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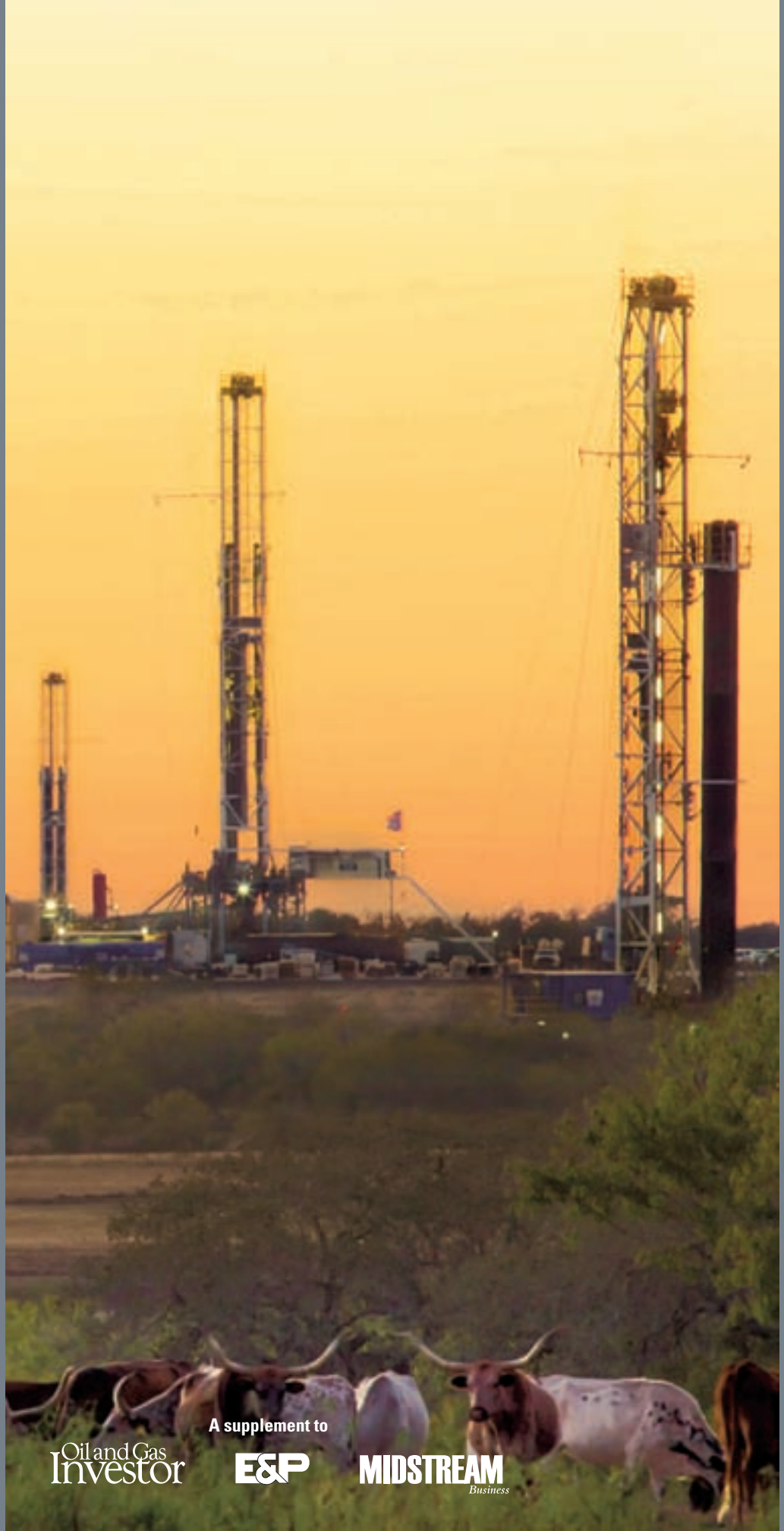
South Texas

The Playbook



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South Texas:
The Playbook

A supplement to *Oil and Gas Investor, E&P,* and *Midstream Business*

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Drilling rigs stand at attention as they work 24-hour days and seven-day weeks tapping high returns in the Eagle Ford Shale. *(Photo courtesy of Marathon Oil Corp.)*

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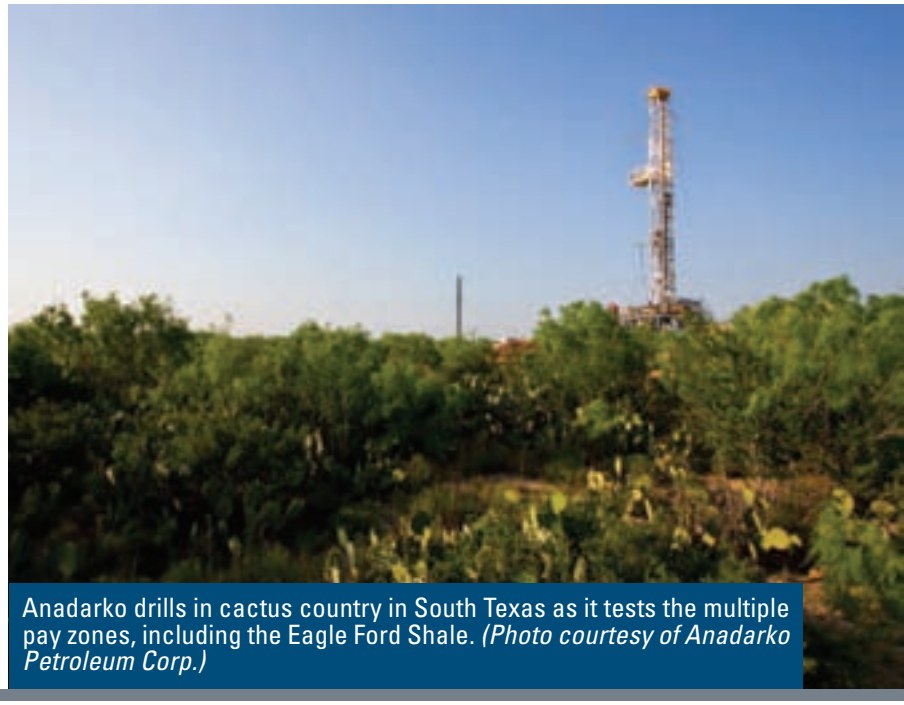


Anadarko drills in cactus country in South Texas as it tests the multiple pay zones, including the Eagle Ford Shale. *(Photo courtesy of Anadarko Petroleum Corp.)*

The South Texas Plays

Operators are pursuing unconventional plays in addition to the Eagle Ford, including the Olmos heavy oil and tight rock plays, the Escondido Shale play, the Austin Chalk and Buda fractured carbonate plays, and the Pearsall Shale play.

Editor's Note: *Isopach maps of the plays mentioned herein can be found on the wall map included in this playbook. Complete details on the references noted within this article are included in the last chapter of this playbook, "Additional Information on the South Texas Plays."*

A discussion of the unconventional plays in South Texas must begin with deposition and diagenesis of the Eagle Ford Formation. The petroleum industry has been aware of this formation for decades; after all, it is a known source rock for Austin and Buda carbonate formations as well the famous East Texas (Woodbine) Field. However, it was not until 2008 when Petrohawk drilled its STS-2411 #1H gas well in LaSalle County and discovered Hawkville Field that the industry became aware of the Eagle Ford's potential as a primary hydrocarbon source. When Petrohawk's gas discovery was followed by an updip Eagle Ford oil discovery drilled by EOG in 2009, industry interest skyrocketed. However, from a geologist's viewpoint, no Eagle Ford dialogue would be complete without a discussion of exactly how the Eagle Ford became the hydrocarbon-rich formation that is causing so much industry excitement. In Texas it is typical to drill through thousands of feet of hydrocarbon-barren shale to reach an oil or gas deposit. Why then is the Eagle Ford, a hydrocarbon source rock, capable of producing oil and gas, while all these other thousands of feet of shale are not? Numerous factors, all working together millions of years ago, made the Eagle Ford Formation the hydrocarbon-producing juggernaut known today.

View of North America during the Late Cretaceous shows the location of the Western Interior Seaway and the Rio Grande Embayment. *(Used with permission from Ron Blakey, Colorado Plateau Geosystems)*

The Eagle Ford story begins approximately 91 million years ago during the Late Cretaceous Period. Earth was a much different place then. Much of Texas was covered by the marine waters of the Rio Grande Embayment and the Western Interior Seaway, a narrow waterway running in a south/southeast direction from what today would be the Arctic Ocean to the

Gulf of Mexico. During this time, earth was going through an intense global warming period. Warming had reached a point where the polar ice caps had melted, causing a much higher sea level than is found today. Based on multiple data sources, scientists are convinced that the Late Cretaceous global warming was brought on by an overabundance of atmospheric CO_2 gas. The abundant CO_2 was thought to be the result of vigorous volcanic and magmatic activity going on at the time. Volcanic activity is particularly evidenced by numerous bentonite layers in the Late Cretaceous strata, the result of wind-blown volcanic ash layering large areas after volcanic eruptions. The resulting greenhouse effect, coupled with an upwelling of basic nutrients, particularly iron and magnesium, caused vigorous organic growth in the warm shallow marine waters. The vigorous organic growth eventually overwhelmed the shallow waters oxygen capacity causing hypoxic (low oxygen) and anoxic (no oxygen) water conditions with a resulting die-off of the marine organisms.

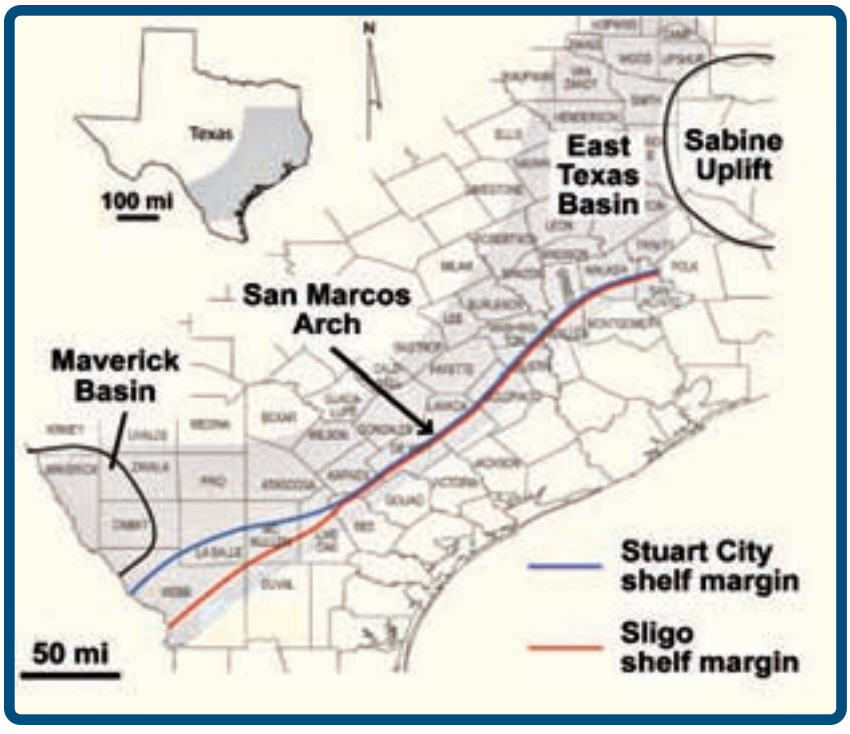
The deeper marine waters were another matter entirely. When the polar caps warmed, the world's oceans lost much of their deep seafloor, cold-water, oxygen-rich currents. Normally, these cold oxygen-rich currents originate at the polar ice caps and spread toward the equator. The ocean bottom currents are the direct result of the cold polar seawater being heavier and denser than the warmer surface water, causing it to sink to the ocean floor, and spread horizontally outwards toward the equator. Cold water is able to hold much more oxygen than warm water. Without the ongoing oxygen-rich water supply, many areas of the world's oceans became oxygen depleted, resulting in either hypoxic or anoxic water conditions. Because there was little or no oxygen, organic material falling to the seafloor was not consumed by the normal bottom dwelling scavengers and bacteria.

In addition, without oxygen, the organic matter was not broken down by oxidation, and because of the associated sea level rise, more of the ocean was too deep to allow organic breakdown by UV radiation from the sun. Instead, ongoing sedimentary deposition buried the preserved organic material, where it was slowly broken down by anaerobic bacteria as well as the heat and pressure of burial. Over time, the anaerobic bacteria died also, leaving the hydrocarbon-rich shale layer that we know today as the Eagle Ford Formation. Explorationists should take note: During the Late Cretaceous this process was going on globally. Additionally, the Late Cretaceous was not the only time in the earth's history when these hydrocarbon-accumulating conditions occurred. Earth scientists have found evidence of several other global anoxic periods in the Cretaceous oceans alone.

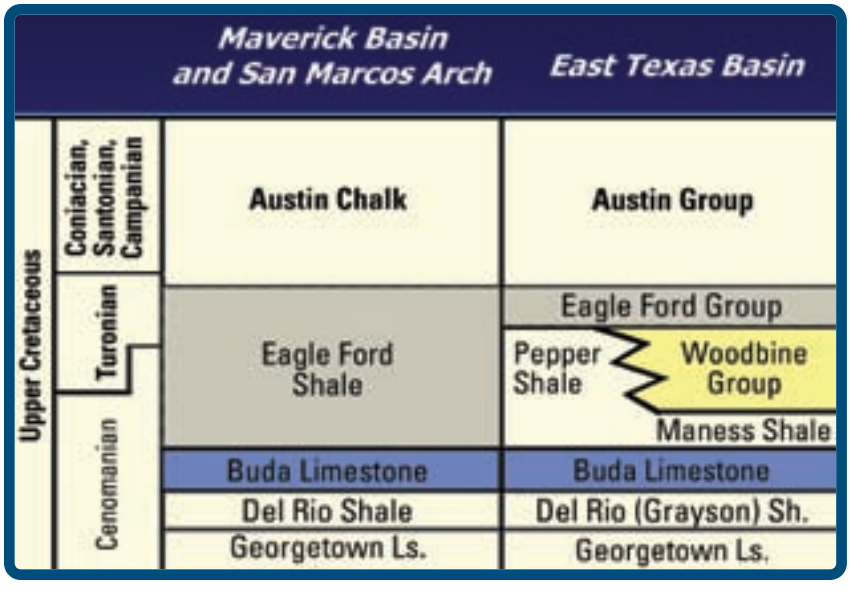
The South Texas Eagle Ford Formation

Examples of the Eagle Ford Formation, or its stratigraphic equivalents, can be found not only in South Texas, but in East Texas as well. Along the eastern margins of the West Texas Permian Basin, the Eagle Ford outcrops and is known by its local name, the Boquillas Formation. As mentioned previously, during the Late Cretaceous much of Texas was part of a shallow marine embayment and seaway, but with the sea level raised several hundred feet making it deeper than it had been earlier. This shallow embayment and seaway was bound by mountainous areas to the west and a broadly uplifted area dominated by the Ouachita Uplift close by to the north, as well as the Appalachian Uplift farther to the northeast. A broad carbonate area, known as the Comanche Shelf, formed over South Texas during the Early Cretaceous period. The Comanche Shelf was bound by the subsiding Maverick Basin to the south and the San Marcos Arch, an eastward extension of the Llano Uplift, to the north. Geological research into South Texas Eagle Ford sedimentary sources points to deltaic sedimentation, mainly from sediments being shed from mountainous areas to the west, while the East Texas Eagle Ford received deltaic sediments mainly from the adjoining Ouachita Uplift to the north.

The South Texas Eagle Ford extends in a crescent-shaped swath from the Texas/Mexico border in the south, to approximately Fayette County, Texas, to the north. Across the Rio Grande in Mexico, the Eagle Ford is part of the Agua Nueva Formation. The Eagle Ford outcrops updip in a band running generally west to east from Val Verde County along the Rio Grande River east to San Antonio where it swings north to Austin. Down dip, the formation deepens to more than 17,000 ft and then plunges much deeper as it goes off the edge of the buried Cretaceous shelf margin, extending in a general line through the Middle of



Overview reveals the known Texas extent of the Eagle Ford Formation with the major tectonic features affecting Eagle Ford deposition. *(Unless otherwise note, illustrations from "Regional Stratigraphic and Rock Characteristics of Eagle Ford Shale in Its Play Area: Maverick Basin to East Texas Basin," by T.F. Hentz and S.C. Ruppel, reprinted with permission of the Bureau of Economic Geology)*



Stratigraphic column describes the Eagle Ford in South and East Texas.

Webb County at the Rio Grande River northeast through Colorado County. What is causing additional excitement, in these days of severely depressed natural gas prices, is that as the formation goes from deep to shallow, it goes from producing dry gas in the deeper eastern Eagle Ford, to wet gas as it gets progressively shallower toward the west, until finally a shallow band is reached in the west that predominately produces oil. Again, explorationists should take note, as it is not uncommon for these hydrocarbon-rich source rocks to go from gas to oil as the depth of burial decreases.

The South Texas Eagle Ford Formation, overlain by the Austin Formation and underlain by the Buda Formation, averages 250 ft thick, with maximum thickness recorded in excess of 600 ft. The formation is composed primarily of carbonate-rich mudstones, wackestones, and packstones, containing varying amounts of total organic carbon (TOC) and Type I & II kerogen. A recent researcher using core data identified nine separate and distinct Eagle Ford facies. In addition, the Eagle Ford Group encompasses numerous local outcrop names, remaining from earlier local studies. However, this report will simply focus on the main two South Texas Eagle Ford zones, rather than individual facies. Researchers have generally broken up the South Texas Eagle Ford into two distinct zones, the lower Eagle Ford zone and the upper Eagle Ford zone. There is also what is considered to be a transitional zone, between the predominately clastic Eagle Ford Formation and the carbonate Austin Formation, sometimes making exact correlation difficult. Each zone has the following gross characteristics and areal extent

The lower Eagle Ford zone covers an area from the Texas/Mexico border (and into Mexico) to the San Marcos Arch and beyond into the Dallas area and East Texas. In South Texas the lower zone reaches its greatest thickness, in excess of 200 ft, near the Texas/Mexico border in the Maverick Basin area, while thinning to less than 50 ft as it approaches the San Marcos Arch area. The lower Eagle Ford, with an average carbonate content of 51% and an average TOC of 5.1%, is the most hydrocarbon-rich zone of the Eagle Ford zones. Its high carbonate content

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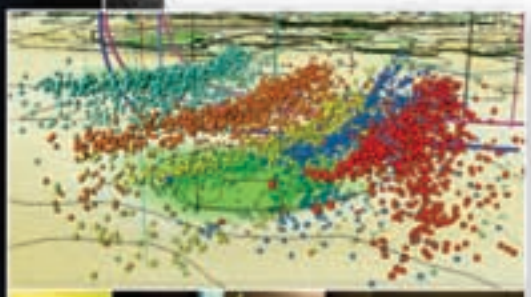

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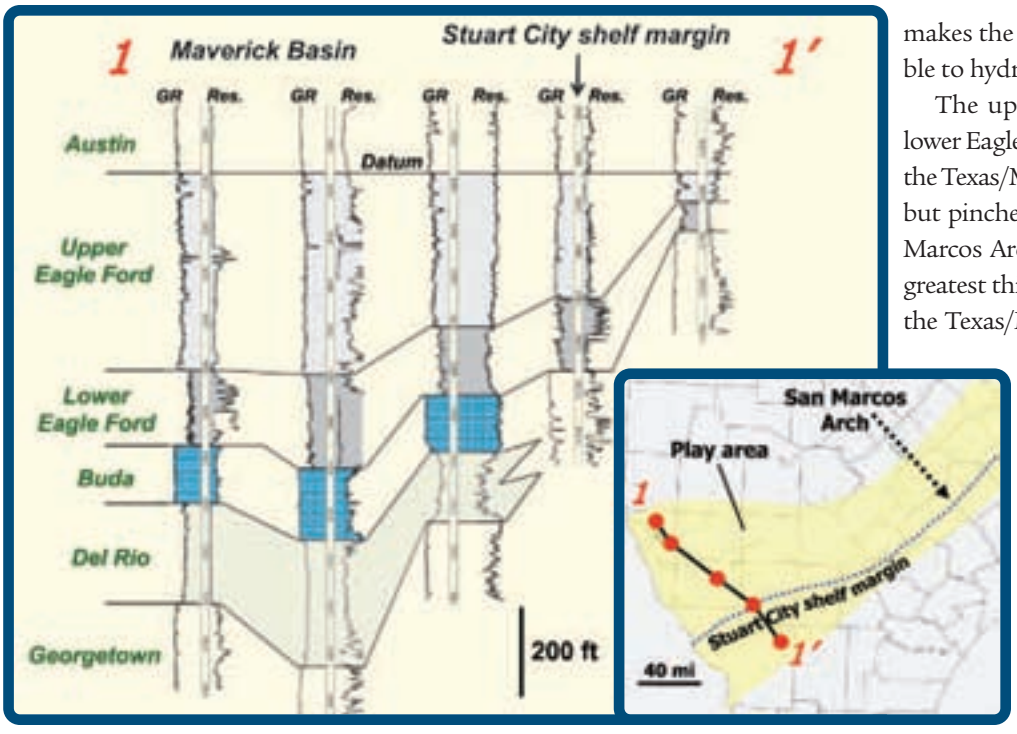
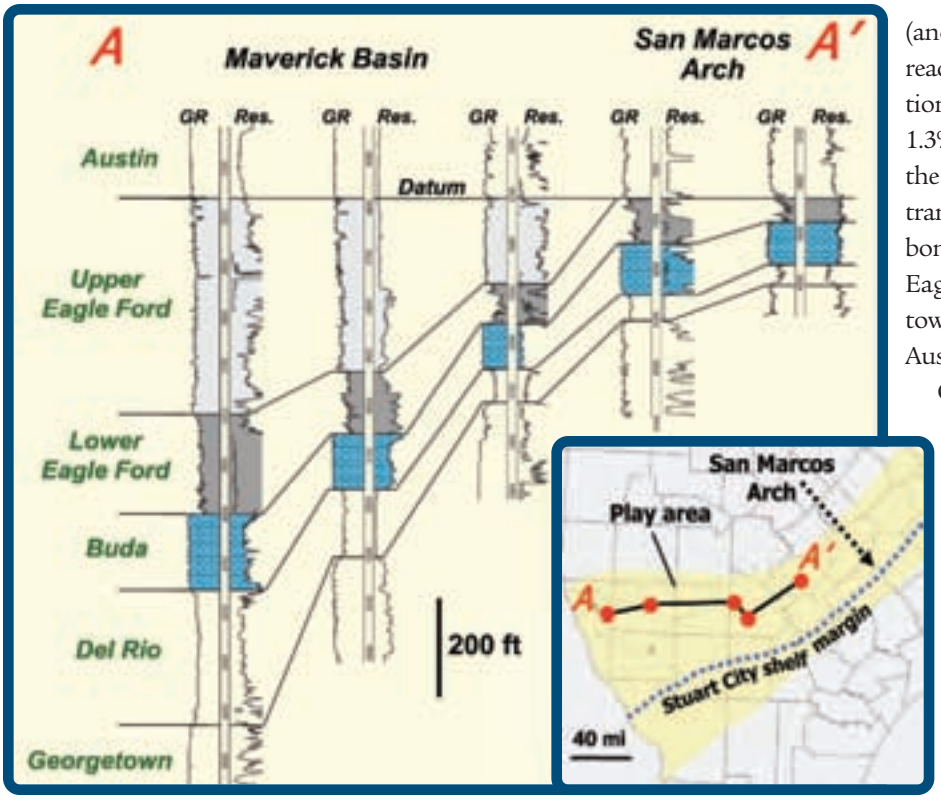


Cross section 1-1′ shows the South Texas Eagle Ford depositional progression through the Maverick Basin across the Stuart City shelf margin.



