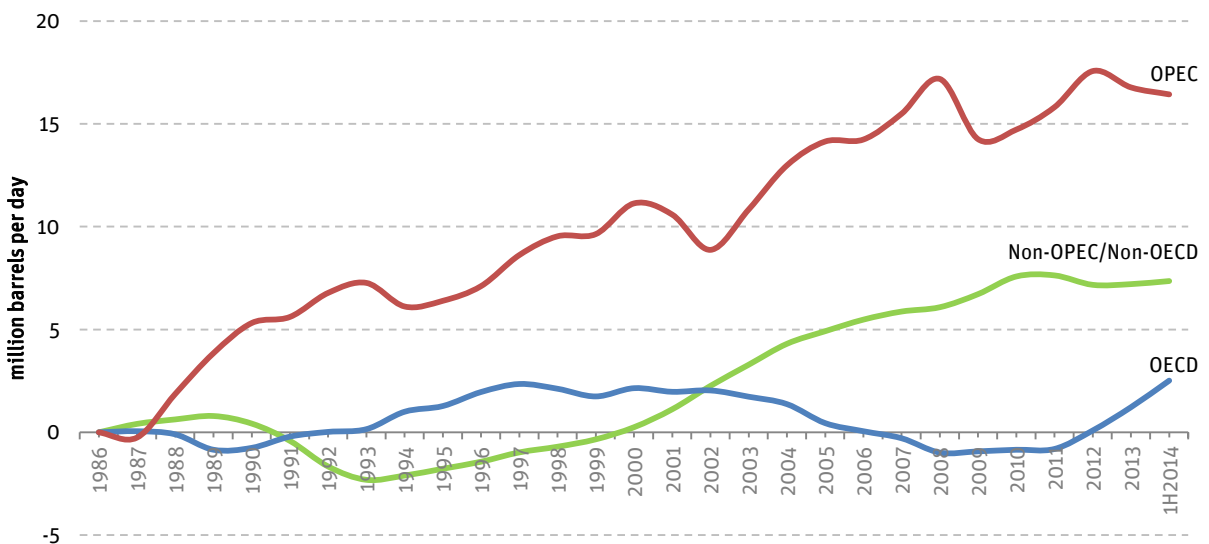
Figure 6 | Global Production of Oil



Source: International Energy Agency

OECD countries, on the other hand, have very slightly increased production since 1986 and today that country cluster produces only 1.2 Mbd more than it did in 1986. However, between 2007 and 2011, OECD countries were producing around 0.7 Mbd less than their 1986 level. The recent reversal of that trend, as we will discuss below in further detail, has occurred thanks to sharp increased output from North America.

