RESERVOIR SOLUTIONS

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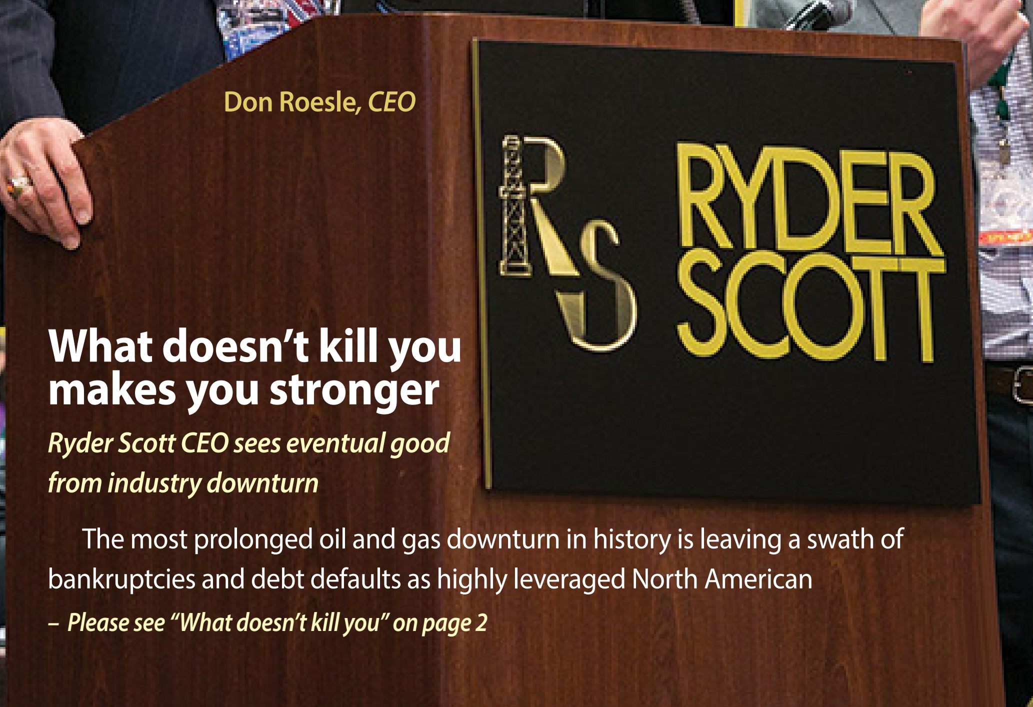
More than 375 attended the Ryder Scott reserves conference Sept. 14 in downtown Houston, again making it the single largest gathering of senior reserves evaluators in the world.



Don Roesle, *CEO*

What doesn’t kill you makes you stronger

Ryder Scott CEO sees eventual good from industry downturn

The most prolonged oil and gas downturn in history is leaving a swath of bankruptcies and debt defaults as highly leveraged North American

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RYDER SCOTT

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Attendees to the Ryder Scott reserves conference in Houston this year filled out evaluation forms with their remarks. Overall, the conference and its presentations received favorable reviews. On a one-to-five scale with five being the highest score, more than 70 percent rated the conference as a five and 29 percent rated it as a four.

One respondent said, "So thankful that Ryder Scott hosts this conference each year; great presentations, quality venue and materials and outstanding networking. Thank you, Ryder Scott!"

Another said, "Stick with same types of topics: SEC comments letters, PRMS, unconventionals, low price environments, adopted plan of development, technical evaluation techniques, reliable technology."

Ryder Scott underwrites its conferences—one in Houston and one in Calgary—to give back to an industry that has given so much to the consulting firm.

One respondent said, "I am deeply appreciative of Ryder Scott's willingness to put on this conference at no cost to the participants. It is extremely valuable to practicing engineers and to the industry in general. Thank you!"

Over a year, reality about oil prices has set in. In 2015, about 60 conference attendees were asked to predict what oil prices would be in one year. The average forecast price was $68, about $27 more than the actual price. This year, the same question was asked, and the average was $59.

"You, your people and we had a hard time getting close to the price," said **Don Roesle**, CEO. "It's a worldwide puzzle with a lot of pieces working together and against each other trying to stabilize price." Please see article, "TP&H model predicts $80 oil by YE 2017," on price forecasts on Page 7.

What doesn't kill you – Cont. from page 1

independents play a waiting game for commodity prices to rise. "You don't have to look very far to see the financial impact of $40- to $45-a-barrel oil. Look at the number of bankruptcies and layoffs," said **Don Roesle**, CEO at Ryder Scott.

Last year, 102 North American oil and gas producers filed for bankruptcy with $68 billion of cumulative debt, said Haynes and Boone. By Sept. 9, another 58 producers had filed this year, representing an additional $50 billion in debt.

