We create change in flow

energy monitor

Oil's Wild Ride, 3rd Edition

A Worldflow Whitepaper

Flow Research, Inc.

Wakefield, Massachusetts

Oil's Wild Ride, 3rd Edition

A Worldflow Whitepaper

Flow Research, Inc.
Wakefield, Massachusetts

January 2018

www.worldflow.com

Researched and Published by:

Flow Research, Inc.
27 Water Street – Suite B7
Wakefield, MA 01880
United States
(781) 245-3200
(781) 224-7552 (fax)
info@flowresearch.com
www.flowresearch.com
www.worldflow.com

Project Team:

Jesse Yoder, PhD – Publisher and Project Director
Norman Weeks
Leslie Buchanan

TABLE OF CONTENTS

I. Oil's Wild Ride: The Imbalance of Supply and Demand

The price of oil in barrels has been of major concern to flowmeter and other instrumentation suppliers for many years. The oil and gas industry is a major consumer of flowmeters, temperature sensors, pressure transmitters, and other instrumentation products at many different phases along the process stream from wellhead to distribution points.

From 2011 to August 2014, oil prices for the most part remained in the range of $80 to $100 per barrel. During this time, the world demand for oil exceeded the world's supply, and the support was there for relatively high oil prices. This spurred exploration and production worldwide, benefiting suppliers of flowmeters and other instrumentation.

Beginning in August 2014, worldwide supply began to exceed worldwide demand. This began a downward spiral in oil prices that resulted in oil prices bottoming out at just above $26 per barrel in February 2016. Since that time, oil prices have retraced their steps through the $30 per barrel to $40 per barrel range. Since December 2016, oil prices have averaged in the $55 per barrel range, though prices were on an upward trend in the second half of 2017.

What factors were involved in the oil price decline in 2015 and 2016, and why are prices recovering today? While oil prices are influenced by many different forces and events, there is a pretty clear series of events that explain why oil prices declined, and why they staged a comeback in 2017. This White Paper tells that story, and outlines the events that have caused the changes in oil prices over the past three years.

How Oil Is Measured

Oil is measured in 42 gallon barrels. The history of this tradition goes back to 1866, soon after Edwin Drake drilled the first oil well in the United States in Titusville, Pennsylvania, in 1859. In 1866, a group of independent oil producers met in Titusville and decided that the 42 gallon barrel was the best way to transport oil. At that time, barges floated barrels of oil down the Allegheny River to Pittsburgh on the way to be refined into kerosene. The adoption of this standard for oil measurement stuck, and today oil is still measured in 42 gallon barrels. Oil production is typically measured according to how many 42 gallon barrels are produced in a day. In many cases, this amounts to thousands or millions of 42 gallon barrels per day.

Factors that Influence Oil Prices

The most fundamental determinant of oil prices is supply and demand. When the demand for oil exceeds supply, oil prices tend to rise, or to remain high, on a relative basis. When supply exceeds demand, however, oil prices tend to decline, or remain low, on a relative basis.

Of course, there are many other factors that influence the price of oil in addition to the balance of supply and demand. These include currency fluctuations, sudden disruptions in major sources of supply, political factors, bad weather such as hurricanes, disasters such as oil spills, etc. All these factors can cause oil prices to spike, or to plummet on a temporary basis. Usually, though, these effects are temporary and oil returns to the price dictated by the balance of supply and demand. Oil prices also depend on the type of oil.

Four Benchmark Oils: WTI, Brent, Dubai/Oman, and the OPEC Reference Basket

Before exploring the effects of supply and demand on today's oil markets, it is worth taking a look at what is meant by "the price of oil." While there are many types of oil, four types have become benchmarks for the oil markets. These are West Texas Intermediate (WTI), Brent, Dubai/Oman, and the OPEC Reference Basket.

WTI is traded on the New York Mercantile Exchange (NYMEX). It is composed of oil extracted in the United States, mainly from fields in Texas, North Dakota, and Louisiana. WTI is light and sweet, and has a low sulfur content. WTI is extracted from oil fields in the United States and transported via pipeline to Cushing, Oklahoma where it is refined. The price of WTI is a benchmark for oil sold in the United States.

Brent crude oil is extracted from oil fields in the North Sea. Originally, it was named after oil extracted from the Brent oil field, which is located off the coast of the United Kingdom in the North Sea. Today, Brent is mainly extracted from four oil fields in the North Sea: Brent blend, Forties blend, Osberg, and Ekofisk. While it is considered to be both light and sweet, it is slightly heavier than WTI. Brent futures are traded on the ICE Futures Europe in London. The price of Brent crude is a benchmark for oil produced in the North Sea and sold in Europe, Africa, Australia, and some Asian countries.

Why Seabirds?

Industry insiders tell an interesting story about why oil wells in the North Sea are named after seabirds. Originally, Esso and Shell began naming their oil wells, in order of discovery, by the letter of the alphabet, followed by UK. So the initial naming scheme was:

A-UK
B-UK
C-UK, etc.

Then a far-sighted person pointed out the consequences of getting to the letter 'F'. So the decision was made to use the names of seabirds instead. The first well's name became Auk, which is the name of a seabird. The second well was called Brent, the third well Cormorant, etc.

As explained in the above sidebar, Esso and Shell named the North Sea oil fields in the order of discovery after seabirds, alphabetically. Brent was the second oil field discovered and was named after the Brent Goose in 1972. The Brent Goose is a small goose with a short and stubby bill.

(Photo by Andreas Trepte, www.photo-natur.net)

For many years, Brent and WTI traded at roughly the same amount. Then in 2011, when oil prices increased, Brent began trading higher than WTI. While the reasons for this are debatable, some analysts attribute it to the fact that the North Sea oil fields are being depleted, while WTI in the United States is more plentiful. Canadian oil production is also increasing. Production from the Brent field has declined to the point that in early 2017, Shell announced plans to decommission this field over time.

Dubai/Oman oil refers to a "basket" of oils from Dubai, Oman, and Abu Dhabi. As a benchmark, it is an average of the prices of oil from Dubai, Oman, and Abu Dhabi. It is heavier than WTI and Brent oil, and is slightly sour. Dubai/Oman oil has been traded on the Dubai Mercantile Exchange since 2007. It has become a benchmark for oil shipped to Asia.

The **OPEC Reference Basket** is another benchmark for oil prices. This is a blend of oils from most of the OPEC countries. The value of this Reference Basket is calculated by the OPEC secretariat in Vienna, Austria. It includes oil from Saudi Arabia, Iran, Qatar, Kuwait, and a number of other OPEC countries.