Figure 7 | Changes in Oil Production by Country Cluster Relative to 1986

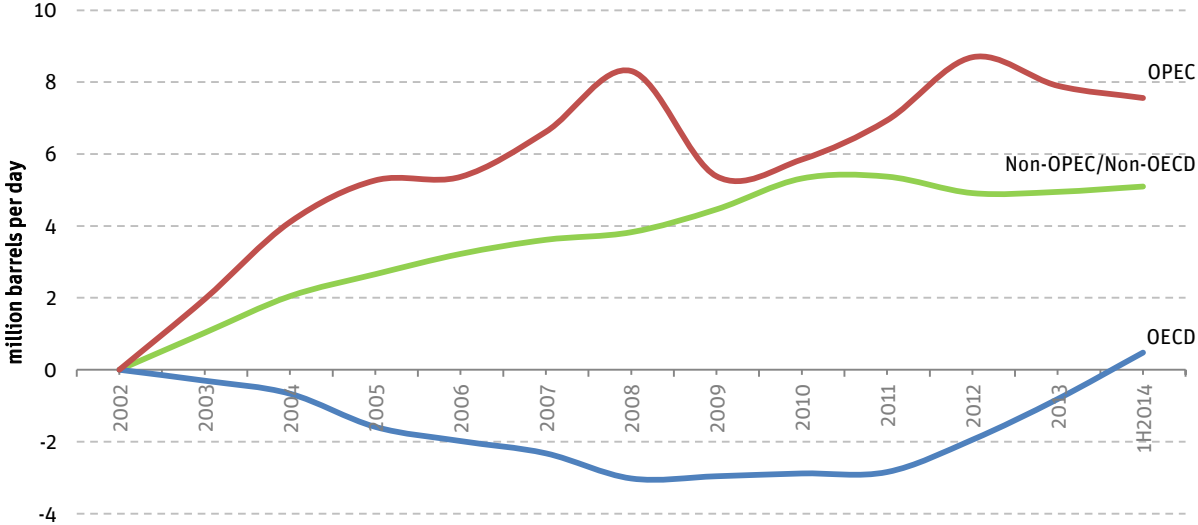


Source: International Energy Agency

Since the break in the price trend that occurred in 2002, OPEC production increased by 8 Mbd in response to the price hike, although its output actually fell around 0.8 Mbd between 2012 and 2013 and a further 0.3 Mbd between 2013 and the first half of 2014. In the same period Non-OECD/Non-

OPEC output expanded by 5 Mbd with the re-emergence of Russian production but the group’s output level has stagnated around the 30 Mbd mark with little growth since 2010.

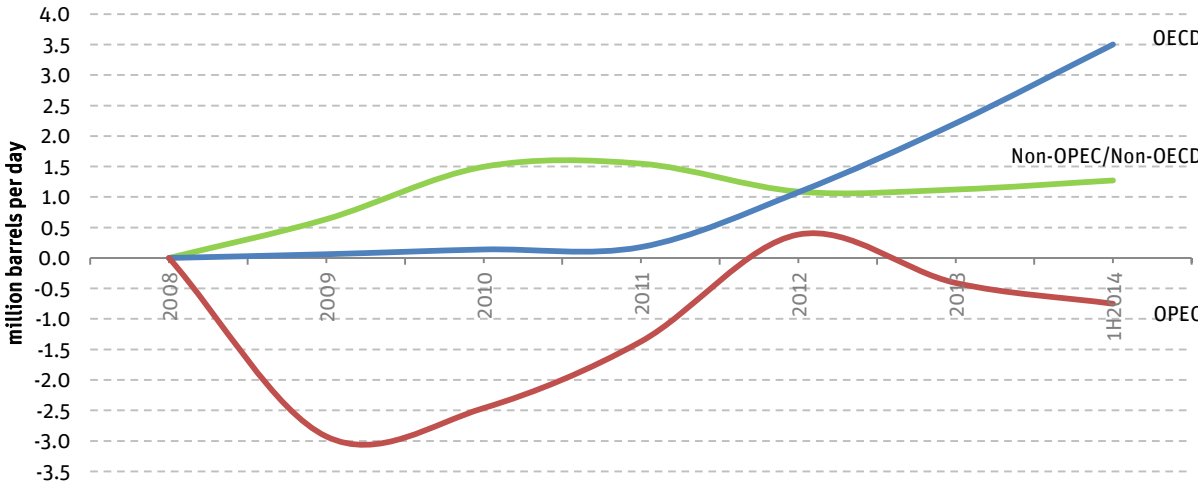
Figure 8 | Changes in Oil Production by Country Cluster Relative to 2002



Source: International Energy Agency

The OECD, on the other hand, is following a very different trajectory. While output between 2002 and 2013 fell by 0.8 Mbd due to the depletion of the fields in the North Sea, over the past five years it has been the fastest growing group of countries among the three. Between 2008 and 2012, OECD output expanded by 6% and between 2012 and the first half of 2014, total oil production in the OECD increased by a further 12%, as shown in Figure 9.

Figure 9 | Changes in Oil Production by Country Cluster Relative to 2008



Source: International Energy Agency

The main factor behind the rapid pace of growth of OECD production is rapid growth in the production of crude oil¹⁰ (excluding natural gas liquids and unconventional oils) in the North American constituency of the OECD: Mexico, Canada, and the United States as shown in Table 3.

Table 3 | Global Production of Crude Oil

million barrels per day	1986	2002	2012	2013	1H 2014	% World Supply	Growth 2002-1H2014	CAGR 2002-2012	CAGR 2012-1H2014
Russia	11.0	7.4	10.0	10.1	10.1	13%	37%	3.0%	0.8%
Saudi Arabia	4.8	7.4	9.5	9.4	9.5	12%	29%	2.6%	-0.2%
USA	8.7	5.7	6.5	7.4	8.3	11%	44%	1.2%	13.1%
China	2.6	3.3	4.1	4.1	4.2	6%	25%	2.1%	0.7%
Iraq	1.7	2.0	3.0	3.1	3.3	4%	65%	3.9%	5.9%
Iran	1.8	3.4	3.0	2.7	2.8	4%	-17%	-1.2%	-2.9%
UAE	1.4	2.0	2.7	2.8	2.7	4%	38%	2.9%	1.6%
Kuwait	1.3	1.6	2.5	2.5	2.6	3%	60%	4.4%	1.9%
Canada	1.3	1.8	2.2	2.4	2.5	3%	44%	2.3%	7.0%
Mexico	2.4	3.2	2.5	2.5	2.5	3%	-22%	-2.2%	-1.3%