"We all know people are struggling, prices have dropped dramatically, rig counts are down and budgets are being cut so companies can remain solvent," said Roesle at the Ryder Scott reserves conference Sept. 14 in Houston. "This will continue until the downturn is over."

All indications suggest more producer bankruptcy filings will occur during 2016, said Haynes and Boone.

Fitch Ratings said that in September alone that $3.8 billion of defaults had been announced, led primarily by energy companies. "If crude oil prices remain in or rise above the mid-high $40 range, the energy default rate could end 2016 … at closer to 16 percent," said Eric Rosenthal, senior director of leveraged finance at Fitch.

Cutting capital expenditures, improving technology

Producers are also cutting capital expenditures, part of $1 trillion in spending cuts across the sector, to survive. Cost cutting and doing more with less through efficient use of reliable oilfield technology will make our industry stronger in the long run, according to Roesle.

"Management is saying, 'Find ways to cut costs. Focus on those operational changes that can help you cut costs and be profitable still,'" said Roesle. "We've had to meet those hurdles, but when the situation does turn around and we have those cost reduction models, they will be put into effect and we will be stronger than we ever were. So there is some good to be taken out of this but it's hard to see now."

More than 370 attendees to the conference — comprised mostly of E&P managers, senior reserves evaluators and financial professionals — listened to Roesle's opening remarks.

"There is one thing we can agree to that is indisputable about this industry. What we can learn in this downturn will

Please see "What doesn't kill you" on page 4

Don Roesle, *CEO*

"I think we all can agree that what we learn from this downturn will help us in the long run."

What doesn't kill you – Cont. from page 2

help us," he said. "You give us the money. You give us the science, and with our innate ability to be innovative, we can face any challenges. We are doing this now in the unconventionals and ultra deepwater. I have an optimistic outlook."

Haynes and Boone said in September that the following financial restructurings are keeping E&P companies operations ongoing:

- ***Converting unsecured loans from non-bank lenders to second-tier secured debt.***
- ***Selling undeveloped assets to meet reserve-based/production lending norms.***
- ***Working with bankers to increase secured debt to earnings before interest, tax and depreciation (EBITDA) and interest coverage ratios.***
- ***Taking delayed drawdown term loans from banks.***

The plunge in borrowing base values has forced some banks to sell risky loan revolvers to private equity firms at "deep discounts," reported Reuters earlier this year. Those firms have emerged as "lenders of last resort" for some energy companies. North American producers are using high-interest debt to fund working capital and make credit payments.

Not all is gloom and doom. "On the other side of the ledger, some of our clients have hedged their production," said Roesle. "Those hedges are still in place and they are OK. Others are receiving funding from private investment and from underwritten public offerings. Even with that, everyone's bottom line has been affected negatively."

Price collapse, reserves shops

The low-price environment has forced companies across the board to curtail drilling plans. "Lots of producers are changing their development plans or putting them on hold. That makes it difficult for reserves managers to maintain a company's reserves base," Roesle told conference attendees.

Adding to that, Roesle said that the U.S. Securities and Exchange Commission is asking public issuers a myriad of questions about moving forward with development plans in this low-price environment, including, "How is the five-year plan progressing?" That rule requires companies to convert PUDs booked more than five years to another reserves category or take them off the books.

"Are you developing everything you said you would develop? Are you developing 20 percent of your undeveloped reserves every year? Do you really have the capabilities to carry out the development plan? These are a few questions from the SEC that our clients are receiving," said Roesle. "We are reviewing historical PUD tables with our clients."

Third-party reserves consultants that prepare independent reserves reports for public companies that file with the SEC are experiencing another fallout, he said.

"It has been suggested that reserves auditors ask clients about their balance sheets, banking facilities and financial stability," said Roesle. "That resonates in our shop. We are not qualified to do that. We are not financial auditors."

He recognized that the SEC is faced with a daunting task of protecting investors during an historical, protracted period of lower prices. "I commend the SEC for asking questions, because it needs to know, but that makes our job more difficult," remarked Roesle.

Quality acreage bringing in "pre-crash" selling prices, says BMO

Geoff Roberts

Price increases and less volatility this year have generated interest in acquisitions in the Eagle Ford, Haynesville, Permian and SCOOP/STACK plays, said **Geoff Roberts**, managing director and head of U.S. A&D at BMO Capital Markets.

The problem now may be too much money chasing after too few deals. "In the market, there is a shortage of high-quality assets with scale," said Roberts.