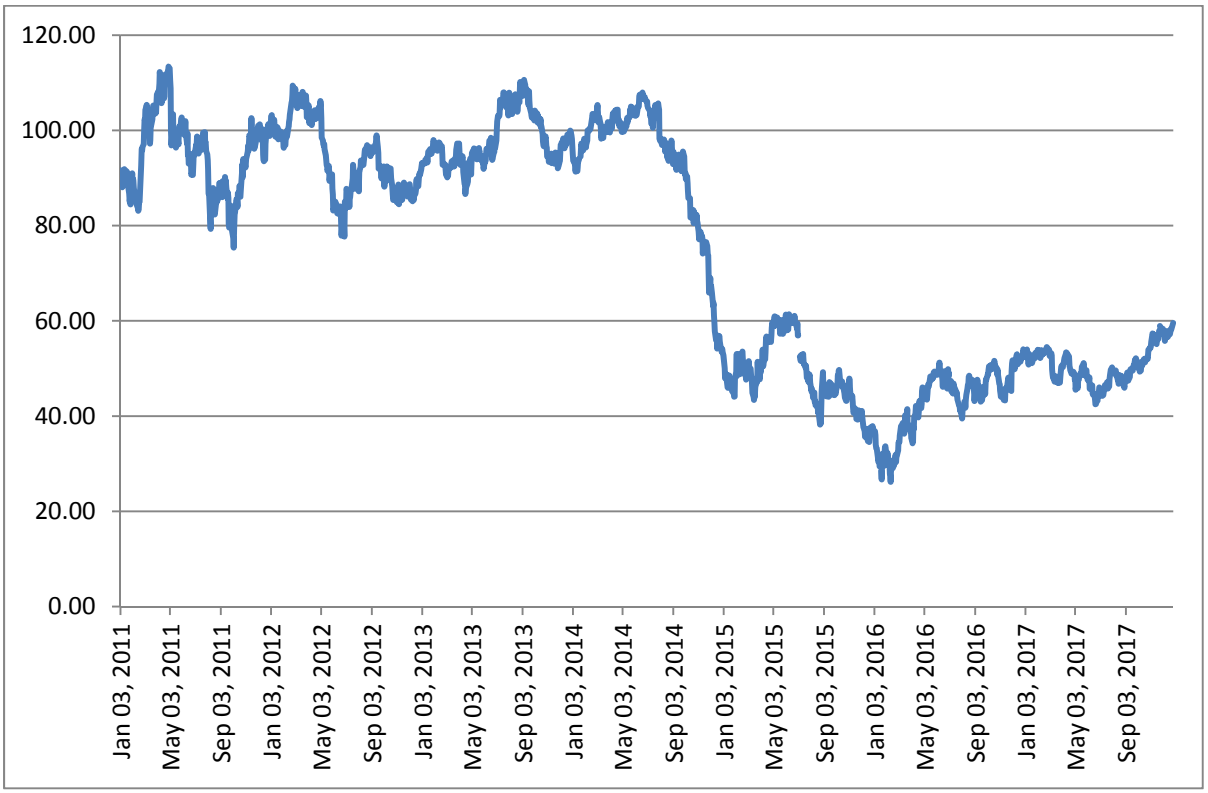
The Price of Oil Since 2011

The following chart on the following page shows the price of WTI from January 2011 to December 2017. It should be clear from the chart that the per-barrel price of WTI crude oil remained mostly between $80 and $100 from January 3, 2011, until August 2014. Beginning in August 2014, oil prices began a steady decline from the $100 level down to the range of $30 per barrel in February 2016. While some of the fluctuations in prices were due to the Arab Spring uprising, to hurricanes in Louisiana, and to other events that temporarily affected oil prices, the chart can mainly be seen as a supply and demand story.

Why Oil Prices Declined

August 2014 marked an important change in the supply/demand equation. From January 2013 until May 2014, world oil demand (consumption) exceeded world oil supply. During this time, oil prices averaged in the $90 to $100 per barrel range. In May, June, and July 2014, world oil supply and demand were very close to being in balance. Then in August 2014, the world's supply of oil began to significantly exceed the world's demand for oil. August 2014 was when oil prices began declining.

Price of WTI January 2011 to December 2017
(Dollars per Barrel)

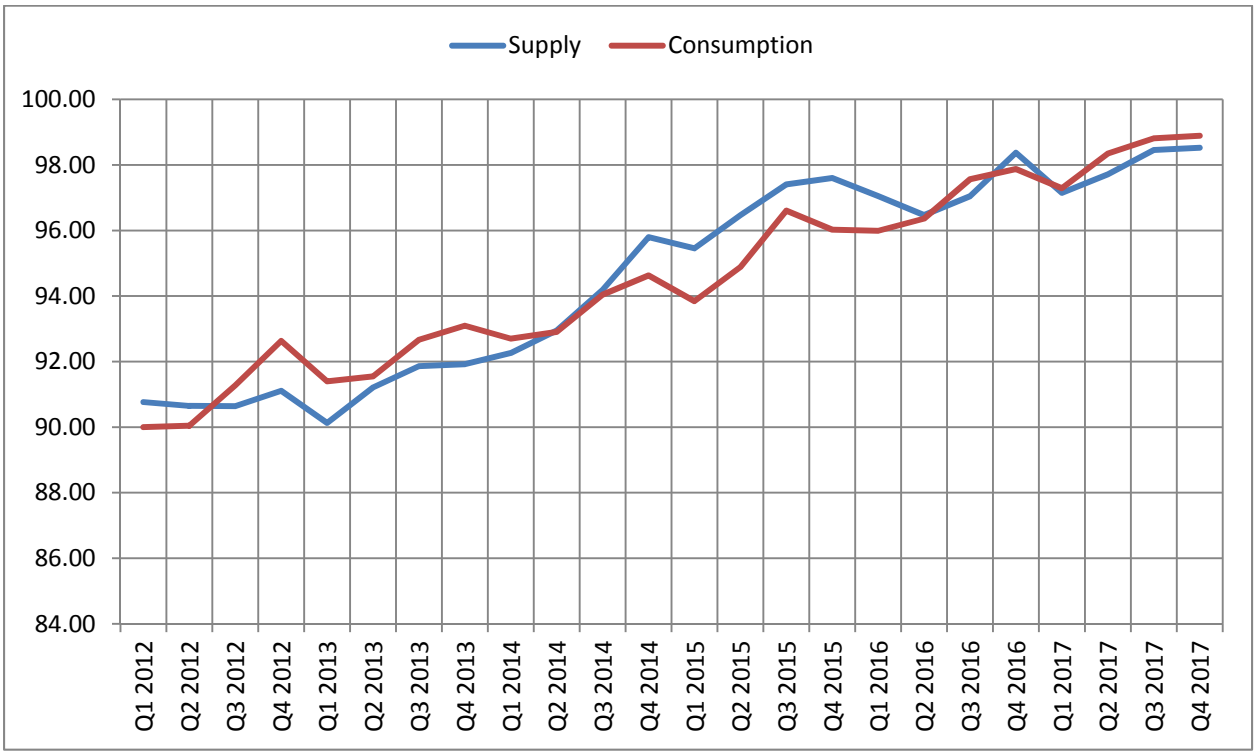


Source: Energy Information Administration (EIA)