Source: International Energy Agency

As shown in Table 4, crude oil output in OECD countries outside of North America has fallen precipitously from 6.6 Mbd in 2002 to 3.1 in 2013 due to diminishing production from the North Sea offshore fields of Norway and the United Kingdom. Over the same period, North American production increased by 25% and growth particularly accelerated since 2012, with annual growth rates of nearly 9%, from 11.3 Mbd in 2012 to 13.3 in the first half of 2014.

Table 4 | OECD Production of Crude Oil

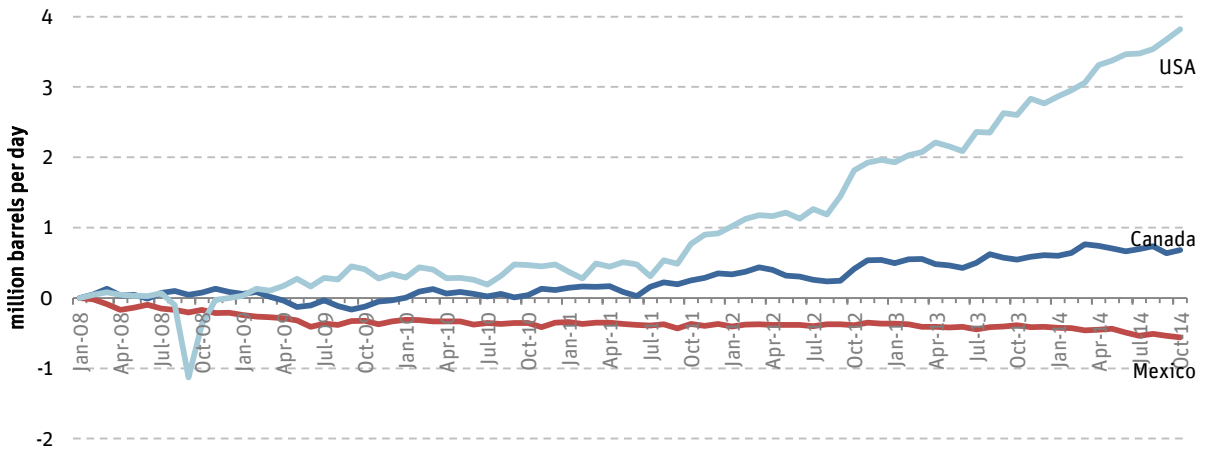
million barrels per day	1986	2002	2012	2013	1H 2014	% World Supply	Growth 2002-1H2014	CAGR 2002-2012	CAGR 2012-1H2014
OECD	16.8	17.3	14.6	15.5	16.5	22%	-5%	-1.7%	6.2%
OECD North America	12.4	10.7	11.3	12.4	13.3	18%	25%	0.5%	8.7%
OECD Non-North America	4.4	6.6	3.4	3.1	3.2	4%	-52%	-6.6%	-3.0%

This tremendous growth in North American crude oil production is caused by three occurrences in increasing order of importance, all shown in Figure 10. The first is the stabilization of Mexican output since 2008 around 2.5 Mbd following the depletion of its offshore fields in the Gulf of Campeche that began in 2005 from a high of 3.4 Mbd.

The second is the growth in Canadian production since 2009 by around 700,000 b/d from 1.8 Mbd to 2.5 Mbd over the first half of 2014. The third and most important cause however is the tremendous increase in production from the U.S. since 2012 with the advent of tight oil production in areas like Eagle Ford of Texas and the Bakken in North Dakota.

¹⁰ Note that the following discussion is on the production of crude oil only, excluding natural gas liquids and non-conventional oils.