Just how much private capital is on the sidelines and available? "Private equity providers have about $150 billion in 'dry powder' to invest in U.S. drilling and production," said Roberts. "Dry powder" refers to cash reserves or liquid assets available to deploy when needed.

Roberts said, "A significant number of management teams have received large commitments and have yet to make their first acquisitions. Some teams with no deals over last 18 months are being shut down," he remarked.

See graph, "Quarterly Deal Activity," which shows the numbers and values of corporate and asset transactions falling off rapidly in Q1 2015 and then partially rebounding this year to make up some lost ground.

"Quality energy assets are seeing meaningful interest and selling for pre-crash prices," said Roberts.

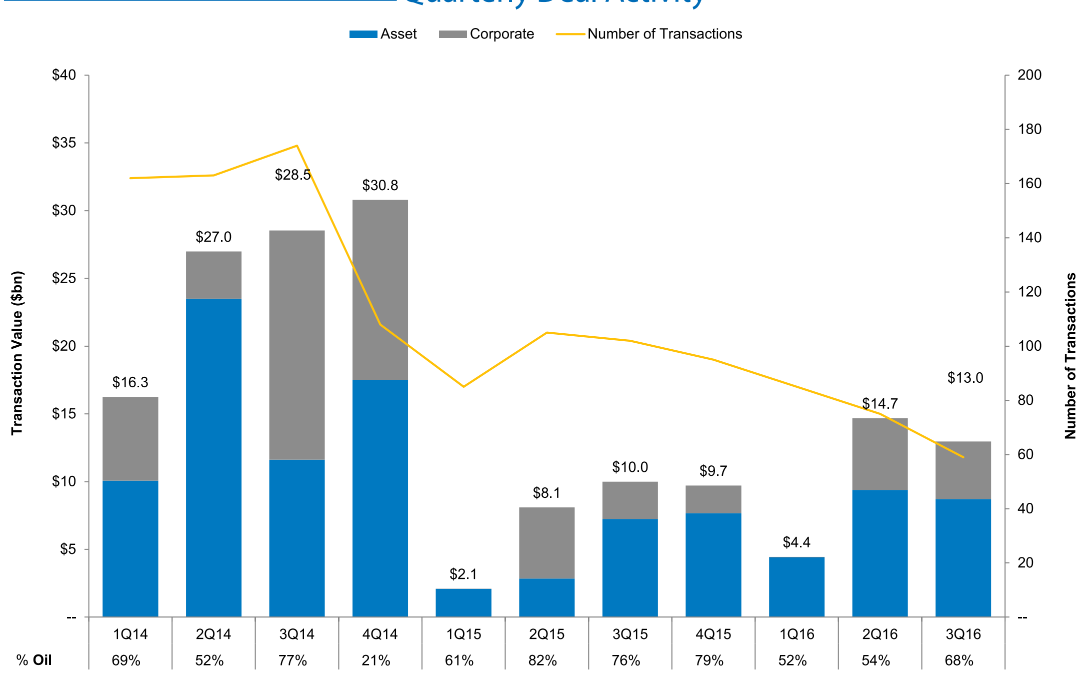
Even though commodity prices remained mired in $45 per barrel oil and $3 Mcf of gas, he said that U.S. breakeven prices per barrel for acquisitions have fallen significantly since 2014, with several at $41 a barrel. Areas with BEPs at or below $41 a barrel include reservoirs in the Bone Spring, Eagle Ford, Niobrara, Stack and Wolfcamp plays.

The breakevens have fallen because service companies have had to cut day rates.

"Reduced prices from service companies are the only way for E&Ps to keep drilling," said Roberts. "We expect A&D offerings and activity to increase if prices stabilize in the fourth quarter. We also expect more horizontal drilling in conventional plays."

BMO is a diversified financial services provider offering investment banking in the oil and gas sector. The company posts *A&D Market Monitor* newsletter, which offers metrics and analysis of the U.S. oil and gas deal market, at http://datarooms.ca.bmo.com/_layouts/petris/loginpageBMOCAN.aspx?ClientId=26.