The hart on the following page shows the pattern of supply and demand (consumption) for oil from January 2013 through December 2017. There are several interesting points about the chart:

1. The world oil supply began exceeding demand on a consistent basis in August 2014. This remained true with the exception of February 2015 until August and September 2016, when demand outpaced supply for two months. But beginning in October 2016, the world oil supply once again exceeded demand.
2. From January 2013 until August 2014, world oil demand exceeded the available supply. During this time, oil prices averaged in the $90 to $100 per barrel range. This period of relatively high oil prices actually extends back to 2011.
3. Even though world oil supply exceeded demand in January 2017, there was a sharp drop-off in supply during that month. In December 2016, oil supply totaled 98.26 barrels per day (b/d). In January 2017, world oil supply dropped 1.5 million b/d to 96.79 b/d. This was a direct result of OPEC's decision to cut production on November 30, 2016, which is described below.

World Oil Supply versus Consumption from January 2012 to December 2017
(Millions of Barrels per Day)



Source: EIA

In the line chart above, the blue line represents the total supply of world oil in barrels per day. The red line represents the total world consumption (demand) of oil in barrels per day. For most of the time prior to Q3 2014, the red line is above the blue line, meaning that demand exceeded supply during most of this time. Oil prices were relatively high during this period. Beginning in August 2014, supply began to outpace consumption, and oil prices began to decline. This is seen more clearly by comparing the actual numbers from Q3 2014 to Q4 2017.

World Oil Supply and Demand Q1 2014 to Q4 2017
(Millions of Barrels per Day)

	Q1 2014	Q2 2014	Q3 2014	Q4 2014	Q1 2015	Q2 2015	Q3 2015	Q4 2015
Supply	92.26	92.95	94.19	95.80	95.46	96.47	97.41	97.60
Demand	92.70	92.91	94.04	94.63	93.85	94.89	96.61	96.02

	Q1 2016	Q2 2016	Q3 2016	Q4 2016	Q1 2017	Q2 2017	Q3 2017	Q4 2017
Supply	97.05	96.47	97.05	98.37	97.15	97.71	98.46	98.53
Demand	95.99	96.36	97.56	97.88	97.29	98.35	98.81	98.89

Source: EIA

In Q3 2014, world oil demand exceeded supply by 0.15 million barrels per day. Then in Q4 2014, oil supply exceeded demand by 1.17 million barrels per day. From that time until February 2016, world oil supply exceeded world oil demand, and oil prices declined from $98 per barrel to the $30 barrel range. In Q1 2016, world oil supply exceeded demand by 1.06 million barrels per day.

Beginning in May 2016, world oil demand again began to exceed world oil supply by a modest amount, and prices edged upward. This trend continued throughout 2016, except for Q4 2016, when world oil supply outpaced demand. During 2016, there was a concerted effort by Russia and by a number of OPEC countries to initiate a production freeze or production cuts to reduce supply. These efforts are described below.

The Role of "Fracking"

Why did the world oil supply increase in 2014 and 2015, pushing down oil prices? Many analysts point to the advent of hydraulic fracturing, or "fracking," which makes it possible to get more oil out of difficult formations or existing wells than was previously possible. Fracking, which is often used with horizontal drilling (but is a distinct method), helps bring additional oil and gas to the top of the well. Until recently, fracking was largely an American phenomenon, but this technology is spreading to other countries. Some other countries where fracking is practiced include Canada, the United Kingdom, Poland, China, and New Zealand.

What is fracking? Hydraulic fracturing involves forcing a liquid (mainly water, usually containing sand and additives) through a well and against a rock formation until it fractures. The liquid is under high pressure. As the high-pressure liquid in the wellbore flows into the formation, the fracture extends deeper into the rock. When the injection is stopped and the pressure is reduced, the formation attempts to return to its original configuration. However, the formation remains open due to the sand and chemical-containing liquid in the well. As a result,

hydrocarbons such as crude oil and natural gas flow from the rock formation into the well and can then be brought up to the surface.

Fracking has substantially increased oil and natural gas production in the United States. According to the Energy Information Administration (EIA), in 2015 hydraulic fracturing accounted for 51 percent of oil production in the United States. This percentage is based on 300,000 hydraulically fractured wells, producing an average of 4.3 million bpd. This amount of additional production was enough to drive up the total world supply to a point where oil supply exceeded oil demand. This had the effect of depressing prices, causing a reduction in plans for increased exploration and production.

Oil Producing Countries, including OPEC, Maneuver to Support Oil Prices

One of the countries hit hardest by low oil prices is Russia. Russia is not part of OPEC, but is a major oil producer that relies heavily on oil revenues for its income. Russia's economy shrank by seven percent in 2015, due in part to lost oil revenues from lower oil prices. According to Vladimir Putin, Russia calculated its 2016 budget based on $50 per barrel oil. Oil prices dropped below $50 per barrel in July 2015, and continued to decline until March 2016.

In late January 2016, Russia's Energy Minister, Alexander Novak, claimed that Saudi Arabia had proposed a global production cut of up to five percent. He said that Russia would be willing to attend a meeting to discuss such a cut, which would presumably involve an extraordinary meeting of OPEC members. Based on the comments from Russia, oil prices rose by as much as $5 per barrel to $34 per barrel in late January and early February. But these comments appeared to be a case of "jawboning" by the Russian minister, since OPEC officials at the time denied any plans for an emergency meeting of OPEC. Oil prices went back down after it appeared that no meetings were in fact planned.

An Output Freeze Discussed

Despite the lack of credibility of Russia's initial comments about a cut in production, the comments seem to have served the purpose of getting some of the major oil producers to begin to discuss the topic of low oil prices and what could be done about them. In mid-February 2016, four large oil producers: Saudi Arabia, Qatar, Russia, and Venezuela, met in Doha, Qatar and agreed to freeze production at January levels if other countries would go along. Qatar was holding the rotating presidency of OPEC at that time. Kuwait later joined the agreement, but Iran blasted the agreement as a "joke." Iran began ramping up production, once international sanctions were lifted. At the same time, Saudi Arabia reiterated that it did not want to cut production.