Cross section A-A′ shows the South Texas Eagle Ford depositional progression from the Maverick Basin east to the San Marcos Arch.

makes the Eagle Ford especially susceptible to hydraulic fracturing.

The upper Eagle Ford zone, like the lower Eagle Ford zone, covers an area from the Texas/Mexico border (and into Mexico) but pinches out before it reaches the San Marcos Arch. The upper zone reaches its greatest thickness, in excess of 400 ft, near the Texas/Mexico border in the Maverick Basin area, while pinching out completely as it approaches the San Marcos Arch area. The upper Eagle Ford with an average carbonate content of 67% is also susceptible to hydraulic fracturing, and an average TOC of 3.2% is the second-highest hydrocarbon-rich zone of the two primary Eagle Ford zones.

The transitional zone, between the Austin and Eagle Ford formations, covers an area from the Texas/Mexico border (and into Mexico), but pinches out before reaching the San Marcos Arch. The transitional Eagle Ford, with an average TOC of 1.3%, is the least hydrocarbon-rich zone of the three Eagle Ford zones. However, the transitional zone has its richest hydrocarbon layers near the laminated wackestone Eagle Ford top zone, becoming leaner toward the more bioturbated carbonate Austin Formation.

Operators are advised to core while drilling through the Eagle Ford. When planning a fracturing program in a new area, rock knowledge is critical and that goes multifold for the Eagle Ford Formation. Because of formation heterogeneity, an operator should not simply assume that one zone is better than another based only on TOC. Other issues such as thickness, friability, and clay content/type are just a few of the obvious formation factors engineers need to take into account when designing a fracture program.

Sediment deposition throughout the South Texas Eagle Ford is horizontally and vertically affected by:

- Tectonic activity, such as the Maverick Basin. The result of the Maverick Basins active tectonic subsidence during the Late Cretaceous is that the Maverick Basin became an important sedimentary depo-center.
- Salt movement and withdrawal affected sediment deposition. Even though tectonic subsidence may have terminated in the Maverick Basin, the overburden accumulation was sufficient to cause large-scale salt movement and withdrawal toward the Gulf of Mexico, causing subsidence and increased localized deposition.
- The salt withdrawal also caused several strike trending large scale normal and reverse fault zones, the Charlotte Fault Zone and Fashing Fault Zone in South Texas. Farther north of the San Marcos Arch are the Luling Fault Zone and the Balcones Fault Zone. The result of the faulting is that numerous downthrown blocks or grabens formed between the normal and reverse faults causing additional sediment to accumulation in these areas.
- Active sedimentary source areas affected sediment deposition. In the South Texas Eagle Ford's case, sediment poured into the area mainly from the mountainous areas in the west. The mountainous areas are likely the result of early Laramide Uplift activity.

The East Texas Eagle Ford Formation

The East Texas Eagle Ford Formation outcrops in a band extending from Austin through Waco and Dallas north to the Texas/Oklahoma border. The formation makes a formal outcrop appearance in its namesake Dallas suburb Eagle Ford, located eight miles west of downtown Dallas. From Dallas and Waco the Eagle Ford trends eastward across the East Texas Basin until it pinches out against the overlying Austin Chalk Formation in a north-south trending line along the western flank of the Sabine Uplift

Researchers have correlated several locally named area formations with the Eagle Ford Formation. As in South Texas, the Eagle Ford is represented by several locally named outcrops, all named and mapped during earlier studies. To avoid confusion, this report will only deal with the various current Eagle Ford-related formation names used in the subsurface. In addition, and not covered in this report, is the fact that the Eagle Ford reappears in the subsurface off the eastern flank of the Sabine Uplift, where savvy Louisiana operators are making successful Eagle Ford completions.

The Eagle Ford Formation in the Austin-Waco-Dallas area has been described as consisting of two depositional units. The first is a lower transgressive unit consisting of dark laminated shales showing almost no bioturbation, an indicator of an anoxic depositional environment. The second is an upper regressive unit shows interstratified shales, limestones, and carbonaceous quartzose siltstones. In the Western Dallas/Waco area of East Texas, the Eagle Ford is overlain by the Austin Formation and underlain by the Buda Formation, thickening as it moves northward away from the San Marcos Arch. As the Eagle Ford moves eastward across the East Texas Basin it thickens to as much as 700 ft in Hopkins County before thinning as it approaches the Sabine Uplift. In general the Eagle Ford is between 100 ft and 300 ft thick throughout East Texas. While the Eagle Ford becomes thinner it is gradually underlain, first by the Pepper Shale, which then grades further eastward into the siliclastic-rich Woodbine For-

mation. Underlying the Woodbine Formation the Pepper Shale also grades into a darker hydrocarbon-rich minor source rock zone named the Maness Shale. The Buda Formation underlies the Maness Shale. To further complicate the regional picture, in the Dallas area the Eagle Ford becomes sand-rich, locally changing into an oil-producing reservoir rock called the Sub-Clarksville Sandstone. Though the East Texas Eagle Ford is time equivalent to the Lower Eagle Ford in South Texas and represents a transgressive unit, it does not have as high an average TOC content as found in South Texas. East Texas Eagle Ford TOC's typically range from 2.1% to 5.2%, with individual units having a TOC as high as 9.1%. Core porosities range from 1.5% to 8% while log porosities range from 10% to 15%; permeabilities are poor. The East Texas Eagle Ford remains carbonate-rich and fracture prone, but has different interstitial clays than South Texas Eagle Ford, the result of having a different sedimentary source. However, the clays are not generally affected by water.

Sediment deposition throughout the East Texas Eagle Ford is horizontally and vertically affected by:

- Tectonic activity, such as the San Marcos Arch to the south, subsidence in the East Texas Basin in the middle of East Texas, and the Sabine Uplift terminating the East Texas Eagle Ford, Woodbine, and Maness Shale to the east. The result of this tectonic activity during the Late Cretaceous is that the East Texas Basin area became an important sedimentary depo-center.
- Salt movement and withdrawal affected sediment deposition. In the East Texas Basin, the overburden accumulation was sufficient to cause large-scale salt movement, causing increased deposition in localized areas.
- The Mexia – Talco fault zone, running in a north/south direction between Dallas and Tyler, Texas, provided opportunity for additional sedimentary deposition along this growth fault zone as did the short east/west trending Mt. Enterprise fault zone located south of Tyler.
- Active sedimentary source areas affected sediment deposition. In East Texas, sediment was deposited into the area from the nearby Ouachita Uplift to the north, as well as the larger Appalachian Uplift farther to the northeast.

Testing the East Texas Eagle Ford

While the South Texas Eagle Ford is getting nearly all the attention, clever operators have been quietly testing the East Texas Eagle Ford as well.

The "Lower Woodbine" or "Eaglebine" play in Madison, Leon, Grimes, and Robertson counties uses horizontal drilling combined with hydraulic fracturing in a heretofore overly tight Woodbine sand, located just underneath the Eagle Ford, to make some extremely prolific oil wells. From the description of the Lower Woodbine, one has to wonder if this zone isn't an extension of the locally hydrocarbon-rich source rock, the Maness Shale. The Maness Shale is a carbonate cemented mudrock, trending from a thickness of 130-plus ft south/southwest of Tyler while pinching out toward Waco to the west. To the north of Tyler, the Maness thins to 35-plus ft. Even if it turns out that the Lower Woodbine is not the Maness Shale, with its fracture-susceptible carbonate cementation and high hydrocarbon content, the Maness Shale may still prove to be a locally productive future oil target.

Other South Texas plays

South Texas operators are pursuing several other unconventional plays in addition to the Eagle Ford. These include the Olmos heavy oil and tight rock plays, the Escondido shale play, the Austin Chalk and Buda fractured carbonate plays, and the Pearsall Shale play.

The Olmos and Escondido plays

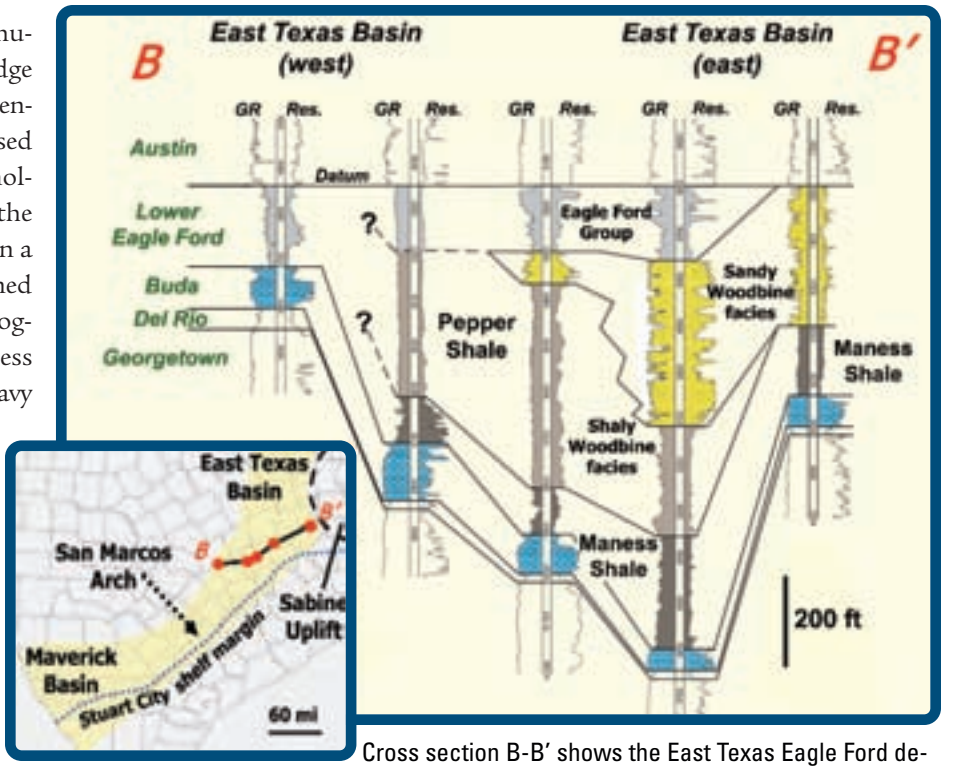
Deposition of the overlying Escondido seal/source rock shale and underlying Olmos sandstone took place during Upper Cretaceous times in the South Texas Maverick Basin. Operators have been producing oil and gas conventionally from the Olmos since the 1920s. Early production was from structural traps as well as updip stratigraphic traps. Since historically the percentage of oil produced from most Olmos fields is low, these legacy fields are worth a thorough review using modern technology. Lately, operators have been taking a look fur-

ther updip at tar and heavy oil accumulations, as well as far downdip shelf edge oil accumulations. The shelf edge potential was known but previously bypassed because of inadequate fracture technology. Geologists have been aware of the updip Olmos tar sands for more than a century. In the late 1800s settlers mined the tar sands for asphalt. It was only logical that with downdip burial and less oxidation the tar would grade into heavy oil. It has been estimated that there is 7 Bbbl to 10 Bbbl of tar and heavy oil in place in South Texas.

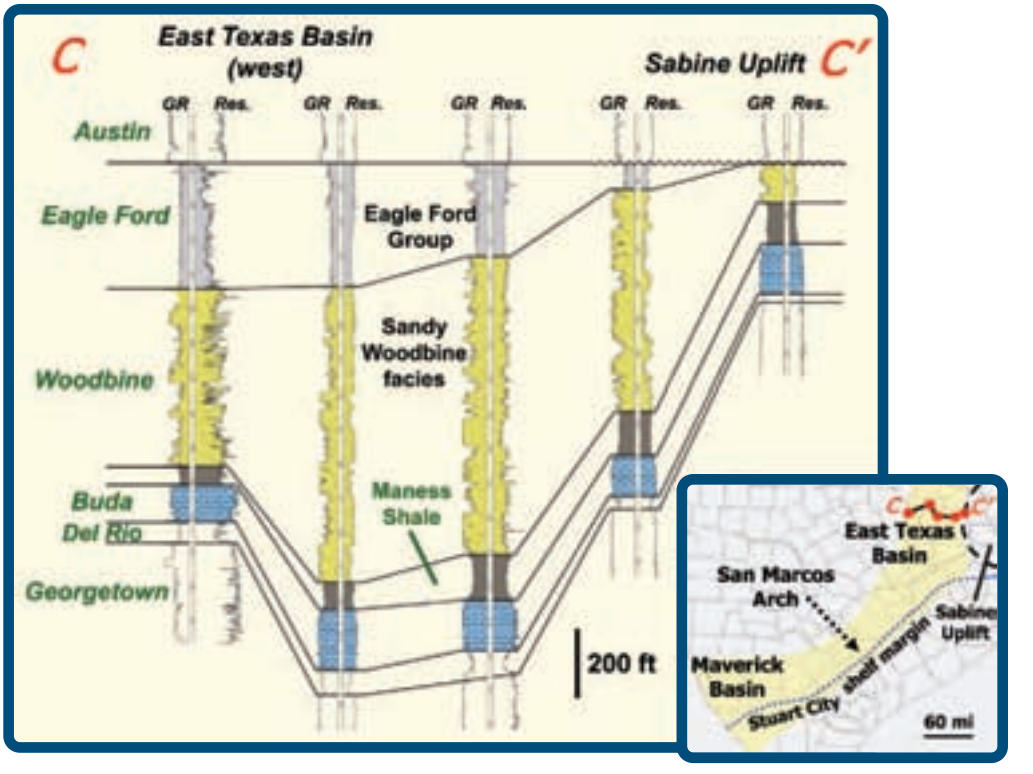
Based on the deposition of Olmos sands and the lack of technology available to early wildcatters, many researchers feel that much recoverable oil remains in existing Olmos oil fields, waiting only for further exploration and infield drilling.

The downdip Olmos shelf edge tight-rock oil accumulations were known but were considered uneconomic to produce until recent advances in hydraulic fracturing.

At the end of the Olmos was an erosional period. The Olmos Formation is overlain unconformably by the Escondido Formation. The Escondido is 875 ft thick in outcrop and consists of alternating layers of sandstones, siltstones, mudrocks, and thin limestones. The Escondido unconformably overlies the Olmos causing hydrocarbon accumulations along the resulting stratigraphic pinchout. Being a thick hydrocarbon seal/source rock, the Escondido has hydrocarbon potential, as was found in the Eagle Ford.



Cross section B-B′ shows the East Texas Eagle Ford depositional progression from north of the San Marcos Arch east across the East Texas Basin and pinching out at the Sabine Uplift.



Cross section C-C′ shows the East Texas Eagle Ford depositional progression across the East Texas Basin east and pinching out at the Sabine Uplift.

The Austin Chalk and Buda plays

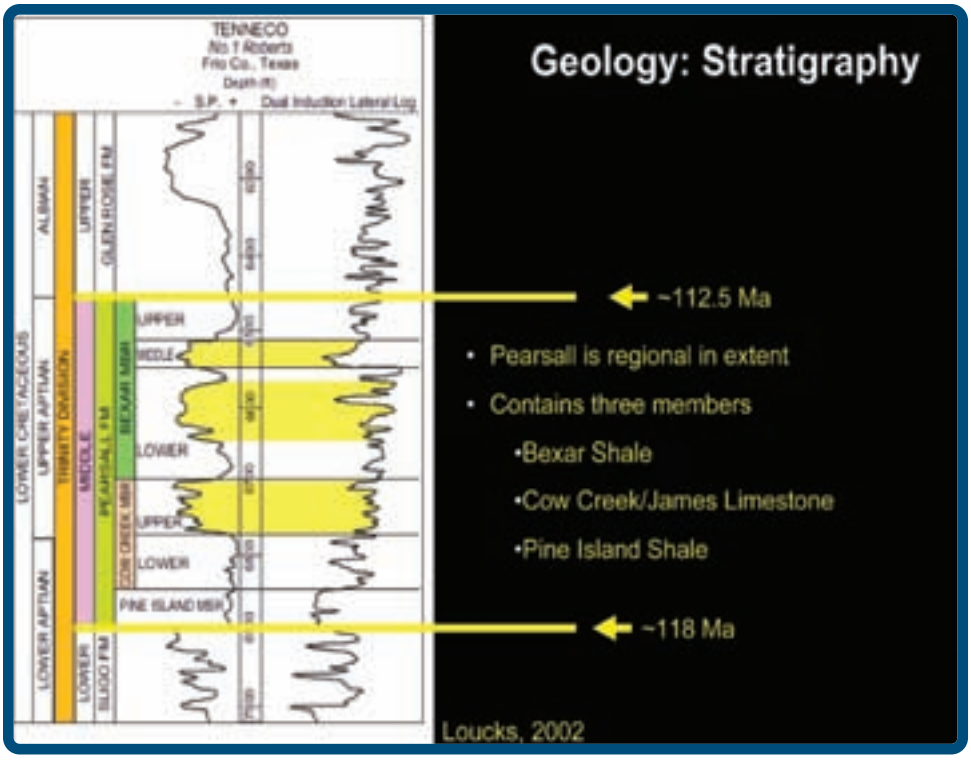
The twin carbonate Austin Chalk and Buda plays, trending in an arc from the Texas/Mexico border to the Sabine Uplift, just east of the Texas/Louisiana border for the Buda and across the Uplift for the Austin Formation, were both Gulf Coast oil darlings in the late 1970s and early 1980s. The Giddings area had so much Austin Chalk drilling activity, a local entrepreneur purchased large sections of concrete drain pipe, installed floors, added walls with doors and windows on either end, equipped them with bunk beds, and rented them out to desperate oil workers for lodging. Then oil dropped to $8/bbl and it seemed like the end of the road for the two unconventional reservoirs that relied on natural fracture systems (sweet spots) to produce oil from the otherwise impermeable carbonate rocks. As the price of oil has returned to adequate levels, and operators have improved horizontal drilling and hydraulic fracturing techniques, there has been a resurgence of interest in these two formations. It certainly doesn't hurt having the incredible source rock potential of the Eagle Ford sandwiched in between these two formations.

The Pearsall play

The South Texas Maverick Basin Pearsall Formation, a 600-ft- to 900-ft-thick Lower Cretaceous, mixed carbonate/siliclastic, hydrocarbon-rich shale, is made up of three members: the youngest, the Bexar Member; the Cow Creek Member; and the oldest, the Pine Island Member. Gas production currently comes from the lower Bexar Member.

The Pearsall Formation is a familiar South Texas source rock.

In a 2009 article, US Geological Survey researchers performed geotechnical analysis of the Pearsall in 12 Maverick County wells and two McMullen County wells. The analysis revealed an average TOC of 0.8% with a TOC range of 0.17% to 2.97%, with some Type II kerogen, but mainly Type III kerogen (gas prone) dominating. Pearsall Ro values are in the gas window, ranging from 1.5% to 2.3%. Operators were beginning to drill and produce the gas-rich Pearsall Formation when it became overshadowed by the shallower Eagle Ford, which can produce either oil or liquids-rich gas in the same area. With natural gas prices currently at extremely low levels, while oil is between $80/bbl to $110/bbl, many Pearsall players abandoned the deeper play for the more economically attractive Eagle Ford. However, several operators are currently pursuing Pearsall hydrocarbon production, apparently relying on the initial potentials of four Pearsall wells that made 451 b/d to 740 b/d condensate and 4.4 MMcf/d to 6.2 MMcf/d of gas as indicators of the expected mixed liquids/gas production. ■



Stratigraphic column reveals the various members of the South Texas Pearsall Formation. *(Illustration from "Preliminary Investigation of the Thermal Maturity of Pearsall Formation Shales in the Maverick Basin, South Texas," by P.C. Hackley, K. Dennen, R. Gesserman, and J.L. Ridgley, republished by permission of the Gulf Coast Association of Geological Societies, whose permission is required for further publication use.)*

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As Eagle Ford Matures, A Need for Fewer Rigs

Efficiency gains transform shale development as the industry enters harvest mode in the Eagle Ford.

By Richard Mason
Chief Technical Director, Upstream, Hart Energy

A touch of gray hair is creeping into the South Texas Eagle Ford as the play enters maturity four years after the Petrohawk discovery started the "all hands on deck" rush in October 2008.

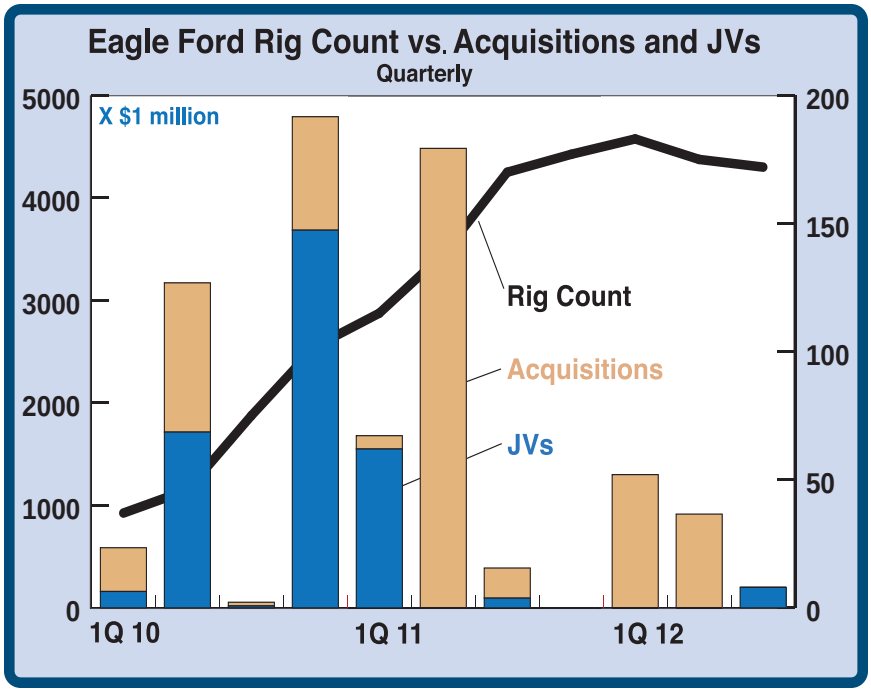
And that gray hair suggests the play has achieved a dignified adulthood following its wild and crazy adolescent stage. After four years of spectacular growth in rig count, South Texas Eagle Ford activ-

Wide-open spaces that once hosted ranchers and hunters now feature modern drilling rigs as oil and gas operators apply the latest technology to generate economic growth from a sparsely populated portion of Texas. *(Photo courtesy of BHP Billiton)*

ity flattened in 2012 as rising efficiencies in the drilling and completion process collided with constraints in regional takeaway capacity to reduce the need for rigs, even as operators generated more wells per year.

The maturity theme is a useful tool for interpreting the changes under way for oil services in the South Texas Eagle Ford.

Operators defined the boundaries of the Eagle Ford in its infancy from 2009-2010 as rig count gradually rose from a half dozen units in 2009 to 35 on average during 1Q 2010. As the play entered adolescence, operators delineated the best rock in the condensate and volatile oil window that gracefully curves in a narrow band from the border with Mexico up to the San Marcos Arch east of San Antonio. Concurrently, rig count expanded from an average 102 in 1Q 2011 to 180 in 2Q 2012.



Graph shows quarterly volume in transactions on a dollar value basis (left axis) and quarterly average rig count for the Eagle Ford shale (right axis). Transactions are broken out by acreage acquisitions versus joint ventures. Operators invested more than $17 billion in Eagle Ford acquisitions and used joint ventures as a funding mechanism for drilling programs. Those efforts in turn stimulated drilling activity during the 2010-12 period. *(Source: Hart Energy A&D Database, UG Center)*

During this era, the Eagle Ford competed with other rapidly developing shale plays in the US, overwhelming the supply of drilling rigs and pressure pumping capacity in the domestic market. Shortages of rigs, pressure pumping equipment, labor, and the bulk goods used in well stimulation corresponded with rapidly rising costs for oil services.