Quarterly Deal Activity



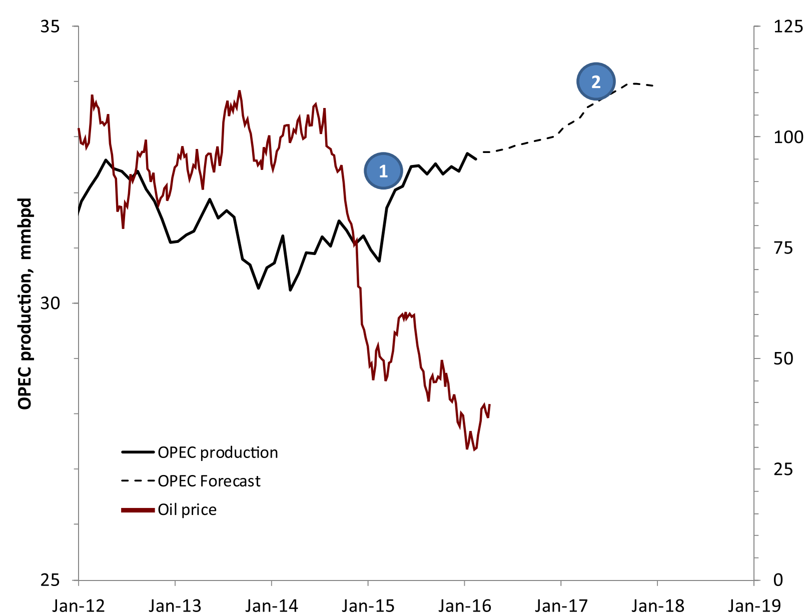
TP&H model predicts $80 oil by YE 2017

Brandon Blossman

A supply-and-demand model of Tudor, Pickering, Holt & Co. predicts $80 a barrel of oil by year-end 2017 based on an outlook that global demand will grow 1 million B/D over the next 12 months, OPEC sustains its record levels of production and U.S. production continues to fall.

The model predicts that next year, WTI crude will average $75 a barrel and thereafter will remain flat at $80. "This is at the extreme end of bullishness," said **Brandon Blossman**, managing director at TP&H. "We understand that we are at the far end of the spectrum and wear that proudly."

Current Cycle – Base Case



OPEC will need to produce at record levels as the market tightens in 2H16 and 2017 with less visible excess capacity.

Blossman's 1 million B/D of demand growth is lower than the International Energy Agency's 1.2 million B/D forecast.

Blossman made his remarks at the Ryder Scott reserves conference in September. His bullish predictions seemed attainable in October. Oil gained $6 a barrel by Oct. 6, passing the $50 mark after an announcement by OPEC in late September that it would remove 700,000 B/D from the market.

Oil production in North America continues to plunge. "U.S. supply is falling like a rock," he said. "We are down almost a million barrels a day from peak production, a more than 10 percent reduction in a short time — a big decline." The TP&H model predicts that by December, U.S. onshore production will be falling to 1.5 million B/D below peak.

On the flip side, organic global demand growth of H1 2016 has been almost 1.5 million B/D. "We have had very extraordinarily strong growth over last year and a half," said Blossman.

OPEC supply is flat now at best, he said, while Saudi Arabia, by its own admission, has little excess production capacity relative to historical norms. The bullish outlook "makes us feel warm and fuzzy," remarked Blossman.

He also presented the bear argument to support a lower-for-longer side, showing that since the Q4 2014, Saudi Arabia, Iran and Iraq have supplied almost 3 million B/D more crude products to global markets while demand grew at half that pace, 1.5 million B/D.

"That's scary. That's a tremendous amount of excess oil," said Blossman.

Non-OPEC production also grew last year at 1.3 million B/D despite oil prices that were cut in half, indicating that U.S. supply is somewhat resilient. "The industry is resilient at $50 a barrel by cutting costs to get barrels to market at a much lower price tag," said Blossman.

Technology has cut costs by optimizing rig efficiencies and fracing practices. "Whether through an increase in lateral lengths or frac stages, technology rules the day," remarked Blossman.

Neither bulls nor bears get it right much of the time, he conceded. "The experts don't always get it right. Often they are wrong," said Blossman, who cautioned against putting too much stead in the analysis of broadcasting personalities.

"Talking heads" on TV put forth their own agenda and backfill with data points to support the notion that demand is slowing despite 30 years of global demand growth, said Blossman. "This is the opposite of scanning data set to come up with a conclusion."

His message was that in the short term, market sentiment rules prices, not fundamentals, while individual data points don't matter in the long term. "Use common sense, think through the data and consider what you know historically," said Blossman.

He showed charts and graphs, including various price cycles since 1998 that provide a window into the predicted 2017 price recovery. His presentation and others from the conference are posted at www.ryderscott.com/presentations/.

Effect of prolonged oil prices on Canada market studied

If oil prices stay in the $50 range over the next seven years, the Canadian economy will undergo an "economic shock," potentially contracting 23 percent, said **Dinara Millington**, vice president of research at the Canadian Energy Research Institute (CERI). "The low oil price environment is expected to continue for several years," she remarked. "Some analysts and central banks around the world are calling the price of $40 to $45 the new norm and (we) may not potentially see the triple-digit prices that we saw at the beginning of 2013."