The discussion of a freeze did seem to have a short term effect on oil prices. In March, oil prices briefly topped $40 per barrel, while in April 2016, prices were above $40 per barrel for much of the month. But this may have had more to do with the slow decrease in supply along with some

increase in demand. There were also some unexpected supply disruptions during this time. Even a drop of 500,000 barrels per day can have a significant effect on oil prices.

The April 17, 2016 Meeting in Doha, Qatar

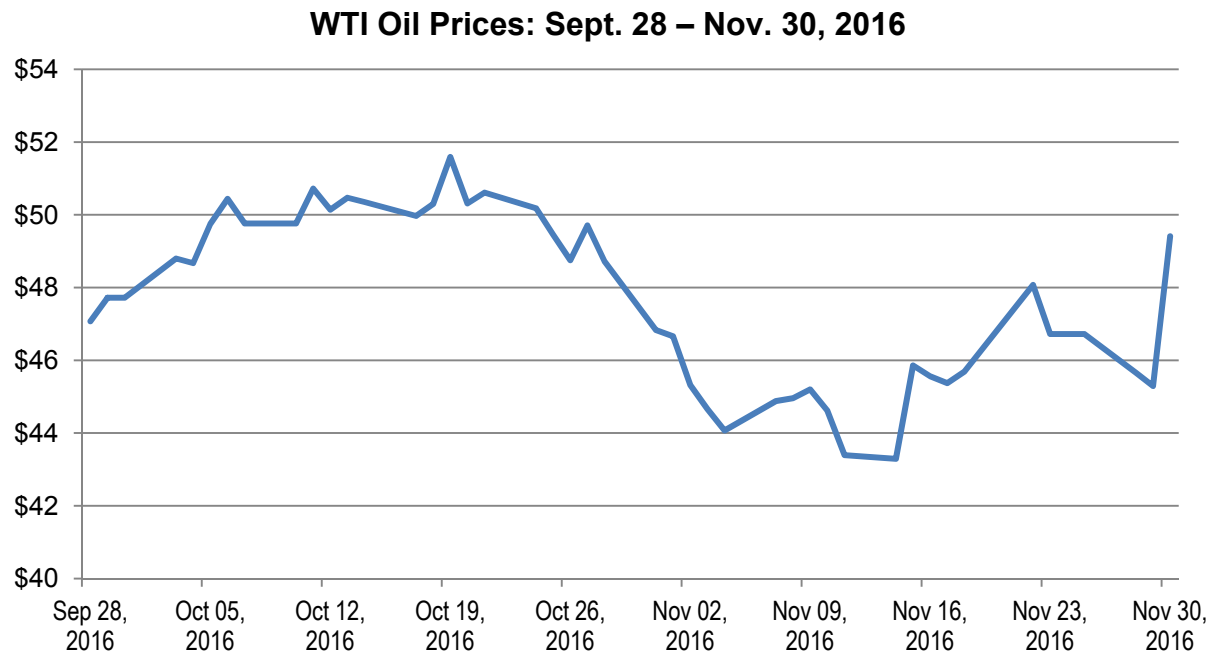
Early in March 2016, there was discussion of a meeting of the major oil producers on March 20 in Russia, or sometime between March 20 and April 1. This meeting would have been led by Russia and Saudi Arabia. However, Iran's lack of interest in a production freeze delayed the meeting, and it did not occur in March.

On March 16, the Qatari minister announced that there would be a meeting of major oil producers in Doha, Qatar, on April 17, 2016. This meeting was held as scheduled, and involved 18 oil producing countries. Chief among these were Saudi Arabia, Russia, Qatar, Oman, and other OPEC countries. After meeting for 12 hours, the countries could not agree on a freeze. The chief stumbling block appeared to be Saudi Arabia's insistence that Iran be part of such an agreement. However, Iran was determined to bring its oil production back to pre-sanction levels before it would discuss or implement a freeze. Iran declined to attend the April 17 meeting.

Prior to the meeting, WTI was selling for just above $40 per barrel. While oil initially sold off by several dollars after the collapse of the potential agreement, it then rebounded and closed above $40 per barrel on April 19, 2016.

A Production Cut Framework Agreed to on September 28, 2016

Even though OPEC failed in its attempt to reach an agreement on oil prices on April 17, 2016, the meeting itself created momentum for an agreement on production cuts. On September 28, 2016, OPEC agreed on the framework of a production cut, with details to be worked out in the next Ordinary Meeting of OPEC on November 30, 2016. Their target for OPEC production was between 32.5 and 33.0 million b/d. The oil market responded positively, with West Texas Intermediate (WTI) oil closing at above $51 per barrel on October 11, 2016. From October 11 to December 1, 2016, the prices of WTI ranged between $43 and $51 per barrel.



Source: EIA

A Production Cut Agreement Reached on November 30, 2016

Despite the skepticism of some analysts, at its Ordinary Meeting on November 30, 2016, OPEC agreed to a production cut based on the framework established at the September 28 meeting in Algeria. The cut included both OPEC and non-OPEC countries, and amounted to about 1.8 million b/d. OPEC agreed to a total target of 32.5 million b/d, which included a cut of 1.2 million b/d from OPEC countries. The balance of 600,000 b/d would come from non-OPEC countries. About half of this amount, or 300,000 b/d, was to come from Russia. The agreement took effect on January 1, 2017.

What made the deal possible was Saudi Arabia's flexibility with respect to Iran. Saudi Arabia agreed to allow Iran to produce up to 3.9 million b/d as a special case. The other production cuts agreed to were as follows:

Saudi Arabia: 500,000 b/d
Qatar, United Arab Emirates, and Kuwait: 300,000 b/d
Iraq: 200,000 b/d

Production Cuts Hold During 2017

Some analysts claimed that OPEC would be unable to enforce its production cuts in 2017, However, for the most part, OPEC did a good job in obtaining compliance with its goals. In April 2017, a Reuters survey showed that OPEC output had declined for a fourth straight month following the implementation of the agreement on January 1, 2017. During this period, oil prices fluctuated in the $50 range.

OPEC holds two meetings each year to determine oil policy and discuss other business related to the cartel and to member countries. There is a Spring Meeting, generally held in May or June, while the Fall Meeting is held in November or December. These are called Ordinary Meetings. Member countries can agree to hold a meeting outside of this schedule, and these meetings are called Extraordinary Meetings.

At its Ordinary Meeting on May 25, 2017, OPEC decided to extend its production cut targets by another nine months to March 2018, further extending OPEC's determination to place a price floor under the oil markets. This rolled the 1.8 million barrel per day price cut into 2018. Just after the announcement, WTI was selling at $49.09 per barrel, but WTI prices trended up 14 percent during most of May 2017.

