

# **PIRA's Forecast Methodology and Assessment of Future Oil Price Trends**

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## Overview

PIRA Energy Group is an international consulting firm founded in 1976 known for its comprehensive and detailed research and market analysis of energy markets. "PIRA" was originally an acronym for Petroleum Industry Research Associates, but PIRA's practice has evolved beyond petroleum and now also includes coverage of natural gas, LNG, coal, power, emissions, and biofuels. We also have groups dedicated to the important macroeconomics, country political risk, energy policy, and shipping assumptions, which underpin our fundamentals-based forecasts.

PIRA is retained by more than 500 companies in over 60 countries. Our clientele includes all of the world's major private integrated oil companies, nearly all of the largest state-owned national oil companies, and over 80% of both the oil producers and oil refiners in North America. Outside of the oil business, we also provide services to over 80% of the U.S. gas and electric companies and over 90% of the gas and power marketers. Our clients are not limited to the energy industry, as we provide consulting to two-thirds of the world's top commercial banks, several proprietary traders and hedge funds, and many industrial end-users, ranging from airlines to automobile companies to chemical manufacturers. This wide-ranging, international clientele is indicative of PIRA's global, balanced view, in which no particular constituency is catered to.

Our approach to market analysis is highly quantitative and highly detailed with databases and models that build up supply and demand at the most disaggregated level possible in order to build up to country, regional and global totals. We begin all of market assessments with a sound understanding of the fundamental forces driving markets (supply/demand/inventory), but we also closely monitor and incorporate the impacts of political risk, financial market investment, and any other relevant "non-fundamentals" factors.

PIRA is staffed by approximately 80 professionals, with the majority of senior consultants holding advanced degrees in economics and engineering. Historically, we have hired staff with extensive experience in industry (particularly the major oil companies) to direct our analytical work.

## Methodology — Long Term Oil Price Outlook

PIRA begins its analysis of the long-term crude price by developing detailed, bottom-up outlooks for liquids demand and liquids supply based on a first-pass oil price assumption. The demand outlook is developed as part of a full energy balance for each country of the world for each end-use sector (i.e. transportation, industry including petrochemicals, residential/commercial, electric power generation). Historical data are assembled using data from the IEA, country sources and PIRA's own estimates. Assumptions are made for each of 140 countries about economic and population growth, the pace of overall energy efficiency improvement, the prospects for new technology, likely government policy developments, and fuel substitution trends. Assumptions on the availability of non-oil fuels, particularly natural gas, are also made on a country-by-country basis. Projections are made for the demand for each major oil product, including LPG and ethane. The country totals are then aggregated to provide us with regional and global results.

On the supply side, PIRA independently develops an outlook for non-OPEC supply at the country, or in some cases, at the field or basin level, depending on data availability. This outlook will be based on our estimates of the original and remaining resource base, expected rate and location of new discoveries,

decline rates in existing fields, specific development plans of companies (private and state), the prospects for technology improvement (e.g. shale liquids), and policy assumptions that could impact supply availability such as environmental or acreage access limits. We also make an assessment of the supplies likely to come from non-crude sources, including natural gas liquids (OPEC and non-OPEC), biofuels such as ethanol and biodiesel, oil sands, and conversion of gas- or coal-to-liquids.

Once we aggregate the supply data into a global total we calculate the difference between the demand and the total non-OPEC outlook in order to develop a requirement for the amount of OPEC crude to balance the market. We then develop an outlook for production capacity for each of the OPEC countries, taking into account their resource base, investment plans, and a reasonable estimate for the risks of supply loss. (Historically, supply disruptions have limited net OPEC capacity growth and we therefore build in a very conservative outlook for future capacity expansion given the continued risks in many of the OPEC countries.) If there is sufficient OPEC capacity to balance global supply and demand (and allowing for some desired volume of spare capacity), we assemble a balanced Reference Case price outlook. If the supply is insufficient, we would adjust (raise) the assumed starting price and recycle through our demand and non-OPEC supply balances until we reach a balance. If the supply is larger than the required demand, we would adjust (lower) the assumed starting price and recycle through our demand and non-OPEC supply balances until we reach a balance.