"Perhaps the biggest economic change as a result of low crude oil prices in Canada has been the collapse in the Canadian exchange rate against the US dollar." — CERI study

Millington made her remarks at the Ryder Scott Canada reserves conference earlier this year. CERI's study, Study 156, analyzed two seven-year scenarios — a low case and a reference case — using a general equilibrium model to evaluate the impact of an "economic shock" on the financial system as a whole. The effects of such market elements as level of crude oil prices, level of investment, production, exchange rate and exports were evaluated.

The results of the low case of $50-plus oil prices by 2021 compared to the reference case, which calls for $73 a barrel of oil by the same year, indicate a dramatic dent in the economy. Gross domestic product (GDP) will drop almost 25 percent, wages will fall more than 22 percent and employment numbers will decrease by almost 20 percent. The forecasted oil prices used in the study were adjusted using differing US/CDN exchange rates, with a 10-percent higher rate for the reference case.

The chart on this page demonstrates the impact an extended low-price environment will have on Canada's market.

Millington pointed out that since Canada is an oil exporting country, GDP growth will slow, which will erode national income and spending power. Low oil prices will deplete Alberta more than any other province in Canada.

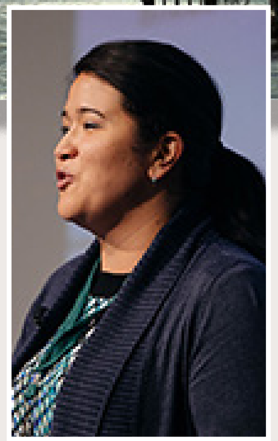
CERI estimates predict that a low-case scenario will drag down a projected $830 billion GDP more than 24 percent to $627 billion, with Alberta bearing 82 percent of the impact. This is no surprise since Alberta is the largest oil and gas producer in the country.

All top economic sectors of the province will see large declines if low-case oil prices prevail. Oil sands and conventional oil, which make up almost 50 percent of Alberta's GDP, are expected to see a drastic drop of approximately 30 percent each.

Not all is doom and gloom on a national scale. Millington said that a low Canadian dollar will boost provincial trade and manufacturing sectors in the non-energy sectors. Ontario, with its high-tech sector, will see more economic growth in the low case.

Each Canadian-dollar-per-barrel increase in the annualized price of WTI would boost Canadian national GDP by $1.7 billion on average, the study shows.

Millington's presentation and others from the Calgary conference are posted at https://www.ryderscott.com/presentations.



Dinara Millington

2015-2021	Unit of Measure	Ref.Case	Low Case	Low vs. Ref. Case	% Change
GDP Growth	Mln CDN$	830,336	626,887	($203,449)	-24.5%
Compensation	Mln CDN$	384,578	297,680	($86,898)	-22.6%
Employment	Thousand person-years	4,109	3,298	(811)	-19.7%
Federal Taxes	Mln CDN$	95,063	71,307	($23,756)	-25.0%
Provincial Taxes	Mln CDN$	58,543	45,457	($13,087)	-22.4%

RS posts price forecasts

Forecasts used in oil and gas reserves filings in Canada

Ryder Scott now posts quarterly price forecasts for oil, gas, natural gas liquids (NGLs) and sulphur through a link on the website home page at www.ryderscott.com. The table provides historical prices and future estimates of 15 U.S. and Canadian benchmarks as well as Canada-to-U.S.-dollar exchange rates.

Price forecasts are especially important in Canada where regulators allow public issuers to file reserves under future-price cases.

The Alberta Securities and Exchange Commission states that "forecast prices and costs are defined in NI 51-101 to be 'generally recognized as being a reasonable outlook on the future.'"

Major reserves evaluation consulting firms play a significant role in establishing reasonable forecast prices and costs used in filings under NI 51-101. Section 4.1 of the national instrument's Companion Policy explains that "(the ASC) would not consider that future prices or costs would satisfy … (its) requirement(s) if they fall outside the range of forecasts of comparable prices or costs used … by major independent qualified reserves evaluators or auditors."

The table lists annual benchmark commodity prices from 2006 to the latest historical prices. Forecasts reach 2033 after which no further escalation is done.

Editor's Note: Information in the table represents our estimates of future prices and other market parameters for the oil and gas industry. The information reflects our opinion of what is reasonable at that point in time. Our estimates are based on an informed interpretation of information extracted from various sources including, but not limited to, public websites of government agencies and oil and gas marketers. Our estimates are based on information available as of the effective date of the forecast. Ryder Scott accepts information from the sources as represented without independent verification. Ryder Scott accepts no responsibility for any inaccuracies in the source information.