Stockpiles Cleared

One of the main reasons that oil prices have remained low for so long is that stockpiles of crude oil and refined fuel in storage facilities have enabled refines and petrochemical plants to find supplies of oil even when production falters. One goal of OPEC's production cuts was to clear some of these stockpiles so that are more closely tied to actual production. This strategy appears to have worked. In September 2017, according to OPEC Secretary-General Mohammad Barkindo, bloated stockpiles of fuel have been "massively drained" and the group implemented more than 100 percent of its agreed cuts in August.

Production Cuts Extended to End of 2018

At its Fall Ordinary Meeting on November 30, 2017, OPEC agreed to continue its production cuts until the end of December 2018. The existing deal had been scheduled to end in March 2018. Rather than simply extend that deal by nine months, OPEC instead implemented a new deal beginning in January 2018 and extending through the end of December 2018. As part of this new deal, the output of Nigeria and Libya were capped at 2017 levels, below 2.8 million barrels per day. Nigeria and Libya had previously been exempt from the output cuts due to unrest in those countries. OPEC will re-evaluate the production cut agreement again on June 22, 2018, at its 174th Ordinary Meeting in Vienna, Austria.

$60.00 Oil Price Benchmark Reached

In 2017, world oil demand exceeded supply, and oil prices continued to increase. Finally, on December 29, 2017, WTI crude oil reached that long-awaited benchmark of $60 per barrel. This is the first time since June 24, 2015, that WTI oil prices exceeded $60 per barrel. $60 per barrel is a price that has been targeted by Saudi Arabia as a desirable benchmark in relation to the production cuts. Many oil production projects that are not profitable when oil sells for $40 or $50 per barrel are profitable at the $60 figure.

Brent crude, which often trades several dollars higher than WTI, had been trading above $60 per barrel since the end of October 2017. But the gap between WTI and Brent crude can be

significant at times. For example, on January 11, 2018, Brent crude topped out at $70.05, while the price of WTI reached $64.77 on that same day.

Who Is Producing All This Oil?

Of course there are other factors involved in oil prices besides the supply/demand equation. But there does appear to be a pretty close correlation between oil prices and the balance of supply and demand.

Who is producing all this oil? And will the reduction in supply bring oil prices back to a level where it is profitable to drill in more locations once again?

The table on the following page shows the supply and demand balance for oil on a worldwide basis in the second half of 2017. The chart views the world oil supply through the prism of OPEC (Organization of Petroleum Exporting Countries) and other non-OECD (Organization for Economic Cooperation and Development) countries, and the OECD countries.

OPEC

OPEC was formed in September 1960 at the Baghdad Conference. Its founding members were **Iran, Iraq, Kuwait, Venezuela, and Saudi Arabia**. Eight other countries, including Nigeria and Algeria, joined OPEC at later times. One purpose of OPEC in the past has been to influence oil prices by controlling production, thereby keeping prices at a desirable level. This has changed recently beginning in November 2014 when OPEC declined to cut production to prevent oil prices from coming down further after they began declining in August 2014. OPEC, led by Saudi Arabia, maintained this stance until November 2017, when it initiated the production cuts described earlier in this White Paper.

OECD

The OECD was founded in December 1960 by a group of 20 countries committed to democratic government and a market economy. Since that time, 10 more countries have joined the OECD, to make up the current total of 30 countries. Some of the more prominent members include the United States, Germany, the United Kingdom, France, Australia, and Japan.

Global Petroleum and Other Liquids
(Millions of Barrels per Day)

	July 2017	Aug 2017	Sept 2017	Oct 2017	Nov 2017	Dec 2017
OECD Supply	27.15	26.93	27.30	27.15	28.00	*28.02*
Non-OECD Supply	71.51	70.95	71.54	70.96	70.87	*70.59*
Total World Supply	98.66	97.88	98.84	98.11	98.87	*98.61*
OECD Consumption	47.41	47.47	46.99	47.05	47.21	*47.87*
Non-OECD Consumption	51.34	51.58	51.64	51.67	51.54	*51.33*
Total World Consumption	98.75	99.05	98.63	98.72	98.75	*99.20*

Source: EIA

What Makes Up the Non-OECD Supply?

The table above shows Non-OECD petroleum supply at 70.59 million barrels per day in December 2017. How does this break out? OPEC makes up the largest portion of the Non-OECD supply. The bulk of this is from crude oil production, though other petroleum liquids make up a part of this total. Although OPEC accounts for the largest portion of the Non-OECD supply, this amount includes other countries besides the 13 members of OPEC. The second largest contributors to Non-OECD supply are production from the Former Soviet Union and from China. Neither of these countries or regions are part of OPEC. An assortment of other countries make up the remaining total. Looking more closely at Non-OECD supply in 2016 and 2017, it becomes clearer what constitutes the Non-OECD portion of the total world petroleum supply. The following chart shows the components of the Non-OECD segment.

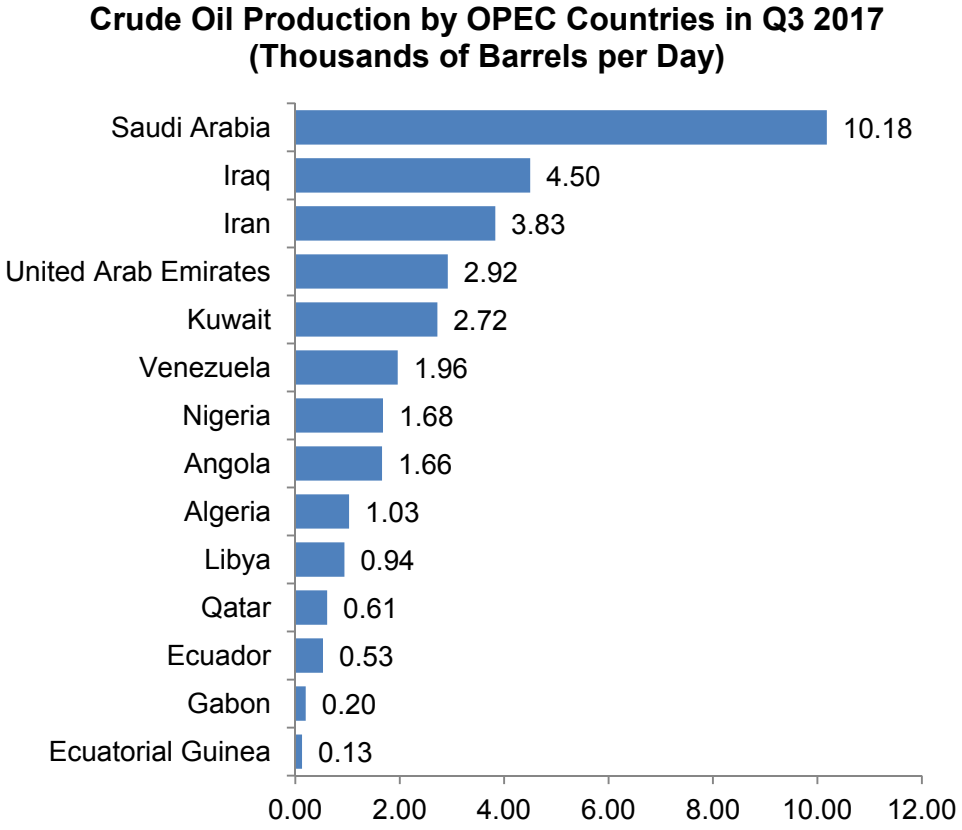
Non-OECD Supply of Petroleum and Other Liquids
(Millions of Barrels per Day)