Commodity prices set the tone for 2012 with interest fading in the dry gas Eagle Ford window, while oil prices stimulated interest in the underpressured shallow oil window to the north.

As maturity settles in on the South Texas Eagle Ford in 2012, operators have moved from delineation to optimization in completions, or the process of determining which combination of techniques in the engineering toolbox produce the greatest hydrocarbon recovery.

In a few cases, well-financed early movers like Pioneer Natural Resources, EOG Resources, and Anadarko Petroleum Corp., are transitioning into full resource harvest, the holy grail of the resource play model where economies of scale and broad swaths of acreage nudge E&P programs toward wealth creation after years of outspending cash flow.

In the summer of 2012, a handful of Eagle Ford operators were experimenting with drilling multiple horizontal laterals from a single well site. Pad drilling will grow in volume as operators refine the technique, creating a need for specialized self-moving, fit-for-purpose rigs on the one hand, but fewer rigs overall.

Several themes characterized the South Texas Eagle Ford during the summer of 2012, including a plateau in rig count with rig employment trending lower by year-end as optimization efforts reduce cycle time.

Secondly, the play has made a transition from a short supply of goods and services during the rapid activity escalation in 2011 into modest oversupply in 2012.

Thirdly, operators are experiencing declining costs as rates for pressure pumping services, coiled tubing, and drilling rigs pull back thanks to the equipment oversupply. For operators, total

well costs in August 2012 were down 5% to 10% vs. the beginning of 2012.

The rapid evolution from short supply to excess capacity reflects changes in the broader pageant of the exploration and discovery cycle.

Between January 2010 and August 2012, oil and gas operators jockeyed for position in the South Texas Eagle Ford, consummating $17.5 billion in acreage purchases, joint ventures, or corporate acquisitions as regional private independents successfully executed exit or monetization strategies. Buyers included major oil companies such as BP, Chevron, Hess, Marathon, and Shell, complemented by public independents, who established beachheads in the play.

Several acreage holders entered joint ventures, trading property for financing, often with foreign partners in Asia, such as KNOC, CNOOC, and Reliance Industries. Through August 2012, Eagle Ford operators had entered more than 15 joint ventures totaling $7.7 billion with roughly 75% of that investment allocated to drilling carries within a three-year timeframe.

Overall, transactions totaled $8.5 billion in 2010, $6.5 billion in 2011, but only $2.4 billion as of July 2012. In other words, the land grab portion of the play had passed from the scene in 2012 with the golden era stretching from late 2010 through the first half of 2011 when nearly two-thirds of all transactions were consummated on a dollar value basis.

The land-grab cycle was followed by a rapid escalation in rig count. Initially, natural gas drilling drove the rise in Eagle Ford activity with gas-directed rig count increasing from less than 30 rigs in January 2010 to 70 by year-end. As gas-directed rig count peaked in late 2010, oil- or liquids-directed drilling became the driving force in Eagle Ford activity.

Overall, rig count grew from 100 in early 2011 to 180 by year-end among rigs specifically targeting the Eagle Ford. But the ratio of rigs drilling for gas vs. oil changed dramatically. There were 67 rigs drilling for gas in January 2011 and 40 rigs targeting oil. In August 2012, the gas-directed rig count fell 40% to 40, while the oil/liquids-directed count surged by 100 units to 140 total, a 250% increase.

The rise in rig count was only part of the story. The South Texas Eagle Ford hosted the largest concentration of technology rigs in the US. Part of this is a function of customer demographics. The majors, large independents, and a few midcaps had a preference for Tier I rigs, or units capable of horizontal drilling with automated control systems, top drives, and large mud pump packages, often configured in a modular layout that facilitated rapid mobilization between wells.

Market share for Tier I technology rigs in the South Texas Eagle Ford grew from 44% in January 2011 to 64% at the end of 2Q 2012. In contrast, Tier I technology rigs represented 28% of total rig count nationwide. Furthermore, while South Texas Eagle Ford rig count grew 70% over the 18 months ending in 2Q 2012, Tier I technology rig employment grew 140%.

Looked at another way, Tier I technology rigs accounted for all the rig employment growth in the South Texas Eagle Ford between January 2011 to June 2012.

In comparison, Tier II rigs, defined as traditional DE-SCR electric units, saw Eagle Ford employment stay the same over that same 18-month timeframe while Tier III rigs, the conventional mechanical units that make up more than 40% of the US rig fleet, saw Eagle Ford employment drop from 15 units in January 2011 to eight units 18 months later.

While it looked initially like 1,000 HP rigs might find a home in the Eagle Ford as operator efforts moved updip to mid-depth condensate and shallow oil, the transition did not materialize. Rather, fleet expansion involved 1,500 HP Tier I technology rigs with employment expanding from 41 units in January 2011 to 96 in June 2012, a 135% growth rate.

Nearly one in four newbuild Tier I technology rigs nationally found a home in the Eagle Ford shale over the last 18 months.

The rapid increase in rig employment in the Eagle Ford occurred in the context of a high demand market nationally, creating the highest hourly rig rates among domestic shale plays during 2011. Rig rates for newbuild 1,500 HP Tier I technology rigs on multiyear contracts in the Eagle Ford shale reached the mid to high $20,000 range in the

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summer of 2011 as operators embarked on the early stages of the optimization cycle.

One year later, optimization had become the name of the game with a few operators entering the harvest stage of resource development. The latter stage often incorporates pad drilling configurations in which fit-for-purpose rigs with self moving capabilities drill multiple wells or multiple horizontal laterals off a single well site.

While average rig rates remained steady in the play thanks to multiyear contracts, rigs rolling off contracts are entering an oversupplied market. Leading edge rig rates are softening while operators are reducing the term length on contracts to six months, or less.

The South Texas Eagle Ford rig fleet remains relatively concentrated with five contract drillers representing 75% of all rig employment. Those contractors are led by Tulsa-based Helmerich & Payne IDC, which is approaching a 60-unit presence in the Eagle Ford, or a 33% share, followed by Nabors Drilling USA and Patterson-UTI, which each have 25 rigs active in the play, or a combined 30% market share.

Among operators, Chesapeake Energy Corp. is the largest rig employer in the play with 25 units turning to the right, followed by BHP Billiton with an average 17 units. Marathon, at 15 units, increased rig employment in the play—mostly newbuild Tier I rigs—from zero in August 2011 after its acquisition of Hilcorp Resources properties. Other operators with 10 or more rigs active on average include EOG Resources, ConocoPhillips, and Pioneer Natural Resources.

Several operators, including Chesapeake and Pioneer Natural Resources, have their own drilling rigs or well stimulation crews. Additionally, operators such as EOG Resources and Pioneer Natural Resources have their own sand mining operations to provide proppant for well stimulation. Such efforts can reduce individual well costs by $150,000 on wells that typically run from $7 million to $9 million.

On the well stimulation side, the South Texas Eagle Ford is looking at a 13% gain in hydraulic horsepower (HHP) in 2012, bringing regional capacity to 1,743,000 HHP. There are 65 well stimulation crews in the region with utilization averaging 96%. A representative Eagle Ford well averaged 9,300 ft in vertical depth with a 5,800 ft horizontal lateral. Operators were employing 17 frac stages per lateral using a pressure pumping spread that averaged 37,000 HHP.

Following the collapse in gas prices in early 2012, drilling slowed in dry gas shale plays nationwide. Consequently, well stimulation capacity and drilling rigs from dry gas basins such as the Marcellus, Haynesville, and Barnett shales rotated to liquids or oil basins, including the Eagle Ford Shale. At the same time, capacity expansion on behalf of pressure pumping firms in response to the tight market in 2010-2011 combined to create an oversupply of crews and equipment. Average price per stage for Eagle Ford wells fell from $204,000 in 2010 as the play was ramping up, to $188,000 on average at the beginning of 2012, to $154,000 in August 2012, according to Energy Sector Analytics LLC, a Houston-based market research firm.

Operators were experimenting with propane fracs on a small scale as an alternative to slickwater fracs. Most wells used a closed hole plug and perf completion technique though there is some experimentation with packer-based openhole sliding sleeve techniques.

The proppant supply shortage also had eased in the summer of 2012, though prices were up about 5% vs. the first of the year, partly due to guar-related increases. Guar is an emulsifier used in cross-linked gel well stimulation for oil- or liquids-based wells. U.S. Silica was establishing a sand storage facility in San Antonio at press time where it could ship unit trains of 100 or more cars carrying high-grade Ottawa sand to South Texas.

Regionally, operators focused mostly on the Eagle Ford. Other formations undergoing evaluation in 2012 included the Pearsall Shale, and the Austin Chalk, although operators had reduced dry gas drilling efforts in the Wilcox and other South Texas reservoirs.

Regional constraints in takeaway capacity will keep Eagle Ford activity on a measured pace. Natural gas prices would have to increase meaningfully for Eagle Ford rig count to expand above present levels. ■

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South Texas Zones Spice Oilpatch Stew

Just as activity grows in South Texas, the number of companies that enjoy the benefits of operating in the region continues to grow as well.

By Don Lyle
Contributing Editor

Multiple high-return pay zones led by the Eagle Ford promise more than 25 Bboe, 150 Tcfe, as fast-improving drilling and completion techniques improve production efficiency.

The rig count grew to 236 in the Eagle Ford alone by late 2011, and companies buying into the rich play spend more than $26 billion for acquisitions to get a piece of the action.

Hart Energy offers profiles on the more active companies in the stacked pays of South Texas in this section, but at least as many more less-active operating companies pull revenues from the zones. Those companies include smaller operating companies with lower drilling budgets and companies that participate in activities in the area as nonoperating partners.

Key Players

Abraxas Petroleum Corp.

- *Operates JV with Rock Oil Co.*
- *Venture holds 12,177 net acres in the Eagle Ford*

While many oil and gas companies strain to gain a foothold in South Texas with the Eagle Ford as their primary reward, Abraxas Petroleum Corp. set wheels in motion to ease out of the play.

The company already had a foothold in the area through production from the Edwards Formation in August 2010 when it contributed 8,333 net acres to a joint venture with Rock Oil Co. to form a 50-50 joint venture called Blue Eagle Energy LLC. Under the terms of that agreement, Rock put up $25 million for its half interest and planned to add another $50 million to take over 75% of the venture. Abraxas operates the program.

The venture continued to grow. By May 2011, Abraxas said the venture held 9,586 acres with 60 net unrisked drilling locations and four planned wells during the year. Abraxas would be carried for $34 million in capital costs.

In a May 2012 presentation, the venture held 12,177 net acres in the Eagle Ford with 75 net unrisked locations on 160-acre spacing. By then, Rock had bought down the Abraxas share to 34.7%. At that time, Rock had funded $47 million of the planned $75 million total. Blue Eagle planned one gross well (0.4 net) to Abraxas in 2012.

Blue Eagle planned to divest its Eagle Ford holdings during 2012.

The venture's properties lie in Atascosa, DeWitt, Lavaca, and McMullen counties.

In its May 2012 presentation, Abraxas said its first well, the T Bird 1H, held 1.5 MMboe of proved, developed, producing reserves and a cumulative production of 120 Mboe. Its second well, the Matejek Gas Unit 1, had produced a cumulative 110 Mboe. The third well, the Grass Farms 1 H, had

produced a cumulative 19 Mbbl of liquids, and the latest well, the Cobra 1H, had produced 50 Mboe.

The Abraxas equity interest earned it 21.1 Mboe, or 226 boe/d, during 1Q 2012.

American Standard Energy Corp.

- *10% working interest in 12,000 gross acres of leases in the Eagle Ford*
- *Holds 7,400 net acres in the play*

Scottsdale, Ariz.-based American Standard Energy Corp. zeroed in on the Permian Basin for its operating activities and on the Williston Basin and the Eagle Ford for its nonoperated activities.

In a May 2012 briefing, the company said it accumulated a 10% working interest in 12,000 gross acres of leases in the play operated by Cheyenne Petroleum Co. called the Auld Shipman development project. New production facilities at that site allowed the companies to add sales volumes from previously drilled wells.

By May 2012, the companies had 11 gross (1.1 net to American Standard) wells producing from the Eagle Ford and Pearsall formations. American Standard's share of production at that time was 250 boe/d.

The companies planned to add production in the near future.

Plans at that time called for 35 gross (3.5 net) wells to American Standard from the project by year-end 2012. That would hold the entire Auld Shipman leasehold by production. Infill drilling could allow another 150-plus wells.

At the end of 1Q 2012, American Standard had seven gross (five net) producing Eagle Ford wells, 15 gross (1.5 net) completed wells, three gross (0.3 net) wells scheduled for completion, and three gross (0.3 net) wells drilling.

In a 2Q presentation, the company said it held 7,400 net acres in the Eagle Ford, 1,200 in La Salle and Frio counties, 4,900 in Maverick County, and 1,300 in Wilson and Gonzalez counties.

Anadarko Petroleum Corp.

- *Top Eagle Ford acreage holder*
- *Averaged 27 Mboe/d from the Eagle Ford in 1Q 2012*

Anadarko Petroleum Corp. executives built the company into one of the top acreage holders and top producers in the Eagle Ford play, a technique that spelled success for the company in other major tight plays across the US.

According to a May 2012 presentation, the company plans capex to be between $6.6 billion and $6.9 billion in 2012 with half that amount going to onshore programs in the US. Only 5% of that amount will go to exploration, while the other 45% will enhance production with a focus on liquids. In that environment, the Eagle Ford tops the company's priority list.

Wildflowers and high returns on investment characterize drilling and production activities in the stacked pays of South Texas. *(Photo courtesy of Anadarko Petroleum Corp.)*

Proof of the company's Eagle Ford priority shows in its rig count. Among US plays, it operates 10 conventional rigs and one spudder rig in the Eagle Ford, eight rigs in Greater Natural Buttes in Utah, seven rigs each in Wattenberg Field in Colorado and in East Texas, and five rigs in the Permian Basin.

The emphasis also shows up in production. The company averaged 27 Mboe/d of production from the Eagle Ford in 1Q 2012, up 55% from the same quarter a year earlier.

Anadarko's acreage count remains at 400,000 gross (200,000 net) acres, but within those numbers, the company doubled its identified drill sites to more than 4,000. The additional drill site potential also results in an increased net resource. It now has more than 600 MMboe in net resource potential, and about 65% of that is in liquids.

For all of 2012, the company expects to double year-on-year sales volumes.

Anadarko's properties lie mostly in the oil and condensate window of the Eagle Ford in Maverick, Webb, Dimmit, La Salle, and Zavala counties.

A company growth chart showed approximately 16 Mboe/d in sales in 2011, an anticipated 35 Mboe/d in 2012, and an expected 50 Mboe/d in 2013. During 1Q 2012, it reached a record 30.2 Mboe/d.

As the company increased production, it also improved efficiency. According to a first quarter operations report, the company drilled 1,082 ft/day per rig, as its nearest rated competitor averaged 955 ft/day.

Anadarko spent $29 million in capital drilling expenditures with 10 operated rigs in the Eagle Ford in 1Q 2012, or nearly 10% of its total $306 million and 32 rigs on all onshore US plays.

Those expenditures allowed the company to spud 69 wells, complete 74 wells, and reach first production on 59 wells.

As reported earlier, Anadarko signed a $1.55 billion deal to give Korea National Oil Corp. 80,000 net acres in the Eagle Ford and 16,000 acres in the deeper Pearsall gas shale. That agreement gave KNOC a one-third stake in Anadarko's properties in the Maverick Basin. That money carries Anadarko's

full drilling costs in the property in 2011 and approximately 90% of drilling costs until all funding is completed, probably by year-end 2013.

As an indicator in the increased value of Eagle Ford land, Anadarko acquired a 75% interest in 93,000 net acres of Eagle Ford leases from TXCO in 2010 for $93 million.

Apollo Global Management LLC

- *Purchased El Paso's E&P business (EP Energy E&P Co.)*
- *EP had 1,246 Eagle Ford drilling locations*

Ownership sometimes changes rapidly in the hottest plays in the industry as one company takes advantage of past performance and another buys into future potential.

El Paso Corp. held a package of strong-performing oil and gas assets. In 2011, the company decided to spin off its oil and gas E&P activities into a new company called EP Energy E&P Co. LP and keep its pipeline-centered operations under the El Paso name.

Early in 2012, Apollo Global Management LLC announced plans to buy El Paso's E&P business. It completed that $7.15 billion purchase in May 2012 with the help of investors that included Riverstone Holdings LLC, Access Industries Inc., and Korea National Oil Corp.

That purchase included Eagle Ford properties, which EP called the highest asset value in its portfolio.

According to EP, it had 1,246 Eagle Ford drilling locations, 1,236 of which were operated on 157,000 net acres of land in the oil and volatile oil windows in La Salle and Atascosa counties.

By the end of 2011, the Eagle Ford accounted for 16% of the company's 4 Tcf in proved gas-equivalent reserves and 8% of its 880 MMcf/d of gas-equivalent production from 64 operated producing wells. It calculated 400 MMboe in resource, 91% liquids on its property.

EP Energy Eagle Ford central well economics	
Total depth	7,000 ft to 9,800 ft
Lateral length	4,500 ft to 6,500 ft
Capital cost	$4.5 million to $6.5 million
24-hour initial potential	750 boe/d to 900 boe/d
30-day initial potential	600 boe/d to 800 boe/d
Estimate ultimate recovery	500 Mboe to 600 Mboe
Internal rate of return	55% to 65%
Net finding and development cost	$20/boe to $23/boe
Source: EP Energy	

One indicator of the value of the Eagle Ford in the corporate portfolio is the investment directed to the play. For 2012, EP planned to invest $899 million of its $1.5 billion capital program in the Eagle Ford.

The company ran four rigs in the play early in 2012, but it planned to add another rig later in the year.

EP drilled 46 wells during 2011 and planned to spud 88 gross wells in 2012. It had drilled 11 of those wells through February 2012.

It also improved well performance from an average initial potential of more than 800 boe/d in 4Q 2011 to nearly 1,200 boe/d in 2012. The number of drilling days dropped from an average of 24 in 2Q 2010 to an average of 12 in 4Q 2011 with a best well performance of eight days. Similarly, it increased the number of frac stages from 2.2 per day in 2Q 2010 to an average 4.4 per day in the last quarter of 2011. It performed 6.4 stages a day on its best well.

The company also wants to optimize spacing. It already tested 100-acre and 80-acre spacing and plans to test 90-, 70-, and 60-acre spacing. Those optimizing steps lowered per-well capital costs by 15%.

Aurora Oil & Gas Ltd.

- *Based in Australia*
- *Recent acquisition boosted position in Sugarkane Field*

Australia-based Aurora Oil & Gas Ltd., an established player in the stacked formations of South Texas, expanded its concentration in the area with the $95 million acquisition of an additional 6% nonoperated working interest in the Sugarloaf area of mutual interest (AMI), the company said in a May 2012 press release.

That AMI is in Sugarkane Field, and Aurora already had a 15.8% interest in the prospect. The latest acquisition will give the company an additional 1,440 net acres in the AMI and boost its position in Sugarkane Field by 9% to more than 17,800 net acres. Marathon Oil EF LLC operates the additional acreage.

Aurora started its activities in the area in 2005 when it participated in the Sugarloaf #1 well directed at the Hosston Sand. On the way to that formation at 12,000 ft, the well bore found reservoir quality Austin Chalk with natural gas. Further appraisal showed a formation below the Austin Chalk with production potential. It was called the "New Chalk" then and the Eagle Ford Shale now.

With confirmation wells nearby, the company began accumulating leases.

Now, Aurora controls 76,989 gross (16,365 net) acres in the heart of the Eagle Ford play in four AMIs.

In currently holds a 15.8% working interest in Sugarloaf with 24,033 gross acres, a 31.9% working interest in the Longhorn AMI with 28,487 gross acres, a 36.4% working interest in Ipanema with 4,627 gross acres, and a 9.1% working interest in the 19,842-gross acre Excelsior AMI. The four AMIs are in Karnes and Atascosa counties.

An independent survey estimated December 31, 2011, the proved reserves for Aurora's interest in Sugarkane Field at 80.4 MMboe, with 76% liquids, and proved, probable, and possible reserves at 124.1 MMboe. Proved and probable reserve estimates were based on 80-acre spacing, but the company also plans to evaluate 40-acre and 60-acre spacing in the Eagle Ford.

The gross acreage in the field gave operators 3 Bcf of rich gas and 1.46 MMbbl of condensate and light oil in 4Q 2011, and 14 new wells went on production, seven in Excelsior and seven in Longhorn for 3.7 wells net to Aurora.

The field produced 553 MMcf of rich gas and 272.2 Mbbl of condensate and light oil for Aurora before royalties and stripping of NGL. After royalties and stripping, the company still had 323 MMcf of gas, 200.6 Mbbl of condensate, and 34 Mbbl of NGL.

By year-end 2011, 71 gross wells had been put on production, four were on production testing, eight wells were being stimulated or awaiting stimulation, and six more wells were being drilled. Marathon said

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it planned to spud 158 gross wells (35 wells net to Aurora) on the Aurora acreage in 2012.

Bering Exploration Inc.

- *Began Eagle Ford acquisitions with 1,200 gross acres*
- *Property included 120 well locations*

Bering Exploration Inc. began acquiring leases in the Eagle Ford area in March 2011with a package of approximately 1,200 gross acres.

That property, the company said, held potential gross reserves of 3 MMbbl and 120 well locations.

The leases had one abandoned well for well control and an aeromagnetic survey had been shot over the property. At the time the company said it planned to use advanced techniques to maximize oil recovery from the Eagle Ford, Austin Chalk, Buda, and Edwards formations.

As of June 2011, the company held a 100% working interest (82% net revenue interest) in the property on a two-year lease.

BHP Billiton Ltd.

- *Acquired Petrohawk Energy Corp. for $15.1 billion*
- *Has about 1 million net acres in Texas and Louisiana*

Drilling rigs show a newer use on South Texas land in addition to the traditional farming and ranching activities. *(Photo courtesy of BHP Billiton Ltd.)*

BHP Billiton Petroleum, the oil and gas arm of Australian minerals giant BHP Billiton Ltd., stormed into the Eagle Ford play with its $15.1 billion acquisition of Petrohawk Energy Corp., an innovative company with strong positions in the Haynesville-Lower Bossier in Louisiana and East Texas and in the Permian Basin. Petrohawk also was the company that put the Eagle Ford Shale on the top play list.

That acquisition gave BHP Billiton approximately 1 million net acres of land in Texas and Louisiana, with net production of an estimated 950 MMcfe/d, or 158 Mboe/d. At year-end 2010, Petrohawk reported 3.4 Tcfe in proved reserves. In July 2011, it had a total risked resource base of 35 Tcfe.

Before the acquisition J. Michael Yeager, CEO of BHP Billiton Petroleum, said, "Petrohawk has a focused portfolio of three world-class onshore natural gas and liquids-rich shale assets. With over a decade of significant investment and volume growth ahead, this transaction would build on our recent acquisition of the Fayetteville Shale in Arkansas and provides the potential to more than double our existing resource base. Following completion of the Petrohawk transaction, BHP Billiton Petroleum will be on track to deliver a compound annual production growth rate of more than 10% for the remainder of the decade as we accelerate our shale development program and leverage our strategic capability in deep water."

The Eagle Ford accounted for 332,000 of those 1 million net acres. Petrohawk had de-risked the play but left it early in the development stage for BHP Billiton to exploit.