We revise our forecasts quarterly. They are subject to material changes because of a high degree of uncertainty inherent in oil and gas price forecasting. Furthermore, material changes occurring between quarterly updates may not be reflected in our latest, published price forecast. Ryder Scott, its directors, officers, employees and/or consultants shall not be liable or otherwise held responsible for the use of the forecasts. Use of the forecasts is performed at a user's own risk and discretion.

SEC wants to know if top managers, board members are aware of changes to development plans that may affect PUD bookings

The U.S. Securities and Exchange Commission is increasingly questioning oil and gas companies about their financial commitment to develop proved undeveloped reserves within the time period allowed under the rules, which is a maximum of five years.

The agency is especially targeting companies that are not on track to comply with the five-year rule because they have scaled back field development to cut costs during the low-price environment. At the same time, they have "stale" PUDs that have to be drilled soon or taken off the books.

A recent study by Ryder Scott has confirmed that 13 percent of YE 2014 SEC comment letters questioning PUD development has narrowed that focus to financial investment decisions (FIDs). Please see chart, PUD Development. Inquiries on FIDs are the fastest growing category of issues surrounding PUD reporting.

PUD reserves are added to other more certain categories of proved of reserves, such as proved developed reserves (PDPs), to get total proved reserves — one key number that is reported to the SEC. Higher proved reserves affect DD&A, boost earnings and improve performance metrics, such as reserves-replacement ratios and finding-and-development costs — all key measures closely scrutinized by investment analysts.

To keep carrying PUDs annually, a company must be reasonably certain that it will develop and economically produce from those undeveloped locations within the SEC time limit. The SEC is checking to ensure that the financial commitment for field development is coming from the top.

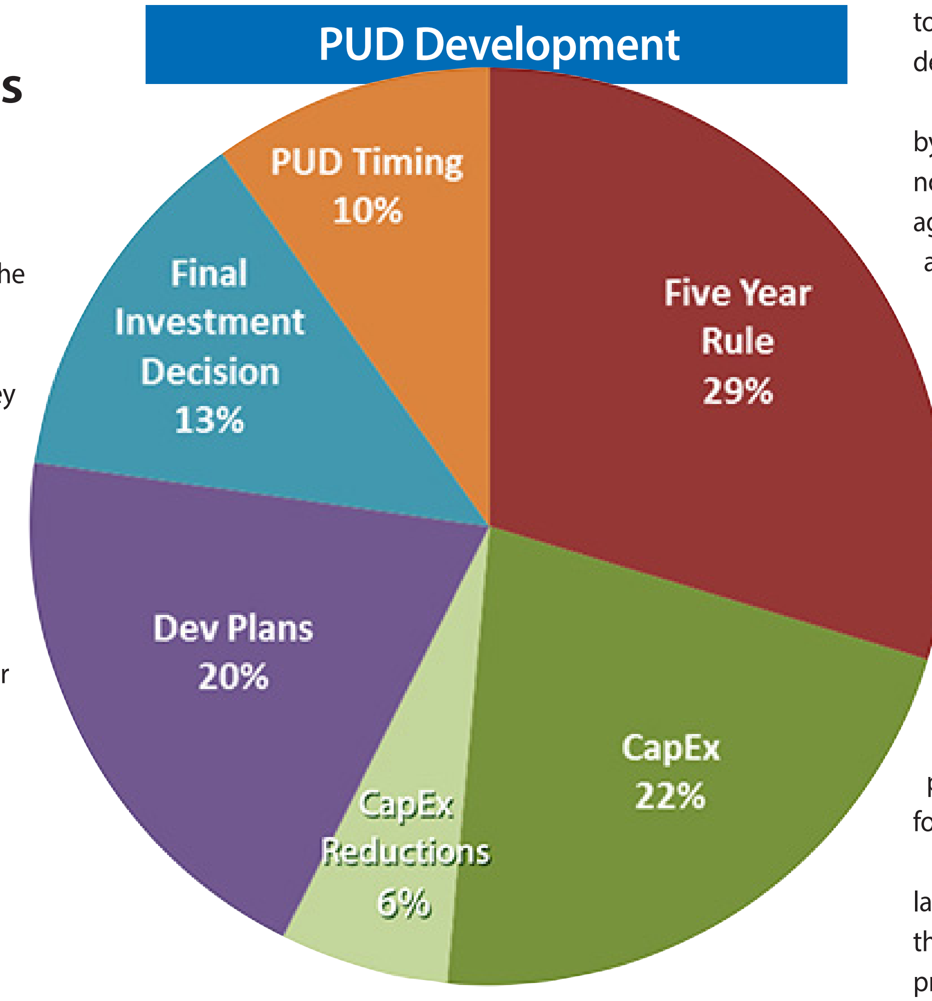
The SEC is more often questioning companies about whether top managers and board members are aware of changes in field development plans that may affect PUD on the books.