	July 2016	Oct 2016	Jan 2017	Apr 2017	July 2017	Oct 2017
Total Non-OECD Supply						
OPEC (total)*	39.40	39.63	38.95	38.88	39.74	39.48
Former Soviet Union	13.93	14.51	14.46	14.35	14.32	14.26
China	4.83	4.67	4.77	4.82	4.77	4.72
Other Non-OECD	12.72	12.59	12.00	12.03	12.68	12.50
Total Non-OECD Supply	70.88	71.40	70.17	70.08	71.51	70.96
***OPEC**						
Crude Oil Portion	32.83	33.03	32.29	31.87	32.94	32.72
Other Liquids	6.57	6.60	6.66	7.01	6.80	6.77
Total OPEC Supply	39.40	39.63	38.95	38.88	39.74	39.48

Source: EIA

Where OPEC's Oil Comes From

The chart below shows the crude oil production in thousands of barrels per day in Q3 2017 for the members of OPEC.



Source: EIA

The crude oil production for the United States in November 2017 was 9.7 million barrels per day, putting it slightly short of Saudi Arabia's Q3 2017 production, according to EIA data.

Most analysts attribute the increase in US oil production to the advent of shale oil technology. Through the process of hydraulic fracturing, or "fracking," it is possible to obtain oil from wells that were once thought to be "dry," or non-productive. This process has significantly increased the total crude oil out of the United States and other countries as well. Fracking has become somewhat controversial, due to its environmental effects, which are still being studied. Even so, the advent of the technology of fracking is one of the major reasons for the increase in oil supply, and for the imbalance of supply and demand.

The Effect on the Flowmeter Markets

In 2017, Flow Research did in-depth new studies on the ultrasonic, magnetic, and thermal flowmeter markets. We also did an analysis of the Coriolis and vortex flowmeter markets. In all these cases, we concluded that the flowmeter markets in 2016 showed a decline from

2015 levels. In fact, we believe that 2016 represented a kind of trough for the flowmeter markets, and that these markets were back on the upswing in 2017. We attribute these changes mainly to the decline in oil prices in 2015 and 2016, and to the accompanying reduction in exploration and production projects. However, with oil prices rising in 2017, and peaking above $60 per barrel at the end of the year, we see positive signs that the flowmeter markets recovered in 2017. And with the groundwork laid for higher oil prices in 2018, we believe that this recovery in the flowmeter markets will continue in 2018 and beyond.

Upcoming Sections

Sections II and III of this White Paper discuss the formation of OPEC and the OECD.

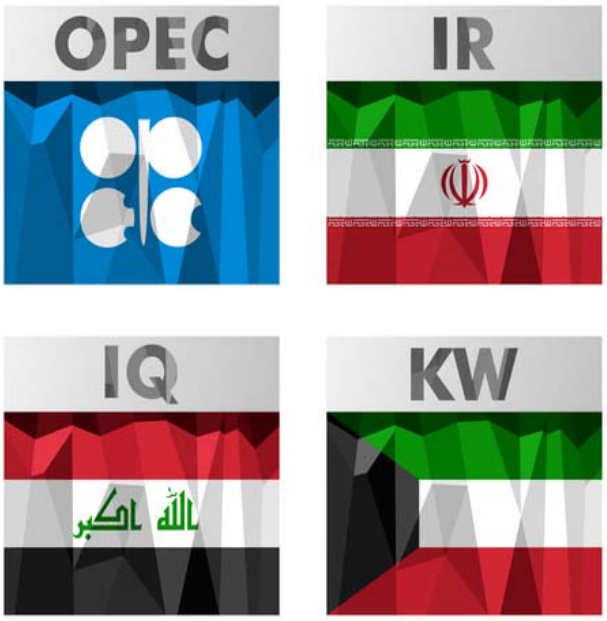
This discussion of OPEC is tied specifically to the organization's role in helping to control oil prices, past and present.

II. Organization of Petroleum Exporting Countries (OPEC)

OPEC Headquarters:
Helferstorferstrasse 17
A-1010 Vienna, Austria
www.opec.org

Organization of the Petroleum Exporting Countries

OPEC is a permanent, intergovernmental organization composed of 14 major oil producing countries. It was founded at the Baghdad Conference on September 10–14, 1960, by the following countries:



- Iran
- Iraq
- Kuwait
- Saudi Arabia
- Venezuela

The following ten countries joined in the intervening years. The year beside the country indicates the year they joined OPEC:

- Qatar (1961)
- Indonesia (1962-2016)
- Libya (1962)
- United Arab Emirates (1967)
- Algeria (1969)
- Nigeria (1971)
- Ecuador (1973)
- Gabon (1975-1994, 2016)
- Angola (2007)
- Equatorial Guinea (2017)

Gabon was a member of OPEC from 1975 to 1994, but withdrew when it was unable to get a reduction in its annual fee. At that time, the annual fee for being a member of OPEC was $1.8 million. Since that time, it has increased to $3.1 million annually. Even so, Gabon did rejoin OPEC on July 1, 2016. Indonesia suspended its membership in 2009, also to save the annual fee, but rejoined the organization at the beginning of 2016. However, on November 30, 2016, Indonesia was suspended from membership in OPEC.

Initially, OPEC's headquarters were in Geneva, Switzerland. On September 1, 1965, the organization moved its headquarters to Vienna, Austria.

OPEC's stated objective is:

"To co-ordinate and unify petroleum policies among Member Countries, in order to secure fair and stable prices for petroleum producers; an efficient, economic and regular supply of petroleum to consuming nations; and a fair return on capital to those investing in the industry."