For example, Black Hawk Field offered "performance and economics superior to all other operators and regions in the play," according to BHP Billiton. Petrohawk discovered Hawkville Field in 2008 in La Salle and McMullen counties when it held 160,000 net acres. It built that holding to 236,000 net acres. Petrohawk had planned to drill 85 wells in Black Hawk Field in 2011 and take part in 51 operated and 23 nonoperated wells in Hawkville.

The company added 69,000 net acres in Hawkville Field in Karnes and DeWitt counties in the heart of the play with a heavy liquids content. It also was starting work on its 77,000 net acres in Red Hawk Field in Zavala County at the time of the acquisition.

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Steel grades:
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- API 5L: up to X 80
- API 5CT: H40, J55, K55, K55 FBN, N80 T1, N80 Q, N80 QHC

Length:
individual length up to 60 ft (18 m)

Coating:
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- MAPEC® 3-layer PE/PP rough coating
- MAPEC® 3-layer PE/PP with T-profile
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Lining:
- Epoxy flow coat
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The Eagle Ford offered 210 MMcfe/d, or 35 Mboe/d, during 2011 and a risked resource base of approximately 13.5 Tcfe.

The acquisition more than doubled BHP Billiton Petroleum's resource base and increased proved reserves by approximately 30%. It also boosted the company into a top 10 upstream oil and gas company among independents.

BP Americas Ltd.

- *Holds about 450,000 net acres in the Eagle Ford*
- *Claims resources of 1 Bboe in the play*

BP Americas Ltd. started its major lease accumulation in the Eagle Ford in 2009 when it invested $160 million for a half interest in 80,000 acres in the play, primarily in Webb County, with Lewis Energy. The agreement also covered properties in Dimmit and La Salle counties.

In a late 2009 presentation, BP estimated its resource exposure at 5 Tcfe.

Since that time, the company built its property position to approximately 450,000 net acres through less well-publicized acquisitions, adding Duval County leases to its holdings. It now claims a resource of 6 Tcfe, or 1 Bboe, in the play. Much of the acreage acquired early in the campaign held potential for dry gas, but later acquisitions concentrated on the liquids segment of the play.

BP initially chose to operate some of the properties but later turned over operations in Webb County to Lewis. In early 2012 Lewis had 10 rigs working the Eagle Ford.

In the wake of the Macondo oil spill incident in 2010, the company chose to divest large portions of its US onshore portfolio, principally in the Texas Panhandle area, but it chose to keep its Maverick Basin properties.

Cabot Oil & Gas Corp.

- *Focusing on the Eagle Ford in the last months of 2012*
- *Signed agreement with Japan's Gas Co. Ltd. in June 2012*

Cabot Oil & Gas Corp. took a firm grasp on its Maverick Basin properties as it concentrated on improving its production techniques.

In a 2011 presentation, the company said it held approximately 61,000 acres in the liquids segment of the play in Powderhorn Field in Zavala County; Harlow Field in Frio and Atascosa counties; Presidio Field in Atascosa County; and Buckhorn Field in Frio, Atascosa, and La Salle counties.

Those fields gave the company between 400 and 500 potential drilling locations, with working interests from 50% to 100% and a potential resource of 150 MMboe to 300 MMboe. By that time, it already had shot 3-D seismic over 95% of its property.

The company's 2011 annual report said it devoted a third of its capital spending to oil plays in 2011 and most of that money went into the Eagle Ford. It managed to increase production from that zone from 1,100 boe/d of oil in January 2011 to 7,300 boe/d by the end of the year.

Through the year, it increased estimated ultimate recoveries (EUR) by 26% with better placement of laterals and more efficient use of proppant.

In a 1Q 2012 report, the company said it had been drilling wells with single laterals and 1,000-ft to 1,200-ft spacing, but it completed a pilot program in which it drilled two wells from a single pad with horizontal legs spaced 400 ft apart and completed the wells with a zipper frac treatment. Those wells gave the company early 24-hour returns of 788 b/d and 791 b/d of oil, respectively – volumes that were greater than average initial rates for its entire portfolio of Eagle Ford wells.

After evaluating results from its programs in the Eagle Ford and Marmaton formations, the company decided to focus on the Eagle Ford in the last eight months of 2012.

In a March 2012 presentation, Cabot said it had drilled 29 wells, with one additional well drilling, 27 producing, and two awaiting completion. Among those wells, the average initial potential was 697 boe/d, with a 30-day average initial potential of 495 boe/d. The average lateral was 4,956 ft and the average EUR was 400 Mboe.

Among its seven more recent wells in its 38,119-acre Buckhorn Field, initial potentials averaged 851 boe/d and 30-day initial potentials of 556 boe/d. Results from the zipper-frac method could raise potential in that field from 275 net wells on 1,000-ft spacing to 700 net wells on 400-ft spacing.

The situation was similar in the Presidio area of mutual interest where the company has a share of 18,000 gross acres. With 10 wells drilled, one drilling, nine producing, and one awaiting completion, the average initial potential was 774 boe/d and the 30-day rate was 476 boe/d, with average laterals of 5,148 ft and EUR between 300 Mboe and 500 Mboe. The most recent three wells offer an average initial potential of 1,038 boe/d and a 30-day IP of 623 boe/d.

In late June 2012, Cabot signed an agreement that gave Japan's Gas Co. Ltd. a 35% nonoperated interest in approximately 50,000 net acres of Cabot's Pearsall Shale properties, below the Eagle Ford, in Atascosa, Frio, La Salle, and Zavala counties for $250 million ($125 million in cash) and the same amount in 85% carries on Cabot's future drilling costs, probably through 2013.

Cabot said it would work two rigs under the joint venture with first spud in July 2012. It planned to add a third rig in 2013 and a fourth in 2014.

Carrizo Oil & Gas Inc.

- *Entered the Eagle Ford in 2010*
- *Has drilled 53 horizontal wells*

Like many other companies, Carrizo Oil & Gas Inc. thought enough of its Eagle Ford properties that it raised its investment in the profitable formation.

The company entered the play in 2010. Since that time, it drilled 53 horizontal Eagle Ford wells, with 37 on production, three in the completion process, and 13 awaiting completion on its 43,000 net acres, mostly in La Salle County. According to an April 2012 presentation, it had four rigs working and produced 5,700 b/d of oil in 1Q 2012, up from 300 b/d in 3Q 2010. It planned to finish 2012 producing 7,000 boe/d.

The company estimated 95% of its land is drillable with room for 355 wells on 115-acre spacing. It anticipated EUR at 400 boe and gross reserves at 142 MMboe.

Carrizo planned to spend $320 million in the shale in 2012, up from $195 million in 2011. That investment will finance a down-spacing program. It already drilled pilot wells on 80-acre spacing and planned to try 40-acre spacing.

Its first 37 wells showed average initial potentials between 600 boe/d and 1,000 boe/d. Carrizo plans to run three rigs through 2012, down from four in the early part of the year, to stay within its capital budget.

Its wells cost $7.5 million to complete and give back a gross 400 Mboe (300 Mboe net) at a finding and development cost of $25/boe. That gives Carrizo a 67% internal rate of return with $100 oil and $3 gas on the New York Mercantile Exchange and a 40% return with an $85/bbl oil price. At that price, its undiscounted payout time was 1.9 years.

It signed a joint venture agreement with GAIL (India) Ltd. in September 2011 that gave GAIL 20% of 20,200 acres, including eight producing wells for $63.7 million in cash and $32.4 million in investment carries.

Cheyenne Petroleum Co.

- *Works both the Eagle Ford and Pearsall formations*
- *Operates the Auld-Shipman development project*

Cheyenne Petroleum Co. works both the Eagle Ford and Pearsall formations in Frio and La Salle counties in South Texas.

IHS Inc. reported in May 2012 the company drilled two Pearsall Shale wells along the Frio-La Salle county boundary.

The company's1H Williams Aline Unit "B" flowed at in initial rate of 744 b/d of oil and 418 Mcf/d of gas or 814 boe/d from the Pearsall, a formation better known for gas production than liquids content. It drilled the horizontal well to 16,222 ft.

Approximately 4.25 miles southwest in La Salle County, the company drilled the 3 Irvin Family, a horizontal well that tapped the Pearsall for 6.2 MMcf/d of gas and 552 b/d of condensate, or 1,591 boe/d. It drilled that well in 15,282 ft with a true vertical depth of 11,672 ft. Cheyenne's 1 Irvin Family, drilled in 2009, was the discovery well for the field.

A release from American Standard Energy Corp. said it held a 10% working interest in the Auld-Shipman development project, a 12,000-gross-acres AMI operated by Cheyenne. Wells in that program went to the Eagle Ford. By mid-May 2012, American Standard had participated in 26 gross wells with Cheyenne.

American Standard said Cheyenne planned to have 35 gross wells online from the project by year-end 2012. That goal would hold the entire AMI by production. Sixty-five-acre spacing on the project would give Cheyenne more than 150 additional drilling locations.

Cheyenne added a third drilling rig in the Auld-Shipman project.

Cinco Resources Inc.

- *Major activity focus is in the Eagle Ford*
- *Lease areas are in the liquids-heavy section of the play*

Cinco Resources Inc. holds 145,000 net acres of leases focused on unconventional resources in the Woodford Shale in the Arkoma Basin, the Powder River Basin of Wyoming, and the Eagle Ford Shale in South Texas, but its major activity focus is in the Eagle Ford.

It acquired most of its Eagle Ford acreage between March 2007 and June 2010, according to the registration statement for its initial public offering (IPO). Those lease areas are in Atascosa, Karnes, Live Oak, and Zavala counties in the liquids-heavy section of the play.

By year-end 2011, it held 15,045 net acres of land. Its production at that time was 13.7 MMcfe/d, 81% oil, and 8% gas liquids. It had 110 gross (94.4 net) drilling locations and an estimated 83.4 Bcfe in proved reserves.

Exiting 1Q 2012, the company had drilled 14 gross (12.8 net) wells and planned to spend $107.6 million in the Eagle Ford to drill 11 wells during the year. It also raised its lease holdings in the play to 18,800 net acres.

To help reach that goal, the company filed a proposal to raise up to $172.5 million via an IPO through a group of underwriters headed by Citigroup Global Markets and Wells Fargo Securities LLC.

Comstock Resources Inc.

- *Acreage has total resource potential of 83 MMboe*
- *Had 216 net drilling locations in the Eagle Ford as of June 2012*

Comstock Resources Inc. targeted the Eagle Ford Shale as the company's strongest growth engine for 2012.

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"Our Eagle Ford Shale in South Texas added 9.3 MMbbl of oil and 8 Bcf of natural gas, or 10.6 MMboe to our proved reserves in 2011," said M. Jay Allison, chairman and president, in the company's annual report for 2011.

"We believe that our acreage has a total resource potential of 83 MMboe. We plan to spend $165 million in 2012 to drill 24 (21.7 net) Eagle Ford Shale horizontal wells and $28 million to complete four wells (3.2 net) drilled in 2011," he said. The company spent $203 million to drill 20 gross (19.2 net) horizontal Eagle Ford wells in 2011 and completed 17 of those wells, including one 2010 well.

Comstock holds approximately 35,000 gross (28,000 net) acres with Eagle Ford potential in Frio, Karnes, Atascosa, McMullen, and La Salle counties, most in the area with black oil potential. According to a June 2012 presentation, it had 216 net drilling locations in the Eagle Ford, with EUR of 500 Mboe per well for a resource potential of 80 MMboe.

By June 2012, the company had completed 27 gross (25.8 net) horizontal wells in the formation with an average initial potential of 698 boe/d.

ConocoPhillips Co.

- *Held 228,000 net acres in the Eagle Ford in June 2012*
- *Planned to drill more than 180 wells in 2012*

ConocoPhillips Co. got a major foothold in Eagle Ford acreage with its purchase of Burlington Northern Resources in 2005. The Eagle Ford was not even a fledgling play at that time, but the company now calls it "one of ConocoPhillips' most promising opportunities" in the company's Spring 2012 Fact Book. It listed the Eagle Ford as a major project from 2012 forward following a major delineation program in 2011.

According to the company's Summer 2011 Fact Book, ConocoPhillips produced 3 Mb/d of liquids and 10 MMcf/d of gas from the formation in 2010, drilling more than 45 wells without a dry hole. At the end of 2010, 11 rigs were operating in the field.

According to the 2012 Fact Book, by year-end 2011 the company produced 22 Mb/d and 39 MMcfg/d, or 29 Mboe/d in the liquids rich shale trend. By year-end 2011, the company raised its rig count to 16 in the field with net production exceeding 50 Mboe/d.

In a June 2012 Credit Suisse conference, ConocoPhillips said it would produce approximately 114 Mboe/d in 2013, 126 Mboe/d in 2014, 128 Mboe/d in 2015, 134 Mboe/d in 2016 and peak at 140 Mboe/d in 2017 from the Eagle Ford. At year-end 2011, it held 223,000 net acres in the play. The company raised that figure to 228,000 net acres by the June presentation.

During this presentation, the company also said its Eagle Ford resources contained 77% liquids and represented a 1.8 Bboe resource. It planned to invest $2.3 billion in the play to drill more than 180 wells in 2012. For that investment, it expected returns higher than 50%, with a cash margin of $48/boe and a finding and development cost of $14/boe. It said its wells lead the industry in performance with a break-even at $37/bbl price for West Texas Intermediate oil.

It enhanced returns with an industry-leading 15 days from spud to release on its Eagle Ford rigs a full day faster than its nearest rated competitors.

According to IHS Inc., among wells drilled under the Burlington Resources Oil & Gas Co. name, the #1 Flying Horse United Asted tested for 1,399 b/d of oil and 375 Mcf/g of gas and the offsetting #1 Brusselman Unit A flowed 1,243 b/d and 534 Mcf/d. Both wells are in Eagleville Field in Karnes County.

Crimson Exploration Inc.

- *Focused on Eagle Ford and Woodbine plays*
- *As of 1Q 2012, held 18,400 gross (8,625 net) acres in the Eagle Ford*

After working more conventional plays and gas-prone prospects, Crimson Exploration Inc. changed its focus to the Eagle Ford play in South Texas and the Woodbine play in southeastern Texas for 2012.

The company started its Eagle Ford activity in the condensate window in Bee County in 2010 and expanded into Zavala and Karnes counties in 2011. In its 1Q 2012 report, the company said it held 18,400 gross (8,625 net) acres in the play. Approximately 89% of that acreage is held by production.

According to its 2011 annual report, it drilled eight wells to the Eagle Ford in Karnes County and produced a cumulative 550 Mboe since April 2011.

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By year-end 2011, it had nine gross (four net) producing wells with proved reserves of 16.17 Bcfe in the Eagle Ford.

Crimson's 2012 budget includes $74 million for the Eagle Ford in Karnes, Bee, Dimmit, and Zavala counties and the Woodbine, Georgetown, Lewisville, and other formations in Madison and Grimes counties. Approximately $38 million of that budget will allow the company to drill nine gross (6.5 net) wells to the Woodbine area stacked plays.

The company said its Eagle Ford properties potentially give the company 230 locations on 80-acre spacing and 68 MMboe in net potential production.

An offset operator to the company's Force prospect in Madison County tested a Georgetown well for more than 700 boe/d. If that result applies to Crimson's properties, it could add 58 drilling locations on 320-acre spacing and a potential 17 MMboe of net production.

It also has potential production from the Buda Formation.

In its 2Q 2012 report, Crimson said it held approximately 18,500 net acres in its Force, Iola-Grimes, and Chalktown areas, all with Woodbine prospects in Madison and Grimes counties in East Texas. Those properties offer the company approximately 115 net potential drilling locations on 160-acre spacing. They also offer the company 34 MMboe in net potential, if all the wells conform to the company's type curve with an EUR of 400 Mboe per well with a 90% liquids content.

The company said in its 1Q 2012 report that it completed its first horizontal Woodbine well, the Mosley #1H, for 1,203 boe/d and produced nearly 60 Mboe in the well's first 60 days online.

That well is on the company's 18,000 net acres of properties in Madison and Grimes counties in East Texas. Wells drilled on 6,000-ft-plus laterals with plug and perf completions offer strong results, averaging more than 680 boe/d in initial potential.

The company calculated ultimate recoveries for all Woodbine wells to date at 400 Mboe, with newer wells averaging 500 Mboe.

A Woodbine well costs between $6 million and $7 million and offers returns from 99% to 150% with a $95/bbl oil price and a $3/MMBtu gas price. For comparison, the company estimated returns of 30% to 75% on its Eagle Ford wells.

Crimson dedicated more than half of its $74 million capex for 2012 to drill seven to nine gross wells in the Woodbine. Its properties will support more than 100 well locations.

New wells in the Eagle Ford and Woodbine helped the company increase oil production from 975 b/d in 1Q 2011 to 1,743 b/d in 1Q 2012.

Dan A. Hughes Co.

- *South Texas targets include Eagle Ford, Georgetown, and Buda*
- *Permitted an apparent Eagle Ford horizontal test in southern Frio County*

Privately held Dan A. Hughes Co. mounted an active campaign in South Texas with targets that include the Eagle Ford, Georgetown, and Buda.

According to IHS Inc. in a May 2012 report, the company permitted the 1H Corbin, an apparent Eagle Ford horizontal test in southern Frio County. The proposed well in Pearsall Field is surrounded by Austin Chalk production, but the Eagle Ford produces within a mile of the well.

Dan A. Hughes completed the 1H McKinney in Eagleville Field in Frio County for 85 b/d of oil and 75 Mcf/d of gas from fractured perforations between 7,900 ft and 13,453 ft.

The company also completed the 2 Hughes-Ashbrook "A" well in the Georgetown Formation in Maverick County at 1,916 ft in early 2011. That well tested for 61 b/d and 10 Mcf/d from an openhole segment between 1,870 ft and 1,916 ft.

In Pearsall Field in Zavala County, the company completed the 1H Heitz in late 2011. That well, initially proposed to the Eagle Ford, ended up producing 200 b/d and 150 Mcf/d from an openhole section of the Buda from 7,314 ft to 11,750 ft.

Dewbre Petroleum Corp.

- *Operated in Karnes County for more than 10 years*
- *Operates more than 200 wells in South Texas*

Dewbre Petroleum Corp. started operating in Karnes County more than a decade ago when it acquired three wells producing a combined 1 MMcf/d of gas in Kenedy Southwest Field. It drilled another well, reached 2.4 MMcf/d production, and

watched that decline to 5 Mcf/d before it drilled a single horizontal well to out-produce its early peak.

Now, according to the company website, it operates more than 200 wells in South Texas and produces more than 500 b/d and 15 MMcf/d.

With Doxa Energy Ltd. as a 20% working interest participating partner, Dewbre completed the 1H Peeler Ranch, a recompletion in the Eagle Ford Shale in Eagleville Field in Atascosa County, according to IHS Inc. The companies drilled the 2H Peeler Ranch in early 2012, and Doxa sold 10.52% of the well out of its 20% share for $847,497.

Doxa said Peeler Ranch could support 10 to 14 gross wells.

Eagle Ford Oil & Gas Corp.

- *Acquired 85% working interest in 3,684 gross acres in Pearsall Field*
- *Potential for production from Austin Chalk, Eagle Ford, and Buda formations*

After working in a limited way in the Eagle Ford Shale, Eagle Ford Oil & Gas Corp. stepped into the popular play in a bigger way with an acquisition in Frio County.

In a June release, the company said it acquired an 85% working interest in 3,684 gross acres in the county south of San Antonio, Texas, for $6.26 million.

The land is in Pearsall Field, famous as a center for Austin Chalk production. The Eagle Ford sourced the oil in the chalk. The area also has potential for production from the Eagle Ford and Buda formations. The purchase also gave the company rights to formations including the Pearsall Shale.

Wells drilled to the three formations by other operators, including Cabot Oil & Gas and Goodrich Petroleum, indicate potential for EUR of 350 Mboe to 500 Mboe per well initial potential production rates between 400 boe/d to more than 1,000 boe/d.

Based on 160-acre spacing Eagle Ford could drill more than 20 wells to each of the formations,

according to Ronald Bain, head of the company's technical team.

The company's previous experience in the Eagle Ford consisted of a 1% working interest farm-in on 2,400 acres in Live Oak County in 2010. The operated drilled two wells in the area, but production from those wells has dropped to minimal levels.

Eagleford Energy Inc.

- *Works two areas prospective for the Eagle Ford Shale*
- *Zavala County property holds potential for up to 20 horizontal wells*

Eagleford Energy Inc. works two areas in South Texas prospective for the Eagle Ford Shale.

In February 2012 through its Dyami Energy LLC subsidiary, the company participated in the Murphy/Dyami #3 well being drilled by Dawsey Operating LLC, on Eagleford's Murphy lease on 2,637 acres in Zavala County. Two previous wells reached the Eagle Ford, according to IHS Inc.

Among targets for potential production from the field are Escondido, Olmos, San Miguel, Anacacho, Austin Chalk, Eagle Ford, Buda, and Georgetown.

The property holds potential for up to 20 horizontal wells on 130-acres spacing with 4 MMbbl of potential oil resource.

In the same field, the San Miguel heavy oil sand at about 2,300 ft also is a primary target.

Eagleford's second major project area is its Matthews Project where another company has farmed in to spend up to $1.05 million to earn as much as 50% of Eagleford/Dyami's working interest to the base of the San Miguel.

The Matthews Lease includes 2,629 acres of land in Zavala County with the Eagle Ford at 4,500 ft and the San Miguel at 2,800 ft. It holds up to 20 horizontal well locations on 130-acre spacing in the Eagle Ford.

Eagleford plans one horizontal well to the Eagle Ford on the Matthews Lease.

Encana Corp.

- *Properties include 115,000 net acres in the Eaglebine area*
- *Had drilled, completed six wells in the Eaglebine by June 2012*

Canada's Encana Corp., working through its US affiliate, assembled 1.7 million net acres in liquids plays in the US as it switched its focus from gas to liquids.

Those properties include 115,000 net acres in the Eagle Ford/Woodbine (Eaglebine) area of East Texas with a net 8.6 Bboe of oil in place, primarily light oil, from approximately 700 net well locations, according to a June 2012 presentation.

By the end of June 2012, the company had drilled and completed six wells in the Eaglebine, including one with a 7,500-ft lateral, among the total 100-plus wells drilled by the industry. Initial potentials on area wells have reach as high as 1,500 boe/d.

During 2012, Encana plans to drill six more wells as it continues appraisal drilling of multiple zones. It also plans longer laterals and improvements to its completion techniques.

The company said a 7,500-ft vertical well with a 7,500-ft lateral can be drilled, completed, and tied in for $7.5 million and provide and estimated ultimate recovery of 465 Mboe.

Among wells completed by Encana, its 1H John Gresham Unit horizontal well in Halliday Field in Leon County was completed in the Woodbine for 123 b/d of oil from perforations between 7,090 ft and 14,470 ft.

In the same county, the 2H John Gresham Unit tested for 150 b/d from Woodbine perforations from 7,145 ft to 14,646 ft.

Its 1H Clyde Williams Unit in Robertson County tapped the Woodbine for 174 b/d and 130 Mcf/d of gas from perforations between 7,675 ft and 13,079 ft.

In earlier information on the company's website, it said it had drilled wells with lateral lengths from 4,500 ft to 6,200 ft. Those wells came in with 30-day production rates between 165 b/d and 230 b/d.

It completed all of the wells with multiple, staged fracture treatments.

EOG Resources Inc.

- *Regards the Eagle Ford as 'the best asset in America'*
- *Biggest producer in the Eagle Ford Shale at 77 Mboe/d*

EOG Resources Inc. "has captured the biggest US crude discovery, net to one company, in the past approximately 40 years," according to a June 2012

presentation by the company. It is talking about the Eagle Ford.