For instance, a YE-2014 SEC letter in response to comments by Energy **XXI Ltd.** stated that the company's "response … (did) not appear to clearly explain the extent to which senior management and the board of directors … (were) made aware of all changes to previously adopted development plans when adopting current or multi-year development plans."

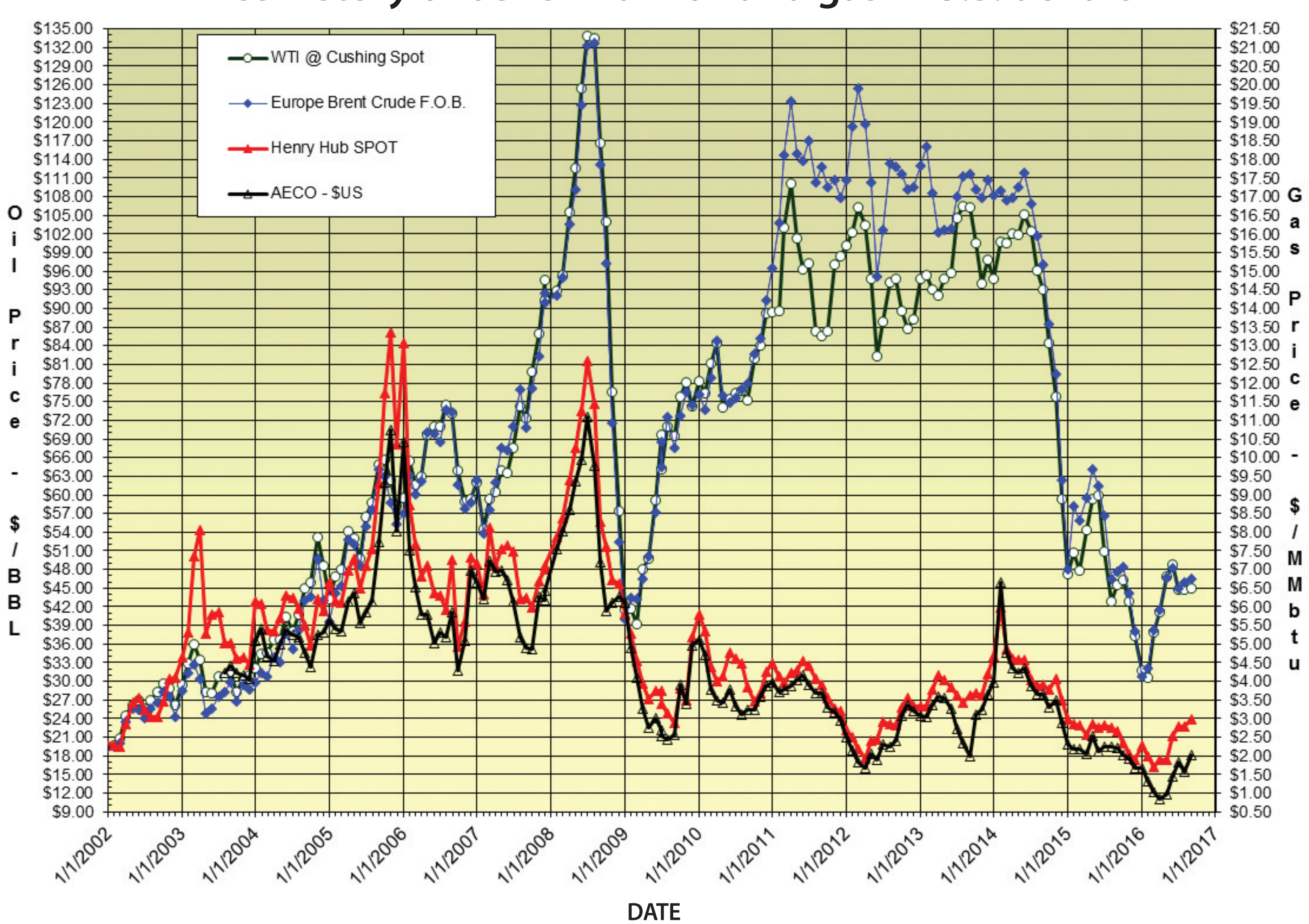
That was in response to Energy XXI's affirmation that the "audit committee of the board is responsible for reviewing the reserve estimates made each year, including any revisions to reserve estimates and … senior management is apprised of the reserves implications of any changes to the development program throughout the year by the corporate reserves group."

The SEC also questioned **Penn Virginia Corp.**, asking the company to "clarify the extent to which … senior management and the board of directors … are fully apprised or aware of all changes to previously adopted development plans, including all previous deferrals, associated with locations for which PUD reserves continue to be claimed."