OPEC's statute calls for it to have two ordinary meetings a year to decide any policy issues. However, OPEC meets in extraordinary sessions when required.

Why Was OPEC Formed?

OPEC was formed in 1960 in response to import quotas on oil. In 1959, the US government established a Mandatory Oil Import Quota Program that restricted how much crude oil and refined products could be imported into the United States. This program gave more favorable terms to imports from Mexico and Canada. As a result, countries in the Persian Gulf received lower prices for their oil. Venezuela was another country that was negatively impacted by the Mandatory Import Quota Program.

In September 1960, Saudi Arabia, Iran, Iraq, Kuwait, and Venezuela met in response to the US Import Quota Program to form OPEC. Their goal was to obtain higher prices for crude oil. In 1960, crude oil was selling for $1.63 per barrel. This is a price that is difficult to imagine today, even with oil selling between $30 and $40 per barrel. OPEC was largely unsuccessful in obtaining higher oil prices during the 1960s. However, in 1973, the organization was able to raise oil prices by curtailing production. Since then, this has become OPEC's main tool for influencing prices. OPEC controls a sufficient amount of oil production worldwide that it can raise prices by cutting production, thereby reducing the available oil supply.

OPEC and "The Seven Sisters"

When OPEC was formed, the world was not exactly operating under the principles of free trade. Instead, a group of major oil companies that were informally called "The Seven Sisters" cooperated to control much of the world's oil production and distribution, along with oil prices.

According to various accounts, the origin of "The Seven Sisters" goes back to an agreement signed on September 17, 1920, among Royal Dutch Shell, Anglo-Iranian, and Standard Oil (now Exxon). Its primary purpose was to control oil prices.

In the following decades, other companies joined this group, and by the 1950s, this group was composed of the following seven companies:

- Exxon
- Mobil
- Chevron
- Texaco

- Gulf Oil
- Shell
- British Petroleum

These are all familiar names. This group controlled distribution of crude exports throughout the world through its ownership of many of the major pipelines in the world. Many members of this group were also partial owners of the major oil companies in the Middle East, such as Saudi Aramco and Kuwait Oil Company.

OPEC is correctly called a cartel, but, in reality, when OPEC was formed, a major portion of the oil in the world was under the control of another cartel called "The Seven Sisters." Hence OPEC, in its formation, was simply forming an organization somewhat similar to one that already existed and that had operated for many years.

OPEC Since 1970

Oil prices have been volatile on a number of occasions since their spike in 1970. In 1973, oil prices spiked due to the Arab oil embargo, and again in 1979 because of the Iranian Revolution. Prices were high in the early 1980s, but crashed in 1986 due to an oil glut and lack of consumer demand. Later in the 1980s, OPEC was instrumental in bringing prices back up by introducing a group production ceiling. Even so, oil prices were only about half as much as they were in the early 1980s. In 1980, the average price of a barrel of oil was in the $35 range; in 1989, it was $17 per barrel.

In the 1990s, oil prices remained relatively stable: between $15 and $22 per barrel. In 2004, oil prices began rising again. This continued until July 2008, when they peaked at $147 per barrel. Then an economic collapse and recession cut prices by more than half in 2009. However, by 2011, oil prices had recovered to the $100 per barrel range. Oil prices remained in the range of $80 to $100 per barrel until August 2014. This was the month when worldwide oil supply began to exceed worldwide demand, and prices began to decline.

Why Oil Prices Declined after August 2014

When oil prices are compared to the balance of supply and demand, as was done earlier in this Whitepaper, it seems pretty clear that the decrease in oil prices correlates quite strongly with the imbalance in the supply/demand equation. On the demand side, economic weakness tends to generate weakness in demand, which can quickly lead to an increase in supply. This is likely to drive oil prices down. Many analysts point to reduced demand from the Chinese economy as a major factor in reducing demand.

There are other factors on the demand side. Automobiles are becoming more efficient, requiring less gasoline, and many companies are shifting to natural gas as a cleaner alternative to oil. Despite recovering economies, factors that influence reduced demand are still at work. While

implementation of clean and renewable energy is still in its early stages, it is already having an impact on the amount of oil needed by many economies.

However, many analysts point to the supply side as the main reason for the imbalance in supply and demand. The advent of hydraulic fracturing, or "fracking," has greatly increased the crude oil output of a number of countries, especially the United States. Hydraulic fracturing has made it possible to get more oil out of existing wells, and to obtain oil from wells that were once thought to be "dry" or no longer viable. According to the Energy Information Administration (EIA), hydraulically fractured wells accounted for about half of the crude oil produced in the United States in 2015, and two thirds of the natural gas produced in the US that same year.

Why Did OPEC Stay on the Sidelines?

OPEC is responsible for more than 30 million barrels per day of the world's approximately 92 million barrels per day of petroleum output. In the past, OPEC has used its clout to support higher oil prices by cutting production. By the time the group met on November 27, 2014, oil prices had already declined from their high of $98 per barrel in August 2014 to as low as $74 per barrel. In a surprise move, OPEC, led by Saudi Arabia, kept its official production target at $30 million barrels per day, and declined to reduce it. This was the same production target that was set in December 2011.

The decision was a victory for the wealthiest OPEC countries, especially Saudi Arabia, which was in a position to weather the storm of lower oil prices. Poorer members of OPEC such as Venezuela and Algeria called for cuts of 2 million barrels per day. These countries are heavily dependent on oil revenues and are suffering greatly from the reduced oil prices.

Many analysts believe that Saudi Arabia's decision to maintain production levels was an explicit attempt to undermine the US shale industry. The advent of shale production in the United States and elsewhere undercut Saudi Arabia's dominance as the world's leading oil supplier. Because of the advanced technology involved in shale production, many shale wells are not profitable when oil is below the $50 or $60 level. Saudi Arabia, by contrast, can easily produce 10 million barrels per day at relatively low cost, and can continue to do so indefinitely. Low prices clearly had an impact on Saudi Arabia, but the Kingdom was in a position to play a waiting game. As a result, oil prices dropped to the $30 per barrel level and below, and many US shale companies were badly hurt.

Saudi's New Oil Minister

On May 7, 2016, Saudi Arabia replaced its oil minister, Ali al-Naimi, who was appointed in 1995. He was replaced by Khalid al-Falih, chairman of Saudi Aramco, who still holds this position today. The position has been expanded and is now called the Ministry of Energy, Industry, and Mining.

Rather than generating a significant policy change, it seems that Saudi Arabia is positioning itself for the time when it will rely less on oil as a source of revenue. Saudi Arabia is aware that its oil-generated wealth will not last forever, and is making long-term plans for its future.