It is the "best asset in America, and improving," the company added.

The company has good reason for those opinions. It holds an estimated 1.6 Bboe in net potential resource, and it is the biggest producer in the Eagle Ford Shale at 77 Mboe/d, 90% liquids, in March 2012. Those potential reserves include 1.14 MMbbl of oil, 256 MMbbl of NGL and 1.248 Tcf of gas.

It also is one of the biggest leaseholders with 647,000 net acres: 572,000 net acres in the oil window, another 26,000 net acres in the wet gas window, and a final 49,000 net acres in the dry gas window.

Not only is the company improving income from the Eagle Ford, it also is reducing costs. EOG uses sand from company-owned mines in the fracture treatments for a savings of $500,000 per well. That will make a big difference in the 600 wells EOG plans for 2012.

It also is developing fields with 65-acre to 90-acre spacing between wells with flow rates offering results equal to or better than its previous development patterns.

It also plans a dry-gas injection test project in 2013 for additional recovery potential.

Improvements show in results. The company drilled two new Henkhaus wells, offsetting six existing Henkhaus wells, in Gonzales County. It drilled the short-lateral Henkhaus Unit #5H offsetting the #4H well and turned the new well to sales at rates of 2,775 b/d of oil, 438 b/d of NGL, and 2.3 MMcf/d of gas. The Henkhaus Unit #12 H, offsetting the #5H, tested at an initial rate of 3,000 b/d, 425 b/d of NGL, and 2.2 MMcf/d.

The Lord A Unit #2 H and 3H were drilled on 65-acre spacing and were tested for 2,448 b/d and 2,562 b/d, respectively; 440 b/d and 400 b/d of NGL, respectively; and 2.3 MMcf/d and 2.1 MMcf/d, respectively.

The company had similarly impressive results on wells in Karnes and McMullen counties.

Escondido Resources II LLC

- *Holds 60,000 acres of land with more than 600 drilling locations*
- *Completed most successful well to date in the Escondido*

Following previous success, Escondido Resources II LLC is taking another run at the stacked pays of South Texas and adding to its winning streak.

Escondido Resources LP, with help from $50 million from EnCap, later increased to $75 million, drilled 163 wells with a 95% success rate and 25 MMcf/d of gas production. After three years, it sold its assets in the Olmos/Escondido Trend to Swift Energy for $249.5 million.

The management, with another $80 million from EnCap, later increased to $200 million, reformed into Escondido Resources II in November 2007.

It drilled its first Eagle Ford well in 2009 with a 5,600-ft lateral and 19 frac stages to produce more than 1 Bcf of gas in its first eight months onstream.

It sold 11,500 acres of leases in La Salle County for $115 million a year later and completed the most successful well to date in the Escondido Trend in January 2011.

The current version of the company holds 60,000 acres of land with more than 600 drilling locations, 400 of them in the Eagle Ford in Webb, La Salle, and McMullen counties. The properties also offer potential in the Olmos and Escondido zones with horizontal drilling.

The company produced 60 MMcf/d at year-end 2011 according to its website and has drilled only 45 of its locations. It was drilling its 24th horizontal well.

The prize is more than 1.5 Tcf of resource potential including the 200 Bcf of proved reserves it already has identified.

In a February 2012 release, Escondido said it drilled 17 horizontal wells in 2011 with no dry holes and an average initial production rate of almost 7 MMcf/d of high-Btu gas. It currently is working two rigs in its three-county active region.

By that time, it had increased production to 66 MMcf/d, with four new wells scheduled for completion in March and April. When those wells come online, Escondido expects production to grow to 90 MMcf/d. The 2011 drilling program targeted the company's "bread and butter" Escondido and Olmos potential, but it also drilled two Eagle Ford wells.

New wells will investigate all three formations.

Exxon Mobil Corp.

- *Acquired XTO Energy in 2012*
- *Gained 120,000 acres prospective for the Eagle Ford*

Exxon Mobil Corp. picked up 120,000 acres of land prospective for the Eagle Ford Formation with its 2010 acquisition of XTO Energy.

In the company's 2011 Financial and Operations Report, the company said it drilled 23 wells as it executed a delineation program across its 90,000 net acres in the shale play. That is an increase from the 15 wells XTO and ExxonMobil drilled in the formation in 2010.

During 2011, the company drilled a series of wells in Hawkville and Eagleville fields in McMullen County.

It drilled two of the latest wells under the XTO Energy name in November 2011, according to IHS Inc. records. The 1H McClaugherty Unit in Eagleville Field tested for 285 b/d of condensate and 4.05 MMcf/d of gas from the Eagle Ford, and the 2H McClaugherty Unit in the same field tested for 200 b/d of condensate and 3.48 MMcf/d of gas from perforations between 14,550 ft and 16,600 ft after fracturing.

Forest Oil Corp.

- *Held 112,000 gross (103,000 net) acres as of May 2012*
- *Produced about 1,000 boe/d from the Eagle Ford in 2Q 2012*

Forest Oil Corp. put one drilling rig to work in the Eagle Ford play initially for 2012 and, sparked by results, moved in a second rig as the company concentrated on its prospects with liquids production.

In a May 2012 presentation, the company said it held 112,000 gross (103,000 net) acres of land with 42 proved undeveloped locations and another 1,031 identified locations.

A month later, the company said it devised a "go-it-alone" plan. That plan, without a joint venture partner, would allow Forest to retain approximately 40,000 net acres of land with a 100% working interest, a posi-

tion that eventually will support three drilling rigs to work approximately 500 locations on 80-acre spacing. It would then plan to monetize its remaining acreage through small sales or farm-out agreements.

During 2Q 2012, Forest produced approximately 1,000 boe/d from the Eagle Ford. Its planned two-rig program should allow it to finish the year producing 3,000 boe/d.

That growth requires capital, and the Denver company said it planned to reduce spending in lower-return areas, including the Texas Panhandle and East Texas, to direct more money to South Texas in the second half of 2012.

It recorded 57 Bcfe in net proved undeveloped reserves and 1.17 Tcfe in unrisked potential in the Eagle Ford at year-end 2011.

Forest said it was targeting sections of the Eagle Ford, from lower to upper, to increase initial potentials and EUR on its wells while lowering costs of completion. It also focused on the central fairway of its properties, an area with the largest, most contiguous acreage and the area with its most consistent results.

The company already has increased initial production rates with new stimulation designs. In a June 2011 release, the company said its three most-recently completed Eagle Ford wells averaged a 24-hour maximum production rate of 787 boe/d, with a 96% oil cut.

With those results, and results from wells earlier in 2012, the company moved a second drilling rig onto its property.

In its 1Q 2012 report, Forest said, "Our Eagle Ford Shale program continues to evolve towards a full development opportunity."

The company drilled 16 Eagle Ford wells during 2011, according to its 2011 annual report. At that time the company said it believed it had identified the optimal completion interval and method. Its investigations led the company to target the uppermost Eagle Ford zone for its laterals and use a less-intensive stimulation treatment in 2012.

Forest's strategy includes a drilling program to further delineate its Eagle Ford properties with a focus on Gonzales County, where most of its acreage lies. It also will use a 1,000-hp drilling rig to help control costs.

GeoResources Inc.

- *Merging with Halcón Resources Corp.*
- *Plans 20 to 24 gross wells during 2012*

GeoResources Inc. continues to work the Eagle Ford play as it awaits completion of a merger into Halcón Resources Corp.

GeoResources holds 24,000 net acres of land in southwestern Fayette and eastern Gonzales counties with production from nine wells. Another four wells awaited completion and two wells were drilling, according to the company's 1Q 2012 report.

The company planned 20 to 24 gross wells with a 45% working interest during 2012, and it set up a back-to-back completion program for its next seven to nine wells. Six of its later wells were completed with revised completion designs.

In an April 2012 merger presentation by Halcón, that company said GeoResources had two rigs running in the play and planned to add a third in the second half of the year.

The property also has potential for additional recoveries with 80- and 120-acres spacing and from the Austin Chalk.

The presentation said the company anticipated a 33% rate of return on a well with an EUR of 325 Mboe at an oil price of $100/bbl and an $8 million well cost. If the well cost grows to $9 million, the return falls to 24.7%.

Halcón said the first three wells, drilled with 3,200-ft to 5,900-ft laterals and 10 to 16 frac stages using 40/70 white sand, had embedment problems, and slick-water linear gels and crosslink frac fluid were not effective.

Six more recent wells with 5,000-ft laterals, 20 frac stages, 20/40 and 30/50 resin-coated white sand, and crosslink gel showed returns higher than the company's type curve.

That type curve estimated a 60-day average production rate of 328 b/d. The first three wells averaged 302 b/d. The six recent wells averaged 402 b/d.

For 2012, 16% of GeoResources' $620 million capital budget will go to the Eagle Ford, more than any other area of company operations but the Bakken, which will get a 17% share.

GeoResources' Eagle Ford wells produced an average 106 boe/d, net, during 2011. That figure rose to 176 boe/d in 4Q 2011 and 262 boe/d in 1Q 2012. The company estimated proved reserves of 890 Mbbl, 349 MMcf, and 69 Mbbl of NGL for a total of 1.02 MMboe.

In addition to the Eagle Ford wells, GeoResources completed its first operated Austin Chalk well on the Eagle Ford acreage in Fayette County. That well, the Rightmer #2HRE, in which the company held a half interest, tested for 339 boe/d, with a 93% oil cut, in its first five days online.

The merger, announced in late April 2012, is expected to close in 3Q 2012.

GeoResources also operates through its Southern Bay Operating LLC subsidiary.

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GeoSouthern Energy Corp.

- *Developing 173,000 gross (120,500 net) acres in the Eagle Ford*
- *Holds half working interest in Black Hawk Field*

Privately owned GeoSouthern Energy Corp. revitalized its Eagle Ford activities in early 2012 when it announced a new $1 billion credit facility with the Blackstone financial group.

GeoSouthern had been working on its interest in Petrohawk's Black Hawk Field in DeWitt County under an arrangement in which Petrohawk operated the wells with a 66% interest through completion and then turn the well operations over to GeoSouthern.

Petrohawk drilled 29 wells on the property in 2010 and budgeted 85 additional wells in 2011 with seven rigs running by the end of the year.

BHP Billiton later bought Petrohawk for $15.1 billion, but the arrangement apparently remains in place.

In the deal with Blackstone, GeoSouthern plans to continue development of its 173,000 gross (120,500 net) acres in the condensate and oil windows in the Eagle Ford.

According to the company, most of the funds from the Blackstone agreement will fund and develop its half working interest in Black Hawk Field, currently a 105,000-gross-acre, 50-50 joint venture in DeWitt and Karnes counties. Some of the money will be used to develop the company's 100% position in 68,000 acres in Gonzales, Lavaca, and Fayette counties.

Goodrich Petroleum Corp.

- *Will spend 70% of its 2012 capex in the Eagle Ford*
- *Holds 54,744 gross acres of leases in the oil window of the play*

Goodrich Petroleum Corp., like many other oil and gas companies, set a capital program to increase its activity in the liquids area of Eagle Ford territory.

According to a June 2012 presentation, the company holds 54,744 gross (38,725 net) acres of leases in La Salle and Frio counties in the oil window of the play. That acreage contains 7% of the company's 501 Bcfe in proved reserves and 12% of its 7.05 Tcfe in proved, probable, and possible potential. In spite of that minor resource position, Goodrich will spend 70%, or $175 million, of its $250 million capex for 2012 in Eagle Ford country.

Its objectives are the Eagle Ford and Buda Lime where it holds an average 72.5 net working interest and a 56% net revenue interest.

If it continues drilling 6,000-ft laterals on 100-acre spacing, it has room for 550 gross (390 net) drilling locations.

To date, the company has completed 19 Eagle Ford wells for an average initial potential of 850 boe/d and nine Buda Lime wells for average initial potentials of $1,000 boe/d.

In June 2012, it had three rigs working the two counties to drill 32 gross (22 net) wells in 2012.

The company's economic profile illustrates its enthusiasm about the play. Using a mid-case type curve with well that offers an EUR of 475 Mboe


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with a 6,000-ft lateral, Goodrich expects a return of about 140% with a $90 oil price and a $7 million drilling and completion cost. If the drilling cost rises to $8 million, the return still comes in at almost 100%.

Halcón Resources Corp.

- *Entering Eagle Ford play with GeoResources acquisition*
- *Halcon exec Floyd C. Wilson was CEO of Petrohawk*

Halcón Resources Corp. made its move to enter the Eagle Ford Shale play when it announced it would acquire GeoResources Inc. and its properties in 3Q 2012 for $1 billion.

GeoResources is running two drilling rigs and plans to add a third in the second half of 2012 on its 24,000 net acres of land in southwestern Fayette and eastern Gonzales counties. It had nine producing wells, with four more awaiting completion and two wells being drilled when it put out its 1Q 2012 report. It completed six of those wells in the first quarter.

The company's 2012 program allows for 20 to 24 gross wells with a 45% working interest, with a back-to-back completion program on the next six to nine wells.

In an April 2012 presentation about the merger, Halcón said it will continue optimizing completions with potential for additional production from 80- and 120-acre spacing. It also has potential for Austin Chalk production.

Halcón outlined its expectations from the Eagle Ford, estimating a 33% rate of return on a well with a 325 Mboe EUR, a $100/bbl oil price, and an $8 million well cost. A $9 million well lowers the return to 24.7%.

The company said GeoResources' first three wells, with 3,200-ft to 5,900-ft laterals and 10 to 16 frac stages, using 40/70 white sand and slick water linear gels and crosslink frac fluid, did not reach the type curve because of embedment problems with the sand. The well tested for an average 302 b/d in the first 60 days online, compared with the estimated type curve of 328 b/d.

Six recent wells with 5,000-ft laterals and 20 frac stages using 20/40 and 30/50 resin-coated white sand with crosslink gel tested for 402 b/d.

GeoResources invested 16% of its $620 million budget in the Eagle Ford.

That company produced an average 106 boe/d from the formation during 2011, including 176 boe/d in 4Q. Production rose to 262 boe/d, 98% oil, in 1Q 2012. It reported proved reserves of 890 Mbbl, 349 MMcf, and 69 Mbbl of NGL for a total of 1.02 MMboe.

In addition to its Eagle Ford wells, GeoResources will turn over its first operated Austin Chalk well on its Eagle Ford acreage when the merger occurs. That well, the Rightmer #2HRE, in which the company held a half interest, averaged 339 boe/d in its first five days on production.

Halcón also holds approximately 150,000 net acres in East Texas prospective for the Woodbine and other formations. It signed a purchase and sale agreement with a consortium of private sellers to acquire operated interests in Woodbine properties, and more sellers joined the group to give Halcón 20,628 net acres and net production of approximately 2,800 boe/d. The company paid $300 million in cash and 20.7 million shares of common stock.

Halcón spudded the Covington 1H well in late May 2012 with the Woodbine, Austin Chalk, and Eagle Ford as prospective targets. It said results were encouraging.

The company currently runs three rigs in the Woodbine area and plans to spud 20 to 24 wells with an average 86% working interest and ramp up to four rigs in 4Q 2012.

Floyd C. Wilson, chairman, president, and CEO of Halcón, previously was CEO of Petrohawk, one of the earliest, largest, and most knowledgeable operators in the Eagle Ford play. Australia's BHP Billiton bought that company for $15 billion.

Hess Corp.

- *Has ended partnership with ZaZa Energy*
- *Turned over its Eagle Ford acres*

Hess Corp. held a 90% interest in 86,000 acres in the Eagle Ford play with ZaZa Energy as its 10% partner and operator, but the companies called off the partnership in mid-2012.

In the agreement terminating the partnership, Hess turned 60,500 Eagle Ford acres and other properties over to ZaZa along with an immediate payment of $15 million and another $70 million on finalization of the deal.

Hess also held interests in the Eaglebine (Eagle Ford/Woodbine) play in Texas.

In return, ZaZa agreed to hand over its shale-prone properties in the Paris Basin in France and pay Hess royalties from 1% to 2% on the contributed properties.

Hunt Oil Co.

- *Active in Eagle Ford, Bakken, and Marcellus plays*
- *Permitted horizontal well in Eagleville Field*

Hunt Oil Co. lists the Eagle Ford Shale play among areas in the US in which it holds significant land positions and conducts active programs. The other two are the Bakken Shale in North Dakota and the Marcellus Shale in Pennsylvania and West Virginia.

Although the privately held company does not publicly report land holdings or production figures, it does report drilling activities to state agencies.

Reporting from state records, IHS Inc. said the company permitted a horizontal Eagle Ford well in southern Wilson County in Eagleville Field. It permitted the 1H Wilson to 18,000 ft, including the horizontal lateral. It previously staked the 1H Ehlers to the north to the same depth.

Three quarters of a mile northeast of the 1H Wilson site, Hunt completed the 1H Niestroy in the Eagle Ford for 257 b/d of oil, 257 Mcf/d of gas, and 996 b/d of water from fractures between 9,992 ft and 13,952 ft.

In May 2012, the company was drilling the 2H Keller "B" almost a mile northwest of the 1H Niestroy. Hunt also operates the 1H Moczygemba and 1H Jarzombek in Eagleville Field, according to IHS.

JBL Energy Partners LLC

- *Has JV agreement with Terrace Energy LLC*
- *Is selling interest in some 23,000 acres of Woodbine leases*

JBL Energy Partners LLC assembled a substantial position in the Woodbine-Eagle Ford play and is expanding its operating flexibility through lease sales and joint venture agreements.

In June 2012, the company entered into a joint venture agreement with Terrace Energy LLC on one Woodbine prospect.

That agreement gave Terrace a 75% working interest in some 13,500 acres in one of JBL's horizontal Woodbine prospects for unstated cash contribution. JBL will keep a one-fourth interest in the property, and Terrace will carry JBL's costs on the first two wells on the property. The first well is scheduled to spud in 4Q 2012.

JBL estimated ultimate recoveries from horizontal Woodbine Sandstone wells at 300 Mbbl to 500 Mbbl of oil.

In a separate agreement, JBL and its partners signed a letter of intent to sell its interest in some 23,000 acres of Woodbine leases in Leon County, Texas, to an unnamed large independent E&P company.

JBL has assembled developing early-stage oil and gas properties in the East Texas Basin for more than a decade.

Laredo Energy LLC

- *Has drilled more than 400 wells in Webb and Zapata counties*
- *2012 focus is outside the Eagle Ford*

Laredo Energy LLC stamped a firm footprint in South Texas with a history of drilling more than 400 wells in Webb and Zapata counties and acquiring more than 500 wells in La Salle, McMullen, Webb, and Zapata counties.

Its executives have built, sold, and rebuilt the company and now puts its expertise to work on the fourth iteration of the company, founded in 2007. This version works the stacked plays on its 1348,000 gross (78,000 net) acres in Eagle Ford territory with equity support from EnCap Investments and Avista Capital Partners.

According to an October 2011 presentation, the company has two rigs working in Webb County and produces 50 MMcf/d of gas from a gross resource potential of 15 Tcf of gas with producing potential from the Eagle Ford, Austin Chalk, Escondido/Olmos, and San Miguel. The Pearsall Shale also has the potential to produce more than 5 Bcf per well. At that time, it had 25 horizontal Eagle Ford wells, eight horizontal Escondido wells, two horizontal Austin Chalk wells, and one vertical well in the San Miguel and Wilcox zones.

In a comparison of completions, the company said it could get a 22% rate of return at a natural gas price of $4.50/MMBtu from an Escondido well drilled to 6,500 ft vertically with a 5,000-ft lateral and eight to 10 fracture stages. That well would produce 3.6 Bcf at a capital cost of $5 million.

An Eagle Ford/Austin Chalk well would return 15% at the same gas price from an 11,000-ft-deep, 5,000-ft-lateral well with 12 to 14 fracs in the Eagle Ford and two to three fracs in the Austin Chalk. The well would produce 6.5 Bcf at a capital cost of $6.9 million.

"With the attractive economics of these shallower reservoirs, it make sense for us to develop those assets while maintaining our Eagle Ford acreage position in Webb County," said Glenn D. Hart, president and CEO.

Laredo currently runs two drilling rigs in the area with a 2012 focus outside the Eagle Ford on its 5,000 potential drilling locations.

Lewis Energy Group

- *Eagle Ford 'pioneer'*
- *Leading gas producer in the region*

Lewis Energy Group justifiably claims the title of the Eagle Ford Shale pioneer after drilling the first well specifically targeting the now popular formation in 2002.

The San Antonio company is much more than an Eagle Ford pioneer. With nearly 30 years of operations in South Texas, it is the leading gas producer in the region and has major production from the Wilcox, Escondido, Edwards, and Olmos zones, as well. Its operations still measure all the zones as it drills through potential pay down to the Pearsall Shale.

Lewis owns its own drilling rigs and runs its own completion crews, and it is still the most dominant drilling company in the Eagle Ford, according to the company website. That position includes most rigs, most acreage, and most drilling.

It currently operates more than 1,300 wells.

In 2010, it signed an agreement with BP for joint operations on 80,000 acres of Lewis leases, and Lewis operates that program with BP carrying Lewis on drilling and completion costs to earn its share.

That is only one segment of the company's operations on 430,000 net acres in South Texas and its 230,000 net acres with Eagle Ford potential. Most of its holdings are in La Salle, Dimmit, and Webb counties. By May 2011, the company produced 99 MMcf/d of gas from the dry zone of the Eagle Ford and planned to finish the year with 13 rigs turning to the right.

Recent activity, reported in April 2012 by IHS Inc., said the company permitted a horizontal Pearsall Shale test in northern Webb County to potentially extend Pearsall production from Indio Tanks Field. It scheduled the 29H Gates 07-DR Gas Unit "A" to 17,000 ft about 45 miles northwest of Laredo. That well also would test the Eagle Ford.

The nearest Pearsall well is about 10 miles to the northwest in Indio Tanks Field in southern Dimmit County. That field was opened in 2007 and had produced 6.3 Bcf of gas and 3.02 Mbbl of oil and condensate from 13 wells.

The company had a solid Eagle Ford program working in the area at that time with wells that included the 21H Gates 10-DR a quarter of a mile to the east in Hawkville Field. That well tested for 2.1 MMcf/d of gas and 139 b/d of condensate.

Lucas Energy Inc.

- *Joint ventures include Marathon*
- *Lucas retains small interests in Eagle Ford properties*

Lucas Energy Inc. is a small company that acts like a large company with high potential and ambitious plans.

The company's business plan called for it to acquire old wells on inexpensive land and put the properties back on production from both old and new producing formations with the help of joint ventures.

Lucas started its research in the Eagle Ford in 2008 and began acquiring properties. By 2010 it formed a joint venture with Hilcorp in Gonzales County and carried that venture to Marathon Oil when Marathon acquired Hilcorp's properties, according to a June 2012 presentation. It also signed a joint venture with Marathon in Wilson County. While the larger companies operated the properties, Lucas retained small interests.

By March 2012, Lucas had gross operated production of 535 b/d of oil, compared with an average 261 b/d for the full 2011 fiscal year.

It also signed smaller joint ventures. In a small venture it estimated 53.5 Mbo gross per new horizontal well, with a 25% working interest on a 75% net revenue interest lease, multiplied by $95/bbl to give the company $953,000 in net revenue per well, and multiplied by four new horizontal wells, for a total anticipated $3.8 million in net, before-tax revenue from small joint ventures. For Lucas, that translates to a $1.2 net revenue contribution in the 2013 fiscal year.