Ryder Scott analyzed 332 SEC letters with 300 reserves-related comments on 22 topics involving 50 companies. Overall, the three most cited SEC inquiries were disclosure, effects of low prices and reconciliations.

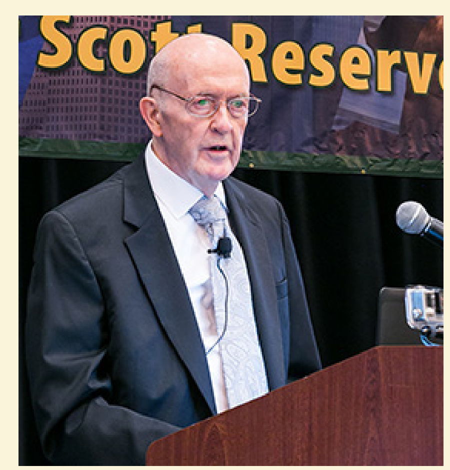


Price history of benchmark oil and gas in U.S. dollars



Published, monthly-average, cash market prices for WTI crude at Cushing (NYMEX), Brent crude and Henry Hub and AECO gas.

Scientific method suitable for testing reliable technology



John Lee

Oil and gas companies have reported proved petroleum reserves to the U.S. Securities and Exchange Commission on the basis of using "reliable technology" since the rules were modernized in 2008. The SEC defines it as technology that has been field tested and demonstrated to provide reasonably certain results with consistency and repeatability in the subject formation or an analogous formation.

John Lee, professor at Texas A&M University, recently cited the following examples of the use of reliable technology to estimate reserves at the Ryder Scott reserves conference earlier this year:

- Oil-water contact from cross-plotting oil and water pressure gradients in reservoir
- Hydrocarbon-water contact from seismic
- Reservoir simulation for production forecasting
- Transformation of long and erratic production histories into equivalent constant-rate reservoir limits tests

He added that companies can validate reliable technology systematically through an adaptation of the scientific method that he and Rod Sidle presented in SPE Paper No. 129689, *"The Demonstration of a Reliable Technology for Estimating Oil and Gas Reserves,"* 2010.

So what is the methodology for demonstrating reliability that will satisfy a technical standard as well as a regulatory or legal standard for valid, convincing evidence? A company needs good documentation to support the claim of a reliable technology, including sufficient case histories and empirical data to provide irrefutable evidence of reliability.

Please see "Adaptation of scientific method" on page 12

Ryder Scott Co. LP
1100 Louisiana, Suite 4600
Houston, Texas 77002-5294
Phone: 713-651-9191; Fax: 713-651-0849
Denver, Colorado; Phone: 303-623-9147
Calgary, AB, Canada; Phone: 403-262-2799
E-mail: info@ryderscott.com
Web site: www.ryderscott.com

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Adaptation of scientific method – Cont. from page 11

A five-step version of the scientific model is as follows:

1. Define how reliable technology will contribute to reserve estimation.
2. Formulate a hypothesis, research the science behind the application and define when results are valid. Questions to ask include the following:
   - How should the reliable technology work in ideal situations?
   - What are the assumptions behind the successful use of the technology?
   - What real-life (non-ideal) conditions will affect the application of the technology?
3. Perform experiments. Test to validate the hypothesis and demonstrate that requirements of reliable technology have been met. One can use both new tests and hindcasting, which is knowing the outcome and confirming the results. Test a statistically significant number of times. Test expected failure situations to confirm limits on successful use. Knowing what failure looks like helps in understanding data.
4. Interpret the data. Draw conclusions and document results, including needed conditions to achieve reliability. For instance, what are the limits on successful application?
5. As necessary, revise hypothesis and repeat steps three and four.

Publisher's Statement

Reservoir Solutions newsletter is published quarterly by Ryder Scott Co. LP. Established in 1937, the reservoir evaluation consulting firm performs hundreds of studies a year. Ryder Scott multidisciplinary studies incorporate geophysics, petrophysics, geology, petroleum engineering, reservoir simulation and economics. With 130 employees, including 90 engineers and geoscientists, Ryder Scott has the capability to complete the largest, most complex reservoir-evaluation projects in a timely manner.

Reservoir Solutions

Editor: Mike Wysatta
Business Development Manager
Ryder Scott Co. LP
1100 Louisiana, Suite 4600
Houston, TX 77002-5294
Phone: 713-651-9191; Fax: 713-651-0849
Denver, CO; Phone: 303-623-9147
Calgary, AB, Canada; Phone: 403-262-2799
E-mail: info@ryderscott.com

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