This outlook is tested for reasonableness in several ways. For instance, we check to see:

- If the burden imposed by oil expenditures in the oil importing countries is consistent with our economic growth assumptions by looking at trends in oil expenditures as a share of GDP.
- If the price allows for sufficient growth in OPEC production. For instance, we would not judge an outlook as sustainable if it required persistent cuts by Saudi Arabia to maintain the price.
- If the price is sufficiently high to cover the likely costs of the marginal source of oil supply, such as Canadian oil sands, shale liquids and new deepwater discoveries.
- If the price/production profiles provide OPEC with the revenue needed to meet budget requirements. This may not be possible in all cases since a country like Iran with declining oil exports may need an impossibly high price in the future for budget balance. But it still provides a useful check for countries such as Saudi Arabia.
- If it is consistent with likely changes in the value of the U.S. dollar. A declining dollar, all else equal, would tend to increase the dollar-denominated price of crude oil since it is our view that the price is set in the global market and simply denominated in U.S. dollars.

Ultimately, the key question is whether the price is high enough to incentivize producers to bring forth sufficient liquids supply to meet the expected demand growth at that price. The growth in shale liquids in North America and the potential for growth globally has emerged as an increasingly important factor over the past several years.

If the outlook balances, and passes all of the above mentioned reasonableness tests, it is considered to be our Reference Case. We characterize this as our "most likely" case and consistent with our most likely assumptions on all of the key inputs to the balances. It is not just one of many plausible scenarios but one that we put forward as a preferred basis for decision-making.

## Scenario Price Determination — Methodology

Even though the Reference Case may reflect our assumptions on most likely economic growth, technology, government policy and Middle East politics, history has shown us that many of these assumptions carry a wide range of uncertainty. PIRA develops its High and Low Price scenarios by combining an internally consistent, plausible set of alternative assumptions that give a range of oil prices around the Reference Case. For instance, in developing the High Price scenario we may reduce our assumption on OPEC supply availability — perhaps in a world in which Middle East unrest prevents any supply growth from the region. Once such an assumption is changed, we would no longer have a balance between supply and demand at our Reference Case prices. Therefore, we would raise the price in our long-term supply and demand models until demand was reduced, and non-OPEC supply was increased sufficiently to bring total supply and demand back into balance — but in a world with less OPEC supply and higher prices.

To develop the Low Price case we might assume a lower rate of economic growth and, in turn, lower oil demand growth. In this case, we would be forced to lower our price outlook until supply and demand rebalanced. Alternatively, we could develop the Low Price case based on increased non-OPEC supply (say from a significant increase in North American and global shale liquids production) that would also create an oversupply situation that would require a decline in price to balance. Again, as in the Reference Case, we would test the price in each of our scenarios against a series of reasonableness checks. For instance, in this latter case, driven by higher shale liquids production, we would have to ensure that the scenario price was still high enough to provide a return on investment to shale liquids investors.

## Current Reference Case — Key Assumptions

PIRA's latest Reference Case outlook is based on the following assumptions:

### Demand

- PIRA estimates that the individual country growth assumptions we make will result in global economic growth that will average 3.6% per year between 2012 and 2025. This projection is in line with the consensus economic forecast of others (IEA, OPEC, BP) that develop long-term forecasts and in line with the global historical trend. It assumes continued weak growth in the OECD and a slowdown in China with the potential for future normal business cycles but no major economic crisis like the 2008-2009 "Great Recession."
- Energy efficiency improvements will proceed at a slightly faster rate in the future than they have over the past decade, driven by a combination of higher price, environmental pressures, and growing supply security concerns (growing in China but possibly shrinking in the U.S.) and policies to slow consumption growth. New, more efficient automobile technology including (but not limited to) hybrids and all-electrics will be brought to market and slowly increase its share of new car sales with the help of government subsidies and regulations. This is assumed to be the case in both the OECD and China. (We note that while there is a tendency to focus on policy developments in the OECD, the most important policy developments may in fact be those taking place in China, where the oil growth potential is the largest – by far.)