As noted previously on page 9, OPEC reversed its position on November 30, 2016, and instituted a production cut of close to 1.8 million barrels per day, beginning January 1, 2017. OPEC has had very good compliance with its target cuts. This has had the effect of increasing prices, and crude oil has found a bottom in the $50 range since this decision by OPEC. Furthermore, OPEC has extended this cut until the end of December 2018. As of January 21, 2018, WTI closed at $63.65. In the meantime, economic activity is picking up, which means that demand for oil and refined products is increasing. As a result, it looks like 2018 will be a very good year for the oil market and for oil and gas producers.

III. Organization for Economic Cooperation and Development (OECD)

OECD Headquarters:
2 rue André Pascal
75775 Paris Cedex 16
France
www.oecd.org

The Energy Information Administration reports oil supply and demand by reporting on OPEC and OECD countries. So it is worth looking at both those organizations, to understand better what they are and how they operate.

The roots of the Organization for Economic Cooperation and Development (OECD) go back to 1948, when the Organization for European Economic Cooperation (OEEC) was formed to administer the US Marshall Plan. The Marshall Plan was designed to help in the reconstruction of a European continent that was ravaged by war. Encouraged by the success of the OEEC, Canada and the United States joined the OEEC members in signing the new OECD Convention on December 14, 1960. The OECD was created officially on September 30, 1961, when the OECD Convention went into effect.

Since its formation in 1961, other countries have joined, including Japan in 1964. Today, there are 35 member countries in the OECD. This is now a mixture of countries from Europe, Asia, and Latin America, as well as the United States and Canada. Most of these countries have some form of democratic government.

Purpose of the OECD

The OECD works with member countries on matters of finance, regulatory reform, environmental issues, fiscal policy, and other issues. OECD monitors events in member and non-member countries and prepares projections of economic developments. OECD countries can form agreements on matters of mutual interest. Examples of these agreements include methods for combating bribery, arrangements for export credits, and procedures for capitals movements. Other matters of agreement include cross-border cooperation in enforcing laws against spam, and guidelines for environmental practices.

OECD's budget for 2015 was 363 million Euros. Unlike OPEC, which has a flat rate annual membership charge for all members, OECD uses a formula based on the size of each member's economy. The United States contributes about 21 percent of OECD's budget, and is the largest contributor.

Comparison to OPEC

The OECD is quite unlike OPEC. OPEC is a cartel that was formed primarily for the purpose of exercising some control over oil prices, and was formed in specific response to an action on import quotas by the US. OECD grew out of the implementation of the Marshall Plan in 1948, and is mainly focused on broad issues of economic development among its members. The so-called "Seven Sisters," to the extent that they were organized at all, were more similar in function to OPEC than is OECD.

The reason the EIA uses the OECD in its prism for reporting on oil prices is not so much because of any influence OECD has on oil prices as because it is a convenient way to group the countries that are not members of OPEC. Some countries such as the Russia and China are not members of either OPEC or OECD.

About Flow Research

Flow Research Incorporated, founded in 1998, is the only market research company whose primary mission is researching the flowmeter and instrumentation markets.

We produce two quarterly Worldflow reports — Market Barometer and Energy Monitor — and an online Worldflow Living Database. Flash Reports keep you posted on breaking news in the flowmeter and energy industries.

Our analysis of the world flowmeter market includes a study on all flowmeters, individual studies on most flow technologies, and a worldwide survey of flowmeter users. We also cover the related markets of pressure, temperature, level, and flow calibration. Studies on the world market for gas flow measurement and oil flow measurement are available. You can find studies listed at www.FlowStudies.com.

Some recent and in progress studies include:

The World Market for Thermal Flowmeters, 2nd Edition

Volume X: The World Market for Flowmeters, 6th Edition
Volume X: Module A: Strategies, Industries, and Applications

The World Market for Coriolis Flowmeters, 5th Edition

The World Market for Magnetic Flowmeters, 6th Edition

The World Market for Ultrasonic Flowmeters, 5th Edition:
Core Study (all), **Module A: Inline**, and **Module B: Clamp-on & Insertion**

The World Market for Vortex Flowmeters, 5th Edition

The World Market for Multiphase Flowmeters, 2nd Edition
Multiphase: Module A: The World Market for Watercut Meters

The World Market Update for Mass Flow Controllers

Worldwide Flowmeter Calibration Facilities and Markets:
Core Study: Gas, and **Module A: Liquid**

The Market for Temperature Sensors in the Americas, 3rd Edition

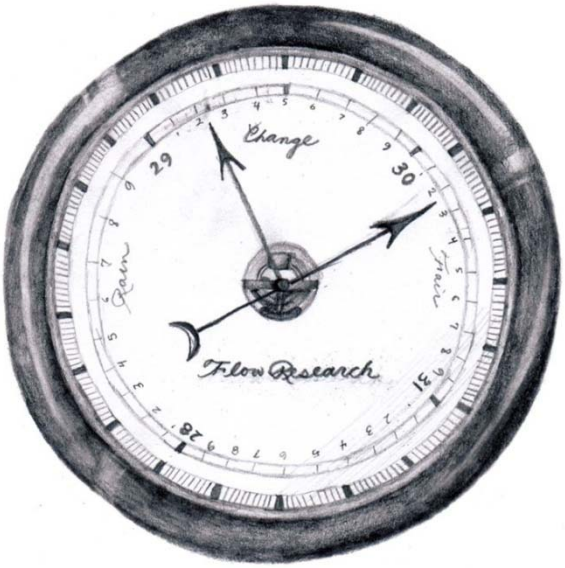
Core Study: The World Market for Gas Flow Measurement, 3rd Edition
Module C: The World Market for Custody Transfer of Natural Gas

Flow Research, Inc.
27 Water Street, Wakefield, MA 01880 USA
(781) 245-3200 fax: (781) 224-7552
www.flowresearch.com

We create change in flow

energy monitor

Whitepaper



Change

Flow Research, Inc.
27 Water Street
Wakefield, MA 01880-3090
(781) 245-3200
fax: (781) 224-7552

FLOW RESEARCH

www.flowresearch.com

Every quarter, the ***Energy Monitor*** shines its spotlight on the oil & gas, refining & petrochemical, and power & renewables industries looking for important events to discuss or highlight.

We find the events, report them, and place them in the context of the flow and instrumentation industries. The *Energy Monitor* explains and interprets the importance of capital spending forecasts, the construction of new refineries and plants, and new regulations that affect the need for more instrumentation.

The *Energy Monitor* gives you the information you need for forecasting, marketing, and making decisions on product features in the flow, temperature, pressure, and valves industries.

www.worldflow.com