Figure 10 | Change in North American Crude Oil Production Relative to January 2008

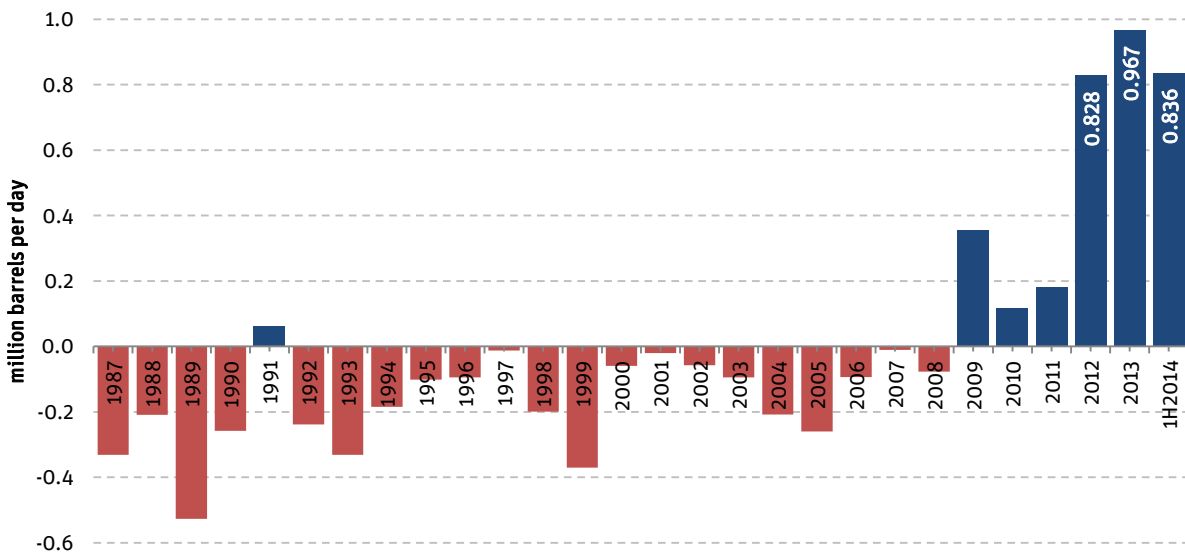


Source: International Energy Agency

Until 2011, the last time crude oil production in the United States had grown for more than two years in a row was between 1983 and 1985. However, starting in 2008 crude oil output in the U.S. has been growing every year, with a noticeable acceleration taking place since late 2011 as Figure 10 so clearly demonstrates. This sustained growth has been driven by technological breaks first in the deep water wells in the Gulf of Mexico, and second, and more importantly, in hydraulic fracturing for developing tight oil in shale formations throughout the country.

According to these latest available figures, in June 2014 the U.S. produced 8.6 Mbd, the first month since July 1986 where production was above 8.6 Mbd. The level of production for October 2014, the latest available month from the IEA, was 8.9 million barrels per day of crude oil, the highest production month for the US in nearly 30 years. As shown in Figure 11, for the first half of 2014, the United States is producing 0.8 Mbd more than in 2013.