While there will be continued steady progress in energy end-use technology, disruptive technological breakthroughs, such as extremely low cost batteries or economic hydrogen vehicles, are not

anticipated. Given the expected low cost of natural gas relative to oil, we have assumed some penetration of natural gas in the commercial transportation sector in the developed world and in personal transport in select developing countries, but the global impact will still remain small. Significant oil price subsidies will steadily disappear, with the exception of the major oil exporting countries where they will be politically difficult to remove in most cases. PIRA estimates that overall oil demand will grow at approximately 1.5% per year (around 1.5 MMB/D/YR) over the entire 2012-2025 period with all of the net growth in the developing world, particularly China, India, and the oil exporting nations. From 90 MMB/D today, oil demand will reach 110 MMB/D by 2025. This demand outlook has been revised up over the past year to reflect the slightly lower crude price now assumed for the longer-term.

### Non-OPEC Supply

- Conventional non-OPEC crude supply will resume its growth after years of stagnation with the net growth coming primarily from liquids from shale source rock. PIRA's assessment of shale crude potential has been revised up significantly over the past two years. Under the right conditions of price, reasonable regulation, and an absence of transportation bottlenecks, shale crude production in the U.S. could reach between 5 and 6 MMB/D by 2025 – up from 1.5 MMB/D today. Much of that growth will occur by 2020. Additional liquids supplies will be made available from the production of natural gas liquids. Shale liquids will initially be developed in North America however post-2020 a growing contribution is expected from other shale resources around the world. Most of the growth in non-OPEC liquids supply will come from OPEC Natural Gas Liquids (NGLs) and condensates (typically counted with non-OPEC) and non-conventional supplies. Canadian bitumen projects account for the largest single source of non-conventional growth followed by biofuels and small volumes of gas-to-liquids. In total, non-OPEC liquids production from all these sources will grow at an average rate of around 1.2 MMB/D per year.

### OPEC Crude Supply

- Reconstruction in **Iraq** is assumed to proceed slowly given the remaining uncertainties, particularly the renewed threat of sectarian conflict. We project growth toward just under 5 MMB/D in 2025. This is still well below Iraqi targets and resource base potential.
- **Saudi Arabia** will add only modest net amounts of new capacity as their required production should average just below current levels longer term.
- **We assume that Iran** and the West will avoid a serious confrontation that impacts long-run capacity or production and that sanctions will ultimately be lifted. This is looking to be a greater risk, and to reflect this we have put in a conservative outlook for capacity growth that has Iran never returning to pre-2011 production levels.
- **Venezuela's** capacity will eventually recover slowly as new investors are found for additional heavy oil projects in a post-Chavez regime.
- The current unrest spreading through **North Africa and the Middle East** will result in periodic short-term losses but no significant, extended losses.
- OPEC will follow the price guidance of the market in the longer term. There is no particular price target that is relevant for the longer term, but the price required to meet the group's revenue needs

will continue to climb; this process has been accelerated due to the increased social spending driven by recent protests. At some point, the growth in spending by OPEC countries will have to slow since the market is unlikely to permit the group to achieve an ever rising price — at least not in inflation-adjusted terms.

- OPEC crude production in total will climb from today's level of 31 MMB/D and plateau at just under 35 MMB/D post-2020. This is lower than our prior outlooks and more consistent with historical experience, where net growth in OPEC capacity has proved to be difficult to achieve due to periodic disruptions. There will be relatively little growth in OPEC production requirements between now and 2020.
- Under these assumptions the Brent crude price will average approximately \$100-105/Bbl (in 2011 inflation adjusted \$) and WTI will average 5-10 dollars lower over the period from 2012-2025 with a modest decline from current levels expected for Brent and a modest increase for WTI as increased pipeline capacity eliminates bottlenecks and reduces the currently large WTI discount to Brent.