Its medium joint ventures anticipate 33,000 gross bbl per new lateral from old well bores with a 20% working interest on a 75% net revenue lease, again at $95/bbl for $470,250 in net revenue per new lateral, multiplied by two laterals a month with Lucas carried on costs to the tanks, and multiplied by seven months for a $6.6 million in revenue. That translates to a $2.2 contribution to 2013 net revenue.

On its large joint ventures, it expected 75,000 gross bbl per horizontal well, again with a 25% working interest on a 75% net revenue interest lease with $95 oil for $1.3 in net revenue per new horizontal well. It multiplied that by two wells per month with Lucas' costs carried to the tanks, multiplied by five months for $13 million in revenues ($6.5 million in contributions) to the 2013 fiscal year.

The company has operated and nonoperated working interests in 123,384 gross (5,893 net) acres, all in the oil window and most held by production in two Marathon Eagle Ford joint ventures in Atascosa, Gonzales, Karnes, and Wilson counties. The properties have an Eagle Ford potential of 12 MMbbl, the company said.

It owns most of the rights above the base of the Austin Chalk in Gonzales County but only 15% of the Eagle Ford and Buda.

Among recent wells, IHS Inc. said Lucas completed the Hagen Ranch No. 4H in Gonzales County in with a horizontal lateral in the Austin Chalk officially flowing 475 b/d and 232 Mcf/d of gas, but additional tested showed the well was capable of producing 846 b/d and 422 Mcf/d.

Lucas also holds 6,758 gross (3,756 net) acres of Eaglebine (Eagle Ford/Woodbine) properties in the eastern expansion of the Eagle Ford in Leon and Madison counties, with potential reserves of 8 MMbbl.

Marathon Oil Corp.

- *Plans to raise Eagle Ford rig count from 18 to 20*
- *Spending about $1.5 billion a year on the Eagle Ford*

Marathon Oil Corp. calls the Eagle Ford Shale the "premier US resource play" and backs up its opinion with growth in acreage, wells, and production.

According to the company's 1Q 2012 report, since its acquisition of Hilcorp in 4Q 2011, it has set up multiple agreements for an anticipated $767 million to add another 20,000 acres primarily in Karnes and Atascosa counties to its 305,000 net acres in the Eagle Ford Trend. That is a price of around $27,000 per undeveloped acre. A big part of those agreements announced in May was the company's agreement to acquire Paloma Partners II LLC. It expects to close on those additional properties in 3Q 2012.

Additional properties mean additional opportunity, and Marathon plans to raise its rig count from the current 18 to a new level of 20.

It sold 12 Mb/d of oil and 13 MMcf/d of gas in 1Q. At that point it was getting 24-hour initial production rates of approximately 1,100 boe/d on restricted chokes on its wells with 1,000 gas-oil ratios (GORs), and expected rates to improve as it moved farther into the condensate window.

In an April presentation, Marathon said it expected to spend approximately $1.5 billion a year

on the Eagle Ford to raise production to approximately 30 Mboe/d in 2012, 60 Mboe/d in 2013, 80 Mboe/d in 2014, 90 Mboe/d in 2015, and 100 Mboe/d in 2016.

That production will come from 300 low-GOR wells, 500 high-GOR wells, and 540 condensate wells. It will employ four frac crews through 2012 and anticipates drilling more than 220 wells in the Eagle Ford this year. At the same time, it will increase lateral lengths to 5,600 ft from 5,000 ft in 2011 and increase proppant concentrations by 25%.

Efficiency increases make up a big part of Marathon's plans for the play. It reduced spud-to-spud times on its rigs from 41 in November 2011 to 25 in May 2012. It also is testing 40-acre spacing with laterals 350 ft apart, 60-acre spacing with laterals 500 ft apart, and 80-acre spacing. It expects results from those tests in 2013. Pad drilling also reduces costs.

Throughout the property, Marathon has the potential to drill 2,200 to 4,400 gross wells to reach a net resource potential between 500 MMboe and 900 MMboe.

An aerial photo shows a well-laid-out drill site in the Eagle Ford play in South Texas. *(Photo courtesy of Marathon Oil Corp.)*

Matador Resources Co.

- *84% of capital budget will go into the Eagle Ford*
- *Will drill only 14% of its identified Eagle Ford locations in 2012*

Matador Resources Co. put its 2012 capital spending where it could earn the best returns. That is a good reason that 84% of that capital budget, or $257.2 million, will go into the Eagle Ford Shale.

Another 4%, or $11 million, will go into the Austin Chalk.

For that investment, Matador anticipates drilling 28 gross (25.5 net) wells in the Eagle Ford and two net wells in the Austin Chalk.

In spite of the aggressive program, the company will drill only 14% of its identified Eagle Ford locations in 2012.

Those formations played a big part in helping Matador show a 10-times increase in oil production between March 31, 2011, and the same date a year later. It produced 200 Mbbl in 1Q 2012.

Matador holds 49,700 gross (30,152 net) acres in the Eagle Ford fairway. Its east area includes properties in Gonzales, DeWitt, Karnes, Atascosa, and Wilson counties. Dimmit, La Salle, and Webb counties make up the west area. It also has property in Glasscock (Winn) Ranch Field in Zavala County and an interest in EOG-operated wells in Atascosa County. Approximately 90% of its acreage is in the oil and liquids window of the play. Matador is running one rig each in its east and west areas.

The properties also have potential for Buda and Pearsall production, and operators in Pearsall Field are looking at the transition zone between the Austin Chalk and Eagle Ford, which they call the Chalkleford.

In all, Matador holds 209 gross (169 net) drilling locations on 120-acre spacing.

It drilled five Eagle Ford wells in the west area in 1Q 2012, including its first test in Glasscock Ranch Field. It will drill two more wells, both Austin Chalk tests, before moving the rig to its Martin Ranch and Northcut properties in the west.

Modern Exploration Inc.

- *Specializes in South Texas*
- *Completed first horizontal Eagle Ford well in Gonzales County*

Modern Exploration racked up a string of successful wells in the Barnett Shale in North Texas, but the company specializes in South Texas where it has plenty of experience, a considerable geologic library, and an experienced team.

It carried its 2009 activities in the Barnett into the Eagle Ford with the first horizontal Eagle Ford well in Gonzales County, the 1 Texas Two Step, completed in January 2010 for 185 b/d of oil and 200 Mcf/d of gas, according to IHS Inc.

Since that time, the company has continued to drill, completing nine more Eagle Ford wells. The latest was the Brothers 5H, which was spudded in January 2012 and was completed as an oil well.

The company reported no dry holes in its Eagle Ford campaign, and all its wells were commercial oil producers, according to the company website.

Momentum Oil & Gas LLC

- *Bought South Texas properties from Newfield Exploration*
- *Acquired more than 5,000 net acres with interests in 60 gas wells*

Momentum Oil & Gas LLC, established in late 2010 with $50 million in equity from Kayne Anderson Energy Funds, bought its way into the stacked South Texas plays in June 2011 when it bought oil and gas properties from Newfield Exploration Co.

The acquisition gave Momentum more than 5,000 net acres with interests in 60 gas wells in Atascosa and Karnes counties. Those wells produced 3.8 MMcfe/d in mid-2011.

Momentum introduced a workover program to enhance output from existing wells and increased production from the field. It moved to a drilling program in 2012 with plans to drill three horizontal wells to the Edwards Formation.

Murphy Oil Corp.

- *Plans expansion of Eagle Ford Shale properties*
- *Holds approximately 216,000 net acres of Eagle Ford territory leases*

Murphy Oil Corp. taps oil and gas fields around the world to build its net income totals, but its prime property in the US is the Eagle Ford Shale, where it plans an aggressive expansion in 2012.

In a May 2012 presentation, the company said it had drilled 97 wells with 64 producing, and it planned to drill 164 wells and complete 133 wells during 2012.

It had two dedicated frac crews trying to keep up with the 10 working drilling rigs, and it planned to add two more rigs and another frac crew before year-end.

Murphy holds approximately 216,000 net acres of Eagle Ford territory leases in Karnes, Atascosa, McMullen, La Salle, Dimmit, Webb, and Bee counties.

The company said in its 2011 annual report it ended the year producing 3,200 b/d of oil and 3.3 MMcf/d of gas from the Eagle Ford and planned to finish 2012 producing 12, 000 b/d and 20 MMcf/d.

Its proved reserves in the play were calculated at 25.7 MMbbl and 38.2 Bcf of natural gas.

The company spent $219.7 million on development in the Eagle Ford in 2011 and had commitments for future costs of $124.5 million.

The company's total capital budget for E&P for 2012 is $3.32 billion, and $985 million of that will reach the Eagle Ford Shale program.

In May 2012, the company staked two new wells along the Atascosa-Live Oak County boundary line in Eagleville Field.

Newfield Exploration Co.

- *More than 250,000 net acres of leases in the Maverick Basin*
- *Will spend $115 million in the basin during 2012*

Newfield Exploration Co. started working onshore Texas in the mid-1990s and currently holds more than 250,000 net acres of leases in Maverick, Dimmit, and Zavala counties in the Maverick Basin. That land position is down from some 335,000 net acres in late 2011.

According to a June 2012 presentation, it will spend $115 million in the basin during the year as it keeps one rig busy full time.

In its 1Q 2012 report, the company's net daily production from the region rose to approximately 87 MMcfe/d. It drilled, completed, and started production from two of four planned super-extended laterals in the Eagle Ford during the quarter. Those wells with laterals of approximately 7,500 ft offered "encouraging results," the company said.

Newfield's 2011 annual report said the three South Texas counties contained 7% of its 2011 proved reserves and in 2012 would make up 10% of its production using 7% of its capital budget.

Its property is prospective not only for Eagle Ford, but also for the Pearsall, Austin Chalk, Georgetown, and Glen Rose formations.

Newfield permitted a horizontal Pearsall Shale well in February 2012 on its Dimmit County property as part of Pena Creek Field. The planned test was surrounded by producing wells in Briscoe Ranch, Pearsall, and Carrizo South fields.

Penn Virginia Corp.

- *Held 36,100 gross acres in Gonzales and Lavaca counties as of June 2012*
- *Budgeted capex of $300 million to $325 million, 89% going to the Eagle Ford*

Penn Virginia Corp. expanded its Eagle Ford activities as it followed a mid-2010 decision to shift its focus from dry gas to liquids.

In late 2011, the company held 13,900 net acres in Gonzales County. By June 2012, that position had expanded to 36,100 gross (24,900 net) acres in Gonzales and Lavaca counties. It was the operator in both counties with an 83% interest in Gonzales County and interests of at least 57% in an AMI in Lavaca County.

By year-end 2011, it had placed 47 wells on production, 44 in Gonzales County, and three in Lavaca County.

Overall, Penn Virginia budgeted capex of $300 million to $325 million, with 89% of that going to the Eagle Ford. In 2011, less than 30% of its capital budget reached South Texas.

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That investment should give the company 13.3 Bcf of gas for 2012.

Penn Virginia estimated its proved Eagle Ford reserves at 60 Bcfe (10 MMboe), with 200 well sites remaining. It added 120 well sites through downspacing. It also is testing results of downspacing on three-well pads.

Its best well to date was the Munson Ranch 1H, which showed an initial potential of 1,921 boe/d.

Its Gonzales County wells typically offer 400 Mboe in EUR, with initial potentials of 1,000 boe/d, and 30-day average production of 775 boe/d.

Lavaca County offers 500 Mboe wells with 1,100 boe/d initial potential and 850 boe/d over the first 30 days online.

The company started 2012 with three rigs working the play but cut back to two rigs in 2Q.

In addition to its Eagle Ford potential, Penn Virginia said it believed it had potential production from the Austin Chalk.

Peregrine Petroleum LLC

- *Operate in Bakken/Three Forks and South Texas*
- *Active in Eagle Ford and Pearsall shales*

Peregrine Petroleum LLC claims two areas of operations. It holds participating interests in the Bakken/Three Forks play in the Williston Basin of North Dakota, but in 2011, the company operated the Eagle Ford and Pearsall shale operations in South Texas.

In September 2011, it put out the word that it was looking for a buyer or joint venture partner on 50,958 net acres of leases in Dimmit and Maverick counties in the Eagle Ford trend.

The properties are 100% operated with working interests from 95% to 100% on most of the property. By that time, seven Eagle Ford laterals had been completed, and only two more wells were needed in 2012 to hold the entire acreage package.

The company did not release results of the offer, but it still lists the Eagle Ford and Pearsall shales as active plays on its website.

According to the September offering, the properties were divided among the 24,745-acre B-L-S area, the 21,729-acre Hamilton Ranch area, the 4,124-acre Carrizo Creek area, and the 360-acre Wilson-Boldt area.

IP rates on recently completed wells in September ranged from 240 b/d to 520 b/d with gas-oil ratios between 1,500 and more than 2 Mcf of gas per barrel of oil and gas content up to 1,500 Btu/cf.

The company estimated the properties contain up to 50 MMbbl per section, with an upside potential for more than 480 Eagle Ford well sites and 530 Pearsall locations on 80-acre spacing.

PetroQuest Energy Inc.

- *Holds 4,600 gross acres of leases in South Texas*
- *Has 12 Bcf of gas equivalent in proven reserves*

PetroQuest Energy Inc. put the drill bit to work as it began developing its 4,600 gross (2,300 net) acres of leases in South Texas.

The company controls 1,700 net acres in La Salle County and another 600 net acres in Dimmit County.

In 1Q 2012, it reached total depth on its PQ#4 Eagle Ford operated well, in which the company holds a 47% working interest and was rigging up on the PQ#5. The wells have lateral lengths of 6,112 ft and 6,280 ft, respectively, and the company planned to complete the wells in 2Q 2012.

Its PQ#1 tested for 263 boe/d, with 96% oil; the PQ2 for 363 boe/d, 94% oil; and the PQ3 for 543 boe/d, 82% oil.

Its TXA/PQ#1 tested for 725 boe/d, 70% oil, and the TXA/PQ#2 for 505 boe/d, 69% oil.

PetroQuest set a company-wide capex budget of $95 million to $100 million, and the Eagle Ford will get 10% of that allotment to drill two or three wells.

In a June 2012 presentation, the company said it had 12 Bcf of gas equivalent in proven reserves and 68 Bcf of gas equivalent in reserve potential at year-end 2011.

Pioneer Natural Resources Co.

- *Eagle Ford is one of four focus areas*
- *Has 120 proved undeveloped locations in the Eagle Ford*

Pioneer Natural Resources Co., the third most active driller in the US, counts the Eagle Ford Shale as one of its four prime focus areas, along with the Spraberry vertical play, the horizontal Wolfcamp Shale play, and the Barnett Shale Combo play.

In 2012 Pioneer plans to spend $130 million in the Eagle Ford, net of the carry provided by Reliance Industries. In 2010, the company sold 45% of its 310,000 developed and undeveloped Eagle Ford acres to Reliance Industries for $1.1 billion in cash and drilling carries. Pioneer operates the properties.

In a June 2012 investor presentation, Pioneer said 70 MMboe of its company-wide 1.1 Bboe of proved reserves lie in the Eagle Ford, where it has 120 proved undeveloped locations. Approximately 600 MMboe of its 4.2 Bboe in additional resource potential exists in the Eagle Ford. That provides approximately 1,700 additional locations.

Pioneer operated 12 of the industry's 241 active rigs in the play at the time of the June presentation, but it planned to raise its rig count to 14 in 2013, 16 in 2014, and 19 in 2015.

The company drilled 21 wells in 1Q 2012 and put 26 wells on production at a gross well cost between $7 million and $8 million. For that investment, the company expected a before-tax internal rate of return of around 70%.

It planned about 125 wells in 2012 with a focus on liquids, but it will drilled 15% of its wells to hold acreage in the dry gas area of the play.

Pioneer uses white sand as proppant in 50% of the wells it drills in the shallower area of the play – approximately 45 wells by mid-2012 – and those wells offer similar performance as its offset ceramic-proppant wells but at a $700 million saving in completion costs.

The company produced 12 Mboe/d in 2011 and plans to raise that number to between 25 Mboe/d and 29 Mboe/d in 2012, 37 Mboe/d to 41 Mboe/d in 2013, and 47 Mboe/d and 53 Mboe/d in 2014.

In addition to drilling rigs, it has two company-owned frac fleets and two coiled tubing units working the Eagle Ford.

The company also is building operations through its majority-owned EFS Midstream LLC to provide gas and liquids gathering, treating, and transportation services. It plans 14 central gathering plants and more than 700 miles of pipeline.

Plains Exploration & Production Co.

- *60,000 net acres of land in the play with 500 to 650 drilling locations*
- *Has Eagle Ford spending budget of $655 million in 2012*

Plains Exploration & Production Co. accelerated its Eagle Ford activity in 2012, calling it one of its prime onshore properties, along with its California assets.

The company said it held 60,000 net acres of land in the play with 500 to 650 drilling locations, a position that gives Plains some 172 MMboe in resource potential.

Under current plans, the company has a seven-year proven reserves-to-production ratio and a 52-year potential reserves-to-production ratio, according to a June 2012 presentation.

It planned Eagle Ford spending budgets of $655 million in 2012, $575 million in 2013, $602 million in 2014, $623 million in 2015, $427 million in 2016, and $200 million in 2017.

In return for that spending, the company anticipates production of around 23 Mboe/d in 2012, 29 Mboe/d in 2013, and production peaking at about 31 MMboe in 2014 and 2015. It expects a production decline to about 29 Mboe/d in 2016, 27 Mboe/d in 2017, and 24 Mboe/d in 2018. Production averaged a net

13,908 boe/d in 1Q 2012, up from an average 9,123 boe/d in 4Q 2011. Production averaged 15,154 boe/d during March 2012 and 19,000 boe/d in April 2012.

Plains will keep seven to nine rigs busy on its properties in the oil and gas condensate window of the Eagle Ford during 2012.

Among recently drilled wells, the Love 1H produced at a peak rate of 2,222 boe/d, gross, and the Love 2H reached a peak rate of 2,122 boe/d.

Reliance Industries Ltd.

- *Has JV arrangement with Pioneer in the Eagle Ford*
- *As operator Pioneer has 12 rigs in the play, increasing to 19 by 2015*

Reliance Industries Ltd., India's largest public company, broke into the Eagle Ford Shale play in mid-2010 through a joint venture arrangement with Pioneer Natural Resources after signing similar agreements with other companies in the Marcellus Shale. Results show those were good moves for Reliance.

A May 2012 report from Reliance in *The Financial Express* said the company made a profit of approximately $30 million from its shale activities in North America in 2011 and early 2012 in spite of low prices for natural gas.

The company's joint ventures with Chevron and Carrizo in the Marcellus Shale are more heavily weighted to gas than its oil-heavy joint venture with Pioneer Natural Resources in the Eagle Ford.

Through its Reliance Eagleford Upstream LP affiliate, the company bought 118,000 net acres, or 45%, of Pioneer's position in the Eagle Ford, for $1.315 billion in cash and operations carries for about four years. The venture partners hold a 91% working interest in 289,000 gross acres (263,000 net) acres.

In mid-2010, when the companies signed the agreement, Reliance said Pioneer believed the acreage would support more than 1,750 wells with a net resource potential of approximately Tcfe, 4.5 Tcfe net to Reliance. It also said the companies planned to drill approximately 140 wells a year within three years, and that Reliance planned to eventually operate some of the areas of the venture.

As current operator of the partnership, Pioneer said it had 120 proved undeveloped locations in the Eagle Ford and another 1,700 locations offering resource potential. In mid-2012, it operated 12 rigs in the play and planned to raise that count to 14 in 2013, 16 in 2014, and 19 in 2015.

It produced 12 Mboe/d in 2011 and planned to produce between 25 Mboe/d and 29 Mboe/d in 2012, 37 Mboe/d and 41 Mboe/d in 2013, and 47 Mboe/d and 53 Mboe/d in 2014.

The companies have properties in Atascosa, Bee, DeWitt, Karnes, La Salle, Lavaca, Live Oak, and McMullen counties.

Richland Resources Inc.

- *Formed Woodbine Acquisition Corp. affiliate*
- *Purchased Woodbine assets of Petromax Operating Co. in Madison, Brazos, and Grimes counties*

Richland Resources Inc. and its Woodbine Acquisition Corp. affiliate represent a strong combination in the Woodbine play.

Richland formed Woodbine to purchase the Woodbine assets of Petromax Operating Co. in Madison, Brazos, and Grimes counties in Texas for approximately $250 million. A Crimson Exploration Inc. release said Woodbine drilled a well that tested for 1,800 boe/d on land west of Crimson's properties.

The Veecy website for companies seeking funds for projects listed a proposal by Richland. The company was trying to raise slightly more than $14 million to drill two horizontal Woodbine wells in Leon County to vertical depths of 7,100 ft to 9,000 ft with 6,000-ft to 7,000-ft horizontal laterals on its Beeler lease.

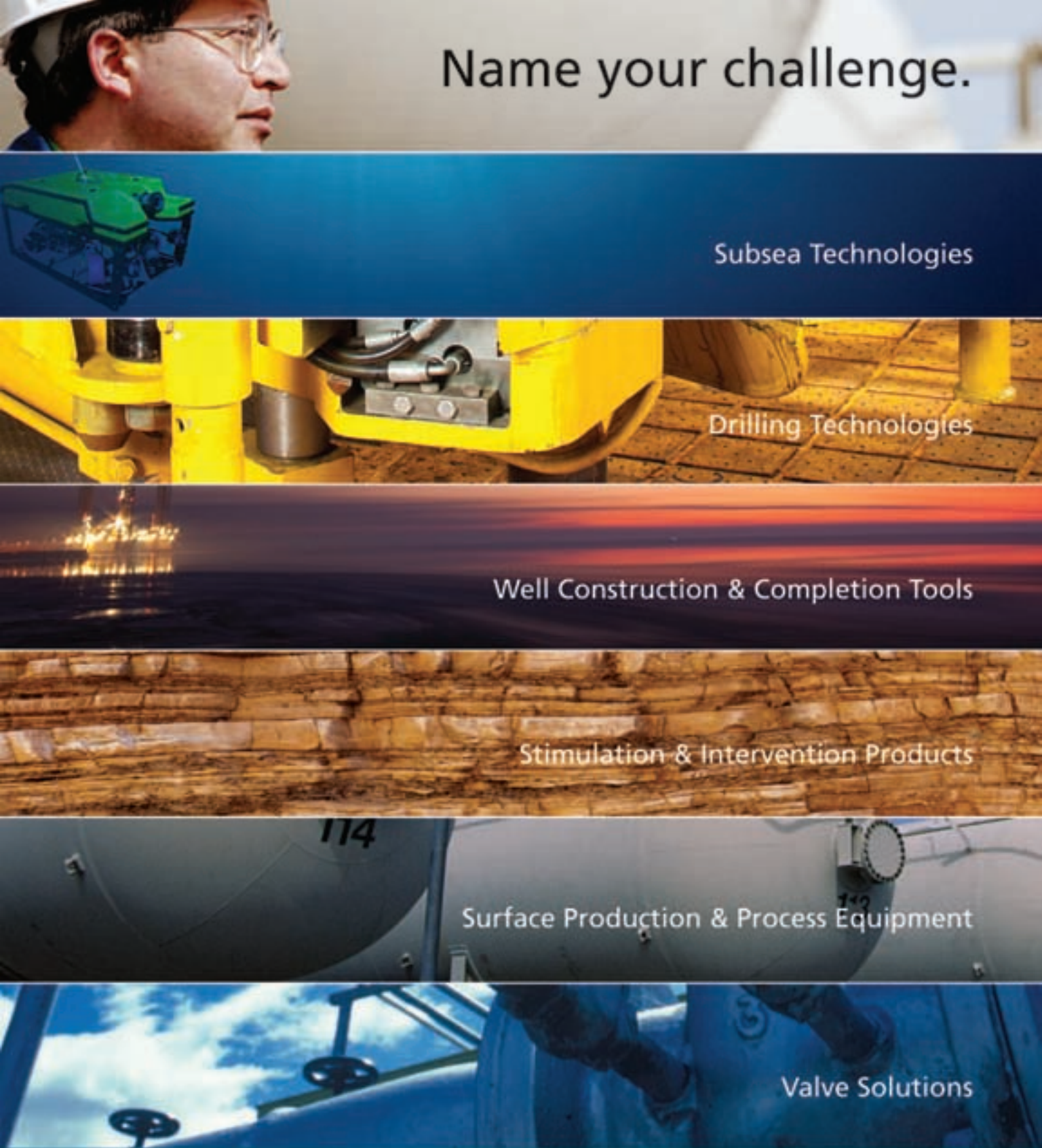
It had 1,360 acres in the lease and estimated reserves at 420 Mboe per well.