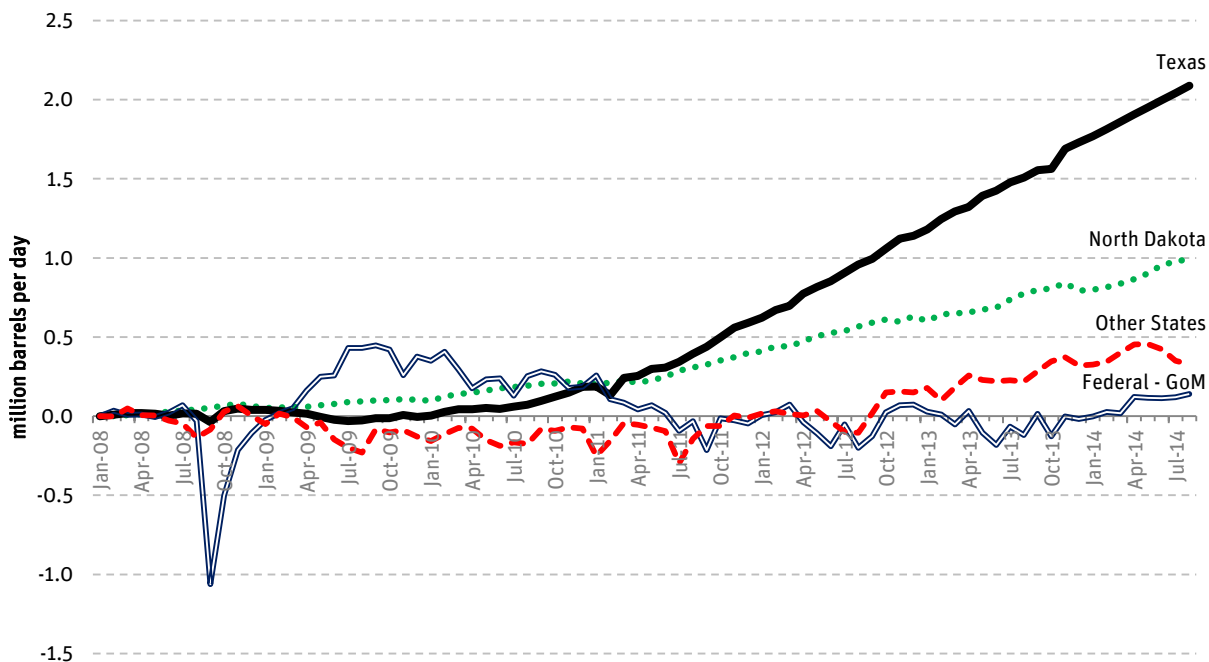
Figure 11 | Year-On-Year Change in Crude Oil Production in the US



Source: International Energy Agency

The vast majority of this additional output has stemmed from the Eagle Ford and Bakken oil plays. As Figure 12 shows, since the end of 2008, Texas has added 2 Mbd of production, almost entirely from those two plays, to triple its output from 1.1 Mbd to 3.2 Mbd by August 2014. Over the same period, North Dakota has reached 1.1 Mbd, from nearly negligible 0.1 Mbd in January 2008. Over the same period, North Dakota has reached 1.1 Mbd, from nearly negligible 0.1 Mbd in January 2008.

Figure 12 | Change in U.S. Crude Oil Production Relative to January 2008



Source: Energy Information Administration

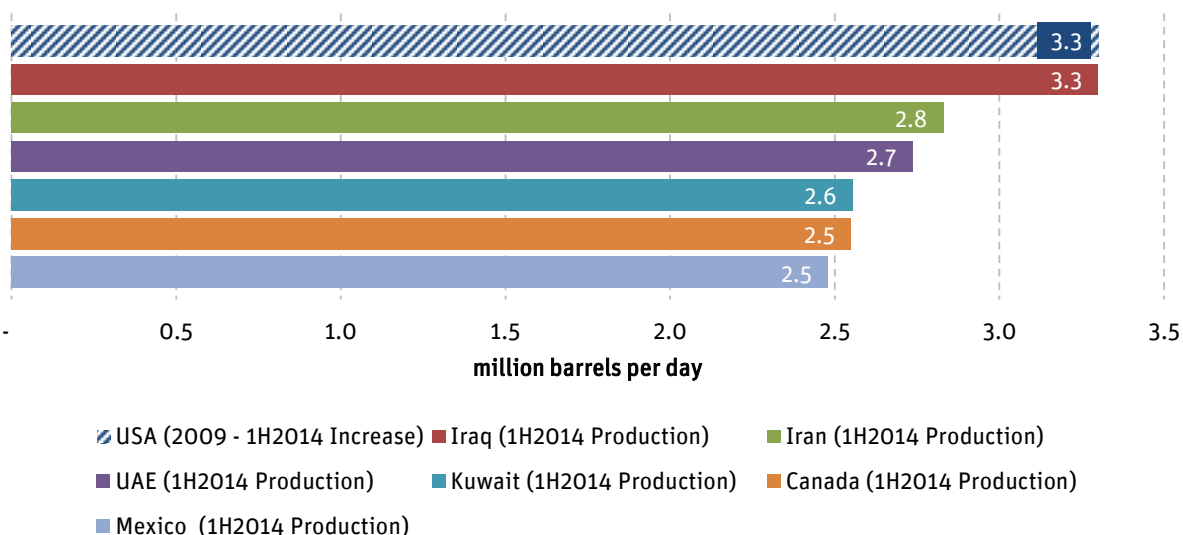
Indeed, between 2009 and 2013, tight oil production – mainly from the two plays mentioned above – more than quintupled, from 0.7 Mbd to 3.5 Mbd and in 2013, tight oil represented around 45% of total crude oil production in the U.S.¹¹