We believe that this Reference Case price path:

- Appears to be broadly consistent with OPEC capacity expansion objectives (appropriately discounted) and post-Arab Spring revenue requirements for Saudi Arabia. OPEC production and capacity will grow slowly under these assumptions and export revenues will be fairly flat through the end of this decade.
- Is consistent with long-term expected trends in the costs of non-conventional supplies (although these tend to follow prices for extended periods). The price does appear sufficiently high to cover the costs of most of the known shale liquids developments.
- Appears sustainable from a demand and economic growth standpoint.
- Overall, will bring forth sufficient liquids supplies (on average) to meet anticipated demand growth at this price.

While Arab Spring developments and the associated potential for supply outages represent new, bullish factors driving long-term prices, the rapid growth of shale liquids represents an equally powerful bearish factor. Our current price outlook has been directionally reduced vs. a year ago. We attach a probability of 45% that the average Brent price will fall within the \$90 to \$130/Bbl range (2011\$) over the 2012-2025 period, with a slightly greater probability of a downside (30%) than upside (25%) case. (This has not always been the case. In past outlooks we have normally seen the risks as skewed to the upside. This change in view reflects the emergence of new sources of supply, shale and other, that are responsive to high price.)

### Potential for a Low Price Scenario

The principal drivers for a sustained average price significantly lower than our Reference Case price would be some combination of the factors below:

- Persistently weaker North American and global economic growth and associated weaker oil demand growth.
- Significantly higher OPEC crude oil production — with Iraq being the country with the most upside if it is able to carry out its plans without disruption.

- Upside surprises to non-OPEC production. This could include, but would not be limited to, much higher shale liquids production in both North America and abroad than assumed under our Reference Case. Note, however, that not only would the shale liquids volumes have to be higher but they would have to be economically attractive at the lower prices of this case. Current estimates suggest that a price of between \$50 and \$70/Bbl (WTI 2011\$) is required to provide an acceptable return on shale liquids wells. That breakeven cost could drift down with improved technology or drift up with increased activity and scarcity of resources, as oil sands costs have done in Alberta.

Under these assumptions, we define a representative low case with an average WTI price of around \$60/Bbl over the 2012-2025 period. This average price would be about 37% lower than our Reference Case price — slightly smaller than the differential assumed back in November of 2009 between our Reference and Low cases.

The reason that our outlook for the Reference Case has recently been revised down more than the Low case has to do primarily with the economics of shale liquids. It is now clear that we will have far more shale liquids supply than anticipated at prices above \$100. Previously, we had assumed that price would have to rise above marginal costs to destroy demand growth. Now it appears that supply is more responsive to high prices so that \$120-130 prices will not be necessary. However, this incremental shale supply is relatively high cost supply. If the wellhead price begins to fall below \$70, a growing proportion of the volume will become economically unattractive and will not be produced. While the availability of price responsive shale liquids is helping to put a cap on long-term prices, it also serves to put a floor on those prices as well.

### Comparison with November 2009 Outlook

The Reference Case that was developed in November of 2009 was slightly higher than our current view. Comparing the forecasts in the same constant 2010\$, over the same time period, our average Reference Case WTI price then was \$100/barrel and the current price for the same 2009-2025 period would be slightly lower at \$91/barrel. An assumption that WTI will sell at a long-range discount to Brent accounts for most of the difference. Our Reference case outlook for Brent price, a better indicator of global prices, is nearly unchanged. The comparable numbers for the Low Case were \$46/barrel (2010\$) then and \$58/barrel now. As mentioned above, the emergence of shale liquids as an important marginal supply step not only reduced the Reference Case but provided greater support in the Low case.

The risk profile was assumed to be biased to the upside in 2009 and we now see it biased to the downside but not by much. With the ever growing uncertainties in the Middle East, including the possibility of a confrontation with Iran that could impact both Iranian and regional production, the potential for severe price spikes cannot be dismissed.