The company planned to drill two wells on the property in 2012, the first in March and April and the second in November and December.

Richland said it bought 17,600 gross acres and more than 3.5 Mb/d of production in the three counties in May 2011 under the Woodbine Acquisition name.

It also said it closed on two properties in 2012 that are prospective for the Woodbine and Buda formations.

IHS Inc. listed 12 completions in Madison and



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Brazos counties for Woodbine Acquisition Corp. in the past 12 months.

Rock Oil Co.

- *In 2012 formed Blue Eagle Energy LLC with Abraxas Petroleum Corp.*
- *Rock, Abraxas now plan to sell their Eagle Ford positions*

Rock Oil Co. joined Abraxas Petroleum Corp. in August 2010 to form Blue Eagle Energy LLC, a venture designed to work the Eagle Ford play in South Texas.

Rock put up $25 million for a half interest in the venture with plans to add another $50 million and take over a 75% share at that time. Now, both Abraxas and Rock plan to sell their positions in the play during 2012.

According to an Abraxas report in May 2011, the venture held 9,586 acres with 60 net unrisked drilling locations and four planned wells during the year. Abraxas, the operator, would be carried for $34 million in capital expenditures.

By May 2012, the companies had assembled 12,177 net acres under the Blue Eagle name and held 75 net unrisked locations on 160-acre spacing in Atascosa, DeWitt, Lavaca, and McMullen counties; Rock also had lowered the Abraxas share of the partnership to 34.7% by funding $47 million of its planned $75 million total contribution.

Blue Eagle planned one gross well (0.47 net) to Abraxas in 2012.

Rosetta Resources Inc.

- *In eighth place among Eagle Ford producers*
- *Holds 50,000 net acres in the liquids area of the play*

Rosetta Resources Inc. fuels its growth with Eagle Ford hydrocarbons. That growth put the company in eighth place among Eagle Ford producers and 5.3% of the formation's production in February 2012, according to a June 2012 presentation.

The company produced 30.4 Mboe/d from the Eagle Ford in 1Q 2012, or 90% of its total production. A fourth of that Eagle Ford production was in oil and another 31% in NGL. In the same quarter the previous year, it produced 14.9 Mboe/d.

Rosetta plans average production of 35 Mboe/d in 2012 with an exit rate around 40 Mboe/d.

To reach that goal, it will put 93% of its $640 million budgeted capex into the Eagle Ford to run four to five drilling rigs and complete 60 wells. It completed 12 of those wells in 1Q 2012.

The company holds 50,000 net acres in the liquids area of the play with 20 Tcfe in place. It has completed 71 horizontal wells in the liquids area, and it has another 628 potential drilling locations.

It controls another 15,000 net acres in the dry gas area of the play with 5 Tcfe in place. That land offers 171 potential locations and produced 300 boe/d at the end of 1Q 2012.

Its 2012 activities will focus on its Karnes Trough and Briscoe Ranch area.

The company's largest holding is its 26,500 net acres at Gates Ranch in Webb County, where it had 57 completions at year-end 2011 and 10 more at the end of 1Q 2012. It has 268 remaining locations and is testing tighter spacing.

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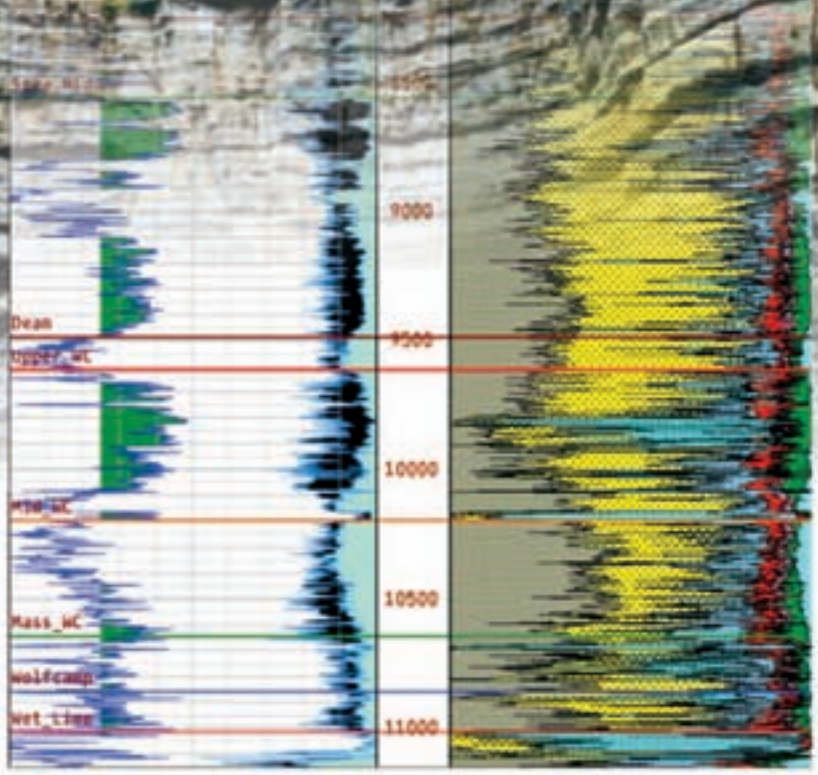

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The original drilling plan called for two 5,000-ft parallel laterals 850 ft apart, or 98-acre spacing on a 195-acre parcel. Now it is examining three parallel laterals 565 ft apart, or 65-acre spacing, and parallel laterals 425 ft apart. It drilled 21 wells on the original plan and will test six wells on the downspaced theme.

It is operating two rigs at Gates Ranch and three more at Briscoe Ranch, central Dimmit County, and the Karnes Trough areas. It also participated in 10 nonoperated wells in the Chupadera Ranch area in western Webb County and planned to test the Hanks area in La Salle County later in 2012.

Its Briscoe Ranch area contains 3,545 net acres with one completion by year-end 2011 and 47 well locations. Rosetta planned to drill on its first three-well pad in 2Q 2012 with full development lasting well into 2015.

It has 1,900 net acres in the Karnes Trough area in two fields, Klotzman in DeWitt County and Rielly in Gonzales County. It had one completion in the area at year-end 2011, two more completions and seven wells in progress in 1Q 2012, and 21 additional locations.

Rosetta had another 8,100 net acres in central Dimmit County, with two completions at year-end 2011, one well drilling in 1Q 2012, and two more planned in 2Q. It had 125 remaining locations.

Overall, the company said, it can drill 60 wells a year on its properties for another 13.3 years at a cost of $6.5 billion. At year-end 2011, it had completed 65 wells and had 799 remaining locations.

Royal Dutch Shell

- *Affiliate Shell Western E&P Inc. holds about 250,000 net acres*
- *Has active drilling program around the Maverick Basin*

Royal Dutch Shell affiliate Shell Western E&P Inc. holds approximately 250,000 net acres in the Eagle Ford, most of it obtained through its 2010 acquisition of East Resources.

The company maintains an active drilling program around the Maverick Basin. According to IHS Inc., Shell was drilling a deep vertical wildcat to 16,000 ft in northern Webb County in early May 2012. The company's E 1V Piloncillo Deep is about a mile south of the Dimmit County boundary line.

The well is about a mile west of Shell's E 2H Piloncillo in Briscoe Ranch Field. It drilled that well to a total depth of 14,860 ft and a true vertical depth of 8,802 ft. The company did not release completion details, but it has produced 249 MMcf of gas and 21,169 bbl of condensate from the Eagle Ford since August 2011.

Approximately 10 miles to the northeast of the new well, Shell permitted another vertical wildcat in southern Dimmit County. That well, the C 1V Piloncillo Deep, also is scheduled to 16,000 ft.

That permitted well is three-and-a-half miles north-northwest of the C 4H Piloncillo, another Briscoe Ranch horizontal well completed in the Eagle Ford. That well produced 6.8 MMcf of gas and 194 bbl of condensate in its first month on production.

Sanchez Energy Corp.

- *Holds 95,000 net acres in three areas of the Eagle Ford*
- *Allotted $136 million to $254 million to drill and complete 24 gross wells*

Sanchez Energy Corp. holds 95,000 net acres in three areas of the Eagle Ford Fairway and mounted an aggressive drilling campaign on its properties in 2012.

That acreage represents 800 to 1,200 net unrisked Eagle Ford drilling locations on 80-acre to 120-acre spacing.

The company calculated proved reserves at 15 MMboe on June 30, 2012, up from 6.7 MMboe at year-end 2011. Those reserves are 87% oil and 91% of the reserves are proved undeveloped. It estimated proved, probable, and possible reserves at 28.8 MMboe and resource potentials between 250 MMboe and 380 MMboe on 80-acre to 120-acre spacing.

Sanchez exited the second half of 2012 producing a net 1,200 boe/d. At that time, it had five wells awaiting completion. The company is targeting production between 4,000 boe/d and 5,000 boe/d for year-end 2012, according to a May 2012 presentation.

Overall, it allotted a capital budget between $136 million and $254 million to drill and complete 24 gross (17.5 net) wells on its leases, which also include potential for production from the Buda Lime and Austin Chalk.

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The company's Maverick area in Zavala and Frio counties covers 26,500 net acres with black oil potential. For 2012, it plans four net operated horizontal wells and one net operated vertical well at a cost between $22 million and $28 million. It holds 220 net unrisked drilling locations on 120-acre spacing and 330 locations on 80-acre spacing.

Sanchez holds 9,400 net acres in the black oil section of the Eagle Ford in Gonzales County, where it holds a half interest in 18,800 acres. Plans call for 13 gross (6.5 net) wells in that area at a cost of $52 million to $58 million. The area contains 75 net unrisked drilling locations on 120-acre spacing and 115 locations on 80-acre spacing.

The company's third operating area, Marquis covers 50,200 net acres in southwestern Fayette and northeastern Lavaca counties and another 6,300 net acres in Atascosa, Dewitt, and Webb counties. It plans six net operated wells in Marquis at a cost of $52 million to $58 million.

In May 2012, it had 10 producing wells in its properties in the fairway, eight producing from the Eagle Ford and two from combined completions in the Buda and Austin Chalk.

SM Energy Co.

- *196,000 net acres of operated properties in the rich-gas window*
- *At year-end 2011 had 483.6 Bcfe in proven reserves in the Eagle Ford*

SM Energy Co. draws production revenue from the Eagle Ford Shale from both operated and nonoperated properties.

It holds 196,000 net acres of operated properties in the rich-gas window. It also held a 27% share of a joint venture with Anadarko Petroleum in the oil/condensate and rich-gas windows, later selling 12.5% to Mitsui of Japan, leaving SM with a 14.5% interest in the nonoperated property. SM's costs will be carried in that 46,000-net-acre package for three or four years.

Anadarko ran 10 to 12 gross rigs on the acreage in 2011, and, even after the share transfer to Mitsui, SM's share of production rose 9% in 4Q 2011. The property produced 12.Mboe/d. The company anticipated a 10-rig drilling program on that property through 2012.

The company's operated properties include 65,000 net acres in Briscoe Ranch, 19,000 net acres in Apache Ranch, and 65,000 net acres in Galvan Ranch fields.

It plans to spend between $650 million and $700 million on those properties in 2012 to keep an average 5.5 rigs at work.

Those fields produced an average 178.3 MMcfe/d in 1Q 2012, down slightly from the previous quarter as SM shifted to pad drilling and experiences completion-related down time, the company said in a June presentation.

It anticipated participating in 95 operated wells and 300 gross nonoperated wells during 2012.

At year-end 2011, it had 483.6 Bcfe in proven reserves in the Eagle Ford.

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Statoil ASA

- *Acquired its Eagle Ford properties in 2010*
- *Partnered with Talisman Energy, Enduring Resources*

Norway's Statoil ASA acquired its Eagle Ford properties in 2010 in two separate purchases, first as a participant, but with the option to become an operator.

First, it partnered with Canada's Talisman Energy Inc. in a 50-50 venture to develop 37,000 Talisman acres. That gave the company its first 18,500 net acres at a cost of $180 million. The partners subsequently acquired 97,000 acres, or 48,500 acres net to Statoil, from Enduring Resources at a gross cost of $1.325 billion. The properties contained an estimated 550 Mboe to 650 MMboe in recoverable resource. Statoil still holds those 67,000 net acres.

Under the agreement, Talisman will operate the properties through the first three years of the partnership. After that, Statoil may choose to take over operations on half the acreage.

Strike Energy Ltd.

- *Has about 215 gross (60 net) well locations*
- *Property could yield 25 MMboe to 40 MMboe in net potential resources*

Strike Energy Ltd. of West Perth in western Australia started active operations in the Eagle Ford/Austin Chalk trend in 2012 as part of the Eagle Landing joint venture with Cypress E&P Corp.

Strike holds 27.5% of the joint venture, which collectively holds 34,793 gross (9,568 net to Strike) acres in Lavaca and Fayette counties.

The company has approximately 215 gross (60 net) well locations on the land with 160-acre spacing with potential for tighter spacing. The property could yield 25 MMboe to 40 MMboe in net potential resources.

The companies leased properties through June 2012 and started drilling the Bigham 1H well in mid-June. They planned to complete the well by the end of September and start a second well in mid-November, according to a Strike presentation in May 2012.

According to the company, the well will test both the Eagle Ford and Lower Austin Chalk with a 12,200-ft vertical hole and a 5,000-ft lateral. The companies may combine both zones for a Chalkleford completion.

Swift Energy Co.

- *Targeting liquids prospects in the Eagle Ford, Olmos*
- *Holds 78,000 net acres prospective for Eagle Ford production*

Swift Energy Co. focused its South Texas activity on the Eagle Ford and Olmos formation as it targeted its liquids prospects for maximum returns.

In a May 2012 presentation, the company said it held approximately 78,000 net acres of land prospective for Eagle Ford production, or 975 locations on 80-acre spacing with 6,000-ft laterals. That position gave the company multiyear potential drilling for oil, condensate, and gas, but it budgeted its 2012 through 2014 programs to reach its oil and condensate resources.

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Drilling Plans, 2012 to 2014						
	Approximate IP (boe/d)	% Liquids	2012 Projects	2013 Projects	2014 Projects	IRR %
Eagle Ford Oil (McMullen)	1,600	86	14 to16	12 to 16	28 to 32	97.7
Eagle Ford Oil (La Salle)	1,000	73	13 to 15	14 to 18	8 to 12	59.1
Olmos Oil (La Salle)	1,300	84	2 to 4	7 to 11	3 to 5	134.9
Eagle Ford Condensate (McMullen)	1,400	51	3 to 5	2 to 4	7 to 11	68.1
Eagle Ford Condensate (La Salle)	1,200	44	10 to 12	1 to 3	4 to 6	69.5
Olmos Condensate (McMullen)	1,500	34	2 to 4	4 to 8	5 to 9	51.2

Multiple targets offer high returns from Olmos and Eagle Ford properties in the Maverick Basin. *(Source: Swift Energy Co.)*

Those resources offer 7 Bcfe to 10 Bcfe per dry gas well and 380 Mboe to 1.125 MMboe per liquids-rich well, or 950 MMboe of resource potential.

In the Olmos tight sand, Swift has multiyear horizontal development potential for oil, condensate, and rich gas from 37,000 net properties in La Salle, Webb, and McMullen counties.

Those properties offer 230 locations on 160-acre spacing with 500 Mboe to 1.26 MMboe in EUG per well and a total resource potential of more than 200 MMboe.

The company planned to exit 2012 with a combined production of more than 25 Mboe/d from the two formations with approximately 17.5 Mboe/d of that coming from the Eagle Ford.

Swift plans to devote more than 95% of its 2012 drilling capital to oil and condensate-rich areas, and 57% of the total will go into the Eagle Ford.

That Eagle Ford money will fund four to five rigs in the play, two in the liquids-rich area of La Salle County.

In June 2012, Swift signed a long-term agreement with Eagle Ford Gathering LLC to lock up to 40 MMcf/d of firm gas gathering and processing services in La Salle County.

In its 1Q 2012 report to shareholders, the company said it drilled 17 operated development wells, nine of them horizontal wells, in the Eagle Ford. Those wells included two wells each in McMullen and Webb counties and five in La Salle County. It drilled six development wells in the Olmos in McMullen County.

It completed 12 operated wells and one nonoperated well. Those wells include five operated and one nonoperated Eagle Ford wells and three operated Olmos wells in McMullen County, three operated Eagle Ford wells in Webb County, and one operated Eagle Ford well in La Salle County.

Among those wells, the SMR JV EF 2H, in which Swift held a 52% interest, was completed in the Eagle Ford in McMullen County for 912 b/d of oil, 65 boe/d of NGL, and 500 Mcf/d of gas.

Talisman Energy Inc.

- *Has increased Eagle Ford spending budget by 65%*
- *12 rigs and two frac crews on 83,000 net acres*

Canada's Talisman Energy Inc. stepped on the accelerator in its Eagle Ford drilling and completion program in the Maverick Basin.

In a June 2012 presentation, the company said it increased its Eagle Ford spending budget by 65% and expected to grow production from 70 MMcfe/d at the beginning of the year to 100 MMcfe/d at year-end, or average production of 12 Mboe/d to 17 Mboe/d throughout the year. It averaged 76 MMcfe/d during 1Q 2012, up from an average 31 MMcfe/d for all of 2011 and 5 MMcfe/d the previous year.

The company is running 12 rigs and two dedicated frac crews on its 83,000 net acres in the play.

That position gives Talisman approximately 780 well locations with 3 Tcfe in contingent resources.

As the company increases investment and production, it also is improving efficiency. From an average 56

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days from spud-to-spud in the first half of 2011, Talisman plans to cut rig time to 37 days per well by 4Q 2012. In the same periods, it plans to lower per-well drilling and completion costs from approximately $11 million to approximately $8 million.

The company has a joint venture agreement with Statoil ASA on Eagle Ford properties. Talisman is the operator and Statoil has an option to take over half of the operations in December 2013. The companies plan to exploit the liquids-rich portion of their properties.

Terrace Energy Corp.

- *Has acquired South Texas properties, increased position*
- *Has options on developments in Dimmit, LaSalle counties*

Terrace Energy Corp. hit the South Texas ground running as it acquired properties and increased its position in the Maverick Basin in late 2011.

In November 2011, Terrace said its Terrace Cutlass LLC subsidiary signed an agreement giving it rights to earn an 18.75% net revenue interest in 3,395 net acres in Dimmit and La Salle counties in Texas from Lightning Oil Co.

Terrace agreed to pay 27.78% of all costs until the partners completed three wells. At that time, its contribution would drop to 25%. It estimated initial costs under the agreement at $2.2 million covering lease payments, prospect fees, and infrastructure costs on the 1,342 acres in Dimmit County plus its share of drilling costs on the first well in that county, planned for March 2012.

After that, Terrace kept an option to decide whether or not to participate on further Dimmit County development. If the companies decide to complete the well, Terrace committed to pay its share of drilling and completion costs on the second well for an estimated $1.9 million to earn its interest in the acreage.

After drilling and evaluating the first well in Dimmit County, Terrace can exercise its option of earning an 18.75 net revenue interest in the remaining 2,053 acres in La Salle County for approximately $3.75 million for existing costs and participation on two wells on that property.

Lightning will operate the project.

At the same time, Terrace said it agreed to buy all of Whittier Energy Co.'s interests in some 14,400 gross (3,875 net) acres of leases in La Salle and McMullen counties for $1 million. That purchase includes an average 26.88% working interest and an average 20.16 net revenue interest in the properties.

The company completed that acquisition in December 2011 through its Terrace STS LLC subsidiary.

At that time, the operator of the property proposed an initial test well, a reentry of a previous pilot hole that tested the Olmos, before year-end 2011 at a cost of $1.06 million to Terrace. The new test includes a horizontal lateral of at least 3,600 ft and a 12-stage frac treatment in the Olmos.

If the partners continue, the acreage can support up to 60 locations.

By May 2012, Terrace said it completed access roads, water wells, and drilling pad work for the West #1A well on its Cutlass project, moved a rig onto the site, and spudded the well. It planned to take the well to an 8,000-ft vertical and add a 4,500-ft lateral in the Eagle Ford.

The companies also completed construction of the pad for the East #1 well, their second well in La Salle County, scheduled for completion after the West #1A.

At that time, Terrace had a 30% working interest (22.5% net revenue interest) in the Cutlass Project, which has the potential for 28 drilling locations prospective for the Eagle Ford Shale.

The companies initiated the second phase of the STS Olmos Horizontal Development Project in McMullen and La Salle counties after successfully drilling the STS 1-667H. They already completed the first well in the program. After completing the new well, the partners will perform back-to-back completions.

Meanwhile, the first well gave the company a cash flow of more than 40% of its capex in the first 90 days online. Terrace holds a one-third working interest in those two wells.

Texon Petroleum Ltd.

- *Based in Australia*
- *Has drilled and completed four wells in the Maverick Basin*

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Texon Petroleum Ltd. of Brisbane, Australia, set its sights on the Olmos and Eagle Ford formations in the Maverick Basin on its path to profits.

By June 2012, the company said it had drilled and completed four wells in the play and planned to put its fifth well on production in July. That well, the Peeler EFS-1H, features a 4,200-ft lateral in the Eagle Ford Formation and a total measured depth of 14,795 ft.

Nearby, Texon's best well to date, the Tyler Ranch-2H, tested for 1,488 b/d of oil and 700 Mcf/d of gas. According to Texon, the well should produce between 550 Mboe and 600 Mboe.

Also in June, the company brought its First Mosman-Rockingham area Olmos well online. The company's Wheeler-1 started production at 193 b/d and 160 Mcf/d, comparable to Olmos wells in the company's former Leighton area.

The Mosman-Rockingham area covers 1,560 acres of leases with room for 30 wells on 40-acre spacing. Full development could produce up to 3 MMboe.

Texon sold its Leighton area Olmos properties to an unnamed US company for $12.4 million, before taxes.

The company has 6,300 gross (5,900 net) acres in the Eagle Ford trend in McMullen County. The property potentially could provide 70 drilling locations and 31 MMboe in resources.

US Enercorp Ltd.

- *Has more than two dozen wells in South Texas*
- *Conducting program in Frio County*

US Enercorp Ltd. operates more than two dozen wells in DeWitt, Duval, Frio, Goliad, Live Oak, McMullen, Willacy, and Zapata counties in South Texas.

According to a May 2012 IHS Inc. release, US Enercorp was conducting an Eagle Ford program in the Frio County, Briscoe Ranch Field area. It completed the 1H Rally Eagle in 2011 flowing 747 b/d of oil from perforations between 6,958 ft and 11,752 ft. That well produced 44,024 bbl and 53.4 MMcf since May 2011.

It also permitted the 1H Red Eagle to a vertical depth of 6,752 ft in the Eagle Ford.