As can be seen in Figure 13, in all, between 2009 and the first semester of 2014, the United States has increased its production of crude oil by 3.3 million barrels per day. This amount is equivalent to Iraq’s crude oil output in the first half of 2014 of 3.3 Mbd. It is also larger than Iranian production of 2.8 Mbd and also larger than production in the United Arab Emirates (2.7 Mbd), Kuwait (2.6 Mbd), Canada (2.5 Mbd), or Mexico (2.5 Mbd) over the first half of 2014. In essence, since 2009, the United States has added all the crude oil production of a large OPEC member or North American neighbor.

As we note above, this increase in U.S. production has continued during 2014. In fact, since 2013 till June 2014 – when the recent price drop began in earnest – the biggest increase in worldwide crude oil production among countries with production levels above 1 Mbd has occurred in the United States, which is 11% above its 2013 total, at 8.3 Mbd.

¹¹ U.S. Energy Information Administration, Annual Energy Overview 2014. Available here: <http://www.eia.gov/forecasts/aeo/er/>

Figure 13 | Growth in US Crude Production 2009 to 1H2014 vs. 1H2014 Crude Production of Select Countries



Source: International Energy Agency

Where Does The Price of Oil Go From Here?

In real terms, the price of crude oil has been on a downward trajectory since it reached 116 \$/b per barrel in April 2011. The cyclical and volatile pattern inherent to crude oil pricing has seen its price move rapidly since that time but it has maintained a clear negative slope as a trend.

Whether that trend, already three years old, continues will depend on a variety of factors on the demand and supply of crude oil – as is always the case – particularly on the economic viability of continued expansion of U.S. production, the willingness of large, swing producers to accept lower prices for their product, continued attenuated demand in the OECD, the potential of recovered Asian demand growth, among many others.

An early sign of how the market could move over the short run recently took place. The 166th OPEC Meeting, held in the last week of November 2014, signaled to the market that swing producers in the Persian Gulf were willing to sell crude at lower prices at least over the short-term as no agreement to lower production was reached among the members of the organization, despite opposition from several members of the organization. The organization instead decided to maintain the previous production agreement of 30 Mbd held since December 2011.¹²

The response to this signal from U.S. producers has not yet emerged in the market in terms of lessened investment or drilling activity but there is clearly increasing pressure on the margin for those fields in the U.S. that have led to the present situation described in this note. It is important to note that analyses by American investment banks show breakeven prices for tight oil producers in the US to range from mid-30s to low-60s dollars per barrel for Brent crude.¹³

¹² OPEC, “OPEC 166th Meeting Concludes,” 27 November 2014. Available here: http://www.opec.org/opec_web/en/press_room/2938.htm

¹³ Myles Udland “Here are the Breakeven Oil Prices for Every Drilling Project in the World”, *Business Insider*, November 28, 2014. <http://www.businessinsider.com/citi-breakeven-oil-production-prices-2014-11>

References

International Energy Agency, “Monthly Oil Data Service” (November 2014) <http://mods.iea.org>

Nigel Pain, Isabell Koske and Marte Sollie, “Globalisation and OECD Consumer Price Inflation,” *OECD Economic Studies*: 44 (2008)

Lutz Killian and Bruce Hicks, “Did Unexpectedly Strong Economic Growth Cause the Oil Price Shock of 2003–2008?” *Journal of Forecasting*: 32-5 (2013): 385–94

International Energy Agency, “Background Paper for the 14th International Energy Forum Ministerial Meeting Moscow 15-16 May 2014,” *International Energy Forum* (May 2014).
https://www.ief.org/_resources/files/events/ief14/ief14-iea-background-paper.pdf

International Monetary Fund, “World Economic Outlook: Legacies, Clouds, Uncertainties,” *International Monetary Fund* (October 2014).
<http://www.imf.org/external/pubs/ft/weo/2014/02/>

U.S. Energy Information Administration, “Annual Energy Overview,” (May 2014).
http://www.eia.gov/forecasts/aeo/MT_industrialdemand.cfm

U.S. Energy Information Administration, “Petroleum & Other Liquids – Crude Oil Production,” (November 2014) http://www.eia.gov/dnav/pet/pet_crd_crpdn_adc_mbbl_m.htm