Valence Operating Co. Inc.

- *Permitted one horizontal well in Atascosa County*
- *Plans two more horizontal wells*

Valence Operating Co. Inc. of Kingwood, Texas, permitted the 1H Jeanes horizontal well to 13,000 ft in southwestern Atascosa County along the Atascosa-McMullen county boundary.

The company plans to place the bottom more than a mile to the northwest, probably in the Eagle Ford Shale in Eagleville Field or a Pearsall Shale well in Indio Tanks Field, according to IHS Inc. In May 2012, the well had not yet been approved for drilling by the state.

The company also planned the 1H Murray a mile and a half to the southwest, also to 13,000 ft, and also possibly as an Eagle Ford or Pearsall well. That well has a surface location in Atascosa County and a bottomhole location in McMullen County.

A third well, the 1H Gann Festervan, also planned to bottom in McMullen County; a southeast offset to the 1H Murray was permitted in early April 2012, also to 13,000 ft.

With a surface location, the company also submitted a permit to drill the vertical 1 Festervan to 16,500 ft.

Venado Oil & Gas LLC

- *Formed by former Pioneer managers*
- *Funded by a $150 million from EnCap Investments*

Venado Oil & Gas LLC, formed in January 2011 by former senior managers of Pioneer Natural Resources and San Isidro Development and funded by a $150 million commitment from EnCap Investments LP, is finding pay in the northeastern portion of the Eagle Ford Shale.

IHS Inc. reported Venado finalized a horizontal Eagle Ford discovery well in Lee County seven miles north of Giddings, Texas.

The company's 1H Ball Unit tested for 357 b/d of oil and 105 Mcf of gas in January 2012 from acidized and fractured perforations between 8,159 ft and 12,540 ft. The well recovered 10.06 Mbbl of oil during its first two months online from a northwest lateral.

The nearest Eagle Ford producer in Giddings Field is nearly two miles to the east of the Venado well.

Venado also drilled the 2H Harrison Unit nearly 10 miles northwest of the 1H Ball. That well was permitted to 13,500 ft with a bottomhole location about a mile southeast of the surface location. It was aimed at the Austin Chalk or Eagle Ford.

That well offset Venado's 1V Harrison Unit, a well drilled vertically to 6,394 ft in January 2012.

ZaZa Energy Corp.

- *Seeking development partners*
- *Net Eagle Ford oil sales, 281 b/d; gas sales, 729 Mcf/d*

ZaZa Energy Corp. holds US assets in the Eagle Ford play in South Texas and the Eagle Ford/Woodbine (Eaglebine) play in East Texas, and it is looking for development partners.

The company signed a partnership agreement with Hess Corp. on the Eagle Ford properties, but the companies ended that agreement in June 2012.

At the shut-down of the agreement, ZaZa received $15 million and agreed to pay royalties to Hess. ZaZa will get another $70 million on signing of the final agreement, breaking up the partnership.

At the closing, ZaZa's interest in the Eagle Ford rose to 72,000 acres from 11,500 acres, including the 10,810 acres in the Moulton Prospect area in Gonzalez, Fayette, and Lavaca counties; 35,650 acres in the Sweet Home Prospect area in DeWitt and Lavaca counties; 1,970 acres in the Cotulla Prospect area in southern Frio County; and 23,120 acres in the Hackberry Prospect area in Lavaca and Colorado counties.

After termination of the agreement, ZaZa's net Eagle Ford oil sales will drop to 281 b/d from 301 b/d and gas sales will increase to 729 Mcf/d from 619 Mcf/d.

ZaZa also holds nearly 98,520 contiguous net acres in the Woodbine/ Eaglebine play in Grimes, Madison, and Walker counties in East Texas.

The company expects to operate five drilling rigs during 2012 to drill 33 operated wells and complete 28 wells.

ZaZa asked Jefferies & Co. to help it find new joint venture partners for its Eagle Ford properties and for its properties in the Eaglebine area. ■

Operational Efficiencies in the Eagle Ford Basin

Service companies continually meet operator demands with new equipment and technologies that include drilling rigs, drilling systems, bits and motors, stimulation modeling, and completion hardware.

By Jerry Greenberg
Contributing Editor

Helmerich & Payne's FlexRig 395 drills for BHP Billiton in the Eagle Ford. The operator has been converting its contracted land rig fleet in the Eagle Ford and other shale basins in which it is active from SCR rigs to A/C units. *(Photo courtesy of BHP Billiton)*

Efficient and economical oil E&P is important when prices are low but perhaps more important when prices are high. In both scenarios, operators need to drill quickly and safely with the most reliable equipment, at the surface and downhole. When it is time to stimulate the well, the operator chooses the quickest as well as the optimal techniques available.

A variety of solutions

Since acquiring Petrohawk in summer 2011, BHP has been investigating ways to increase rig, drilling, and completion performance and efficiency in the Eagle Ford and Haynesville shale plays, and in the Permian Basin. The company tested a variety of rotary steerable systems (RSS) in several of its Fayetteville, Haynesville, Eagle Ford, and Permian Basin wells with mixed results. It also is nearing the end of the process to convert its contracted land rig fleet from SCR rigs to A/C units, including about 26 rigs in the Eagle Ford as of mid-July. The newer A/C rigs are cost efficient in terms of controlling the drillstring, the feedback on drilling parameters is better, and the ability to monitor remotely is easier.

"We believe starting with good iron is the first real step to being efficient in [the drilling] process," said Nigel Smith, president of Development for BHP Billiton Petroleum. "We have been in this program of upgrading our rig fleet the past six to eight months, moving out the under-performing SCR rigs and moving in the newer A/C rigs."

BHP uses three primary drilling contractors, Helmerich & Payne, Nabors, and Patterson UTI, awarding them drilling contracts ranging from three to five years, trying to reach critical mass in each of its operating areas. For example, the six Patterson rigs are in the Permian Basin, most of the H&P rigs are in the Eagle Ford, and Nabors is BHP's big rig provider in the Haynesville. Reaching critical mass with rigs in a particular region provides several advantages to BHP such as continuity of crews. A rig worker can be trained as BHP prefers, move from one H&P rig to another when necessary, and be familiar with the next rig, Smith said.

"The number of H&P rigs we have in Eagle Ford warrants them having a senior manager overseeing the rigs," Smith explained. "We can talk with them about the supply chain, efficiencies in rig moves, and learn from experiences of the group of rigs to continuously improve our performance."

Downhole motors and bent subs

The operator typically drills its Eagle Ford Formation wells with a downhole motor and bent drilling sub, although it has examined the use of RSS as well as high-build rate RSS. In the Eagle Ford, at least, the company is sticking to its typical drilling method. "We think there is a great opportunity [for RSS] if we can drill the curve and lateral in one run," Smith said, "but they are cost prohibitive right now."

While the company would like to use RSS because of better hole cleaning and ROP, "the benefits are not quite there to compensate for the higher cost," Smith explained.

Schlumberger performs a HiWAY fracture stimulation job on one of BHP Billiton's Eagle Ford wells. *(Photo courtesy of BHP Billiton)*

BHP is looking at other, more reasonably priced similar technologies, he said, that offer comparable performance if not quite at the level of rotary systems. "They are getting pretty close," he added. "The question is, are they going to perform reliably.

"These advanced downhole drilling systems have promise so we are willing to experiment with them but they have to be controlled experiments," Smith continued. "We aren't going to run it everywhere, and we have to at least have the line of sight to being reliable and repeatable and cost advantageous to us.

"The advantage for us is we get to use it, test it, see it early on, and hopefully, if it works, we can replicate and adopt it. For the [service] company, they get an opportunity to use it in a well and learn from that with an operator who is interested in seeing it work," Smith said.

BHP presently drills its directional wells with a motor and bent sub, including curves planned with build rates up to 14°/100 ft. "Whatever the rotary steerable system, it has to significantly outperform the ROP achieved by motor drilling, yield predictable and repeatable results building curves, result in more lateral footage in zone, significantly reduce circulation times required to clean the hole, and the tool's [mean time between failure] must be extremely low for us to utilize such high-cost tools regularly on our wells," said Mike Bloom, the company's senior manager, Drilling and Completion.

"We look at three levels: financial, performance, and technical advantage," Bloom said. "When these levels are aligned by the right tool, BHP will give the service company an opportunity to try the tool and more than likely will offer more than one opportunity. If we can't see a marked improvement then motors are the way to go."

Streamlining completion techniques

In Eagle Ford wells, operators case and cement the complete lateral section and install plug and perf (PNP) completion systems. However, the service industry is seeking ways to efficiently use sliding sleeve completion systems. "One of the methods Eagle Ford operators have tried from a completion optimization standpoint is cemented sleeves, but

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Baker Hughes AutoTrak Curve high-build rate rotary steerable system features a new design steering unit to achieve high-build rates, and it has fewer components due to limiting LWD functionality. The system is available only with a Baker Hughes-designed drill bit. *(Photo courtesy of Baker Hughes)*

with mixed success," said Myron Protz, senior manager, Completions Engineering, for BHP.

The challenges include the Eagle Ford's high temperatures (300°F to 333°F) in which the tools have to operate and the debris left in the well bore from the casing running and cementing operations.

"With a cemented sleeve system we can eliminate the fracture preparation stage and save costs and time off the critical path of the well, but mainly costs," Protz continued. "The Eagle Ford team tried cemented sleeves at the toe of the well to initiate stimulation and then pump down perforating guns on wireline, but with mixed success as well.

"It's a tool design maturity issue," Protz said, "and one of the bigger factors is the debris mitigation has been a challenge for the tool companies.

"We are working with drillers to see if we can go with a monobore design versus a tapered string design, which will allow for a single size wiper plug versus a tapered wiper design that has been observed to have lower wiping efficiency," he continued. "There has been some limited success there so we are pursuing that because we want to enhance operational optimization, get past the critical path, and save come costs.

"The technologies are there," Protz said. "They are coming."

High-build rate RSS

Baker Hughes launched its AutoTrak Curve high-build rate RSS in March 2012. The RSS can drill up to about 15°/100-ft doglegs compared with about 12°/100 ft to 13°/100 ft with downhole motors and 7°/100 ft with conventional RSS. "The steering unit is a new design," said Svein Steen, Baker Hughes product line manager, Advanced Drilling Systems. "The principle is the same as our AutoTrak system. However, in order to achieve high-build rates, we have a new mechanical design, new hydraulic design, and new [steering] pad design as well."

To enable the high-build rates, the RSS uses expanding steering pads that push against the side of the well bore and deflect the bottomhole assembly (BHA) farther than the company's standard RSS. The steering pads are designed to work in formations from soft to very hard or brittle. The BHA is more flexible in order to manage the increased bending loads, which is aided by building the MWD unit into the flexible BHA.

"The need for [LWD] functionality in these BHAs is limited," Steen said, "so we didn't build in that compatibility in order to increase reliability on the system. The benefit is that the tool now has fewer components because it doesn't have to dock with LWD tools in the future."

The RSS is only available with a Baker Hughes-designed bit. "It is engineered to be optimized when combined with a Baker Hughes bit from the Talon design family," Steen said.

Directional control can be achieved with on-bottom downlink commands, which can be sent manually using rig pump controls or by using surface computers with an automated downlink system. The result is that an operator can land the bit into the target and potentially produce from an additional 750 ft of lateral reservoir compared with a typical RSS that delivers a dogleg severity of 5°/100 ft.

The company has drilled about 1,400,000 ft of hole with the high-build rate RSS between the start of field testing that began in July 2011 through the summer of 2012. This compares with three years to drill 1 million ft with its conventional AutoTrak RSS in the 1990s, Steen noted. "We have shaken out a lot of issues during the testing," he said. He added that developing a high-temperature AutoTrak Curve is on the company's agenda.

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Case history

An operator in the Eagle Ford Shale wanted to drill an 8½-in. hole consisting of vertical, curve, and lateral sections exceeding 10,400-ft total depth (TD). The curve required an 8°/100-ft build rate. The operator needed to drill the build and turn the profile while eliminating trips to change or adjust the BHA, and wanted to stay within a 50-ft lateral window. Baker Hughes recommended its 6¾-in. AutoTrak Curve RSS with Baker Hughes bit. The RSS allowed the operator to drill out the 9 -in. surface casing and drill from 2,631 ft to 13,188 ft in one run for a total of 10,462 ft in 116 total drilling hours, achieving an average on-bottom ROP of 90 ft/hr for the entire well. The RSS was able to kick off from the vertical well section and build to 88° inclination with an 8°/100-ft build rate. The RSS drilled the entire lateral section.

One BHA was used, saving two of the typically three BHA trips for changes and adjustments. The sections were drilled in six days, saving two days compared with the average for offset wells. The average spread cost for the rig was $40,000/day, saving the operator $80,000 in associated rig operating costs for the well.

Earlier this year, Halliburton launched its Geo-Pilot enhanced dogleg (EDL) high-build rate RSS for drilling up to 10°/100 ft in hole sizes 8½ in. and larger. It is offered for use mainly in areas where high-build rates are required or where soft formations typically limit build rate capability, according to the company. When drilling through interbedded formations, the RSS system can provide a more consistent build rate and help maintain higher ROP, the company said.

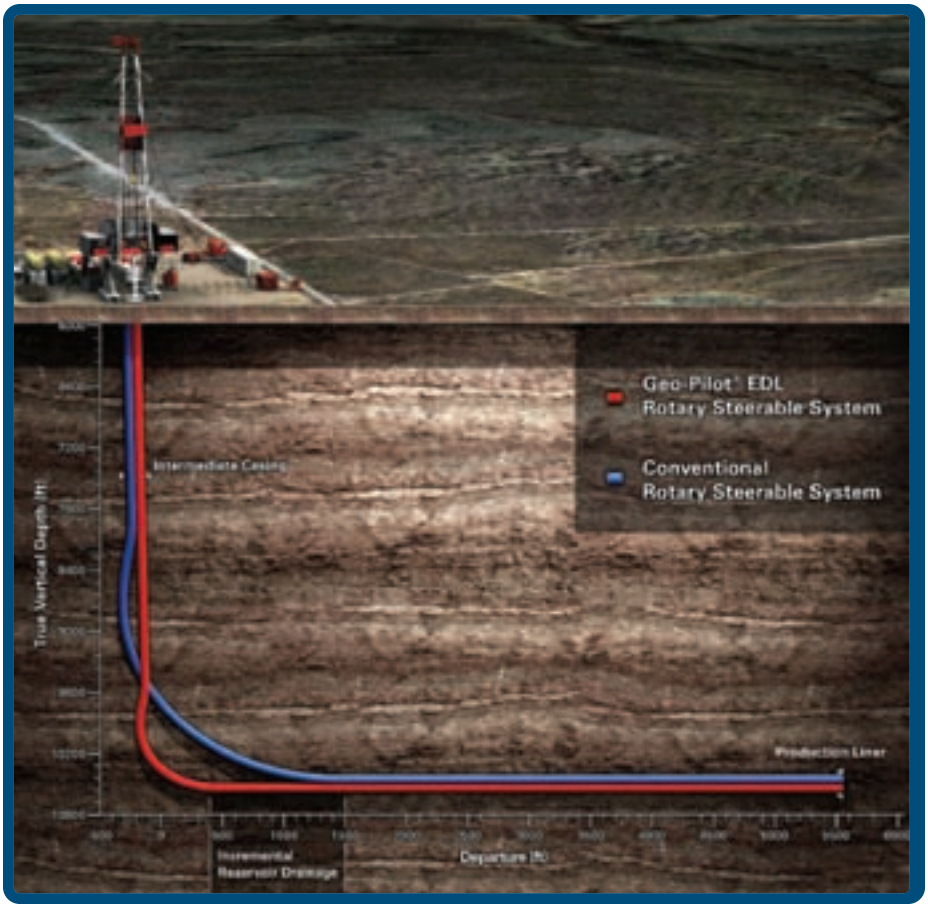
"Rotary steerables are used in about 10% of the wells drilled in the Eagle Ford today," said George Sutherland, marketing manager, Global Business Development, for Halliburton's Sperry Drilling business line. "Drilling motor technology is also improving with more torque and weight to bit, which is challenging the value proposition of rotary steerables.

"It depends on the formation but 10°/100 ft is the build rate for the 8½-in. tool," he said. "With the Geo-Pilot EDL 5200 series system we can get up to 15°/100 ft in a 6-in. hole size."

The company also offers its 7600 series for up to 10°/100 ft in 8-in. to 10-in. hole sizes and its 9600 series for hole sizes from 12 in. to 17½ in.

The company can use other manufacturer's drill bits with the RSS, however, "We find that when using [a Halliburton matched system] we maximize footage and reduce the cost per foot," Sutherland said.

When it comes to drilling performance, motors still deliver higher build rates than rotary steerables. "Doglegs in the Eagle Ford are still 8° to 10°/100 ft, but you can achieve as high



Halliburton's Geo-Pilot EDL high-build rate rotary steerable system can drill curves up to 10°/100 ft in hole sizes 8 ½-in. and larger and is offered for use mainly in areas where highbuild rates are required or where soft formations typically limit build rate capability. *(Image courtesy of Halliburton)*

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as 15° to 18°/100 ft in an 8½-in. hole with the appropriate motor configuration," Sutherland said.

He noted that the company's new XL motor technology is resulting in more robust equipment, including ruggedized bearing packs, stronger drive shafts, and shorter bit-to-bend distances that allow for higher build rates with less sliding. "The new XL and XLS motor technologies allow more weight on bit, deliver more torque to the bit, and offer better directional control," Sutherland said.

Drill bits

Since about 2008, operators in the Eagle Ford reservoir have drilled exploratory wells with a wide array of casing designs. "Operators were drilling either a 14¾-in. surface with a 9 -in. intermediate size and then they went to either 8½-in. or 8¾-in. production hole sizes," said Alan Huffstutler, South Texas Technology manager for Halliburton's Drill Bits and Services business line. "Some operators went to 6¾-in.for their curve and lateral."

Now that most operators are into the development phase, some involving pad drilling, the wells tend to be more standardized. "We are seeing a lot more operators going to 12¼ in. for surface and either 8½ in. or 8¾ in. for the rest of their production hole," he explained.

Huffstutler said that most operators have wanted to drill from surface casing to TD with one BHA and drill bit. However, he sees some operators moving away from that method in search of better drilling efficiency. "In some areas significant increases in ROP are being achieved using more aggressive bits from surface casing to curve kickoff point. Frequently, the temperature range of wells creates challenges and diminishes the life of motors, which can limit the success rate of drilling the entire interval with one BHA,"

he said. "PDC bits in these applications don't typically wear out so bit life doesn't limit the interval length. If you are drilling through the Wilcox and Olmos sands, you can destroy a PDC bit if you're drilling with energy levels that are too high, such as high RPM, but good drilling practices should be able to eliminate that."

Huffstutler is seeing some operators moving toward drilling the wells with two or three drillstrings, drilling from the surface pipe to the kickoff point, replacing the BHA and bit for the curve and lateral or sometimes using separate BHAs and bits for the curve and lateral.

"We are successfully designing bits for the vertical, curve, and lateral sections that not only drill as fast as possible but also include directional control capabilities required by directional drillers, such as toolface control and build rate capability," Huffstutler explained. "You can drill the curve and lateral sections with the same BHA and bit type separate from the vertical/tangent section. It allows us to optimize ROP in the vertical section or the tangent section using a much more aggressive bit."

The company uses its FXD55M bit in many Eagle Ford Basin wells to drill the entire production hole (vertical and lateral). However, using a dedicated BHA and bit for the vertical section has allowed the company to design and build more aggressive bits. "We have a new bit to drill the vertical section, a 5-blade 19-mm bit designated as the FX56RM, with which we set recent ROP records," Huffstutler said.

He said nearly all of industry can average about 150 ft/hour down to kickoff to the Austin Chalk but now the industry has bits that can drill 180 ft/hour, 250 ft/hour, and 280 ft/hour. "There are economics that justify drilling that fast and yet still pull pipe and change the BHA. And then the motor has a better chance of lasting to the end of the run," Huffstutler added.

Drill bit case histories

In one well in the Eagleville Field in Gonzales County, an operator was able to drill the entire 8,353-ft vertical section with an 8½-in. FX56RM bit at an average ROP of 172 ft/hr, the fastest among the direct offset runs for the operator in the field. The bit showed aggressive ROP while maintaining durability and was pulled out of the hole in excellent dull condition, according to the company.

In another Eagleville well in Atascosa County, an 8¾-in. FXD55M bit drilled the vertical, curve, and lateral, a total of 10,148 ft from 5,080-ft MD to 15,228-ft MD in a single BHA run at an overall average ROP of 66.1 ft/hr. The well was drilled in fewer than 12.5 days. The bit was pulled out of the hole in excellent dull condition. Two other FXD55M bits drilled even farther, with one drilling total footage of 11,363 ft at an average ROP of 97.5 ft/hr, and another drilling 11,470 ft at an average ROP of 88.9 ft/hr.

Freshwater drilling system

"Lost returns can be such a major issue in Buda wells that some operators will case off and displace to a brine-type system to control the mud weight better [than an oil-based system], and because it is more economical when compared to oil-based muds," said Scott Costner, Halliburton's Baroid Southern Region technical manager. "Brines are more readily available to operators."

The company formulated and tested a brine system that has been used in Wilson, Frio, Gonzales, and Karne counties where the surface section is drilled with water-based fluid and is displaced to a brine system to drill through the Escondido and Olmos formations and to the Eagle Ford Formation. Brine, however, has its drawbacks, chief of which is disposal. "Texas regulations limit the amount of chlorides that can be disposed to 3,000 milligrams per liter," Costner said. "A saturated brine is going to be 170,000 to 180,000 parts per million, so you can eliminate diesel and other costs switching to a brine system but you can't eliminate disposal costs."

The company tested freshwater systems and developed its SHALEDRIL water-based drilling system for unconventional shale reservoirs. Operators using the system have been able to reduce their overall drilling fluid costs as they see reductions in areas such as cuttings disposal and rig cleanup, according to the company, while they see advantages in wellbore stability, CO_2 tolerance, and fracture sealing.

"With the SHALEDRIL system concept we're asking operators to supply us with core and cuttings samples so we run them through x-ray diffraction to determine their mineralogy," Costner said. "We are attempting to match chemicals to specific mineralogy in an effort to provide inhibition and stabilization for specific counties, as the Eagle Ford varies from county to county and even within counties."

Escondido and Olmos wells still are drilled with oil-based fluids from top to bottom, according to Costner. When drilling though the Austin Chalk on the way to the Eagle Ford Formation, the company has been successful with different types of lost circulation materials in keeping losses minimized through the chalk.

Fracture stimulation systems

The type of completion systems used most often in the Eagle Ford Basin is horizontal cemented and cased hole, and the PNP systems. The nature of the reservoirs do not necessarily dictate the cased hole completions, however. Texas is extremely particular about how zonal isolation is achieved, which has led most operators toward cemented completions.

"On a technical basis, the Eagle Ford is less naturally fractured than some of the other reservoirs that are openhole isolated completions," said Bill Melton, sales manager, Completions, for Halliburton. "It does benefit having set entry points that perforations or some jetting of entry provides."

According to Melton, the first few wells drilled in the Olmos reservoir were openhole isolated completions, but operators moved away from that method to cemented PNP design. The Buda reservoir just below the Eagle Ford generally is more of an openhole completion formation and some operators are running just a slotted liner and pumping acid into the well, Melton added.

"In 2010 operators were stimulating 12 to 14 stages on average," he said. "Last year it was probably 15 to 16 stages and this year we are seeing 18 to 20 stages. We have customers that are talking about 30 stages in the lateral. Most operators are not extending the lateral length but finding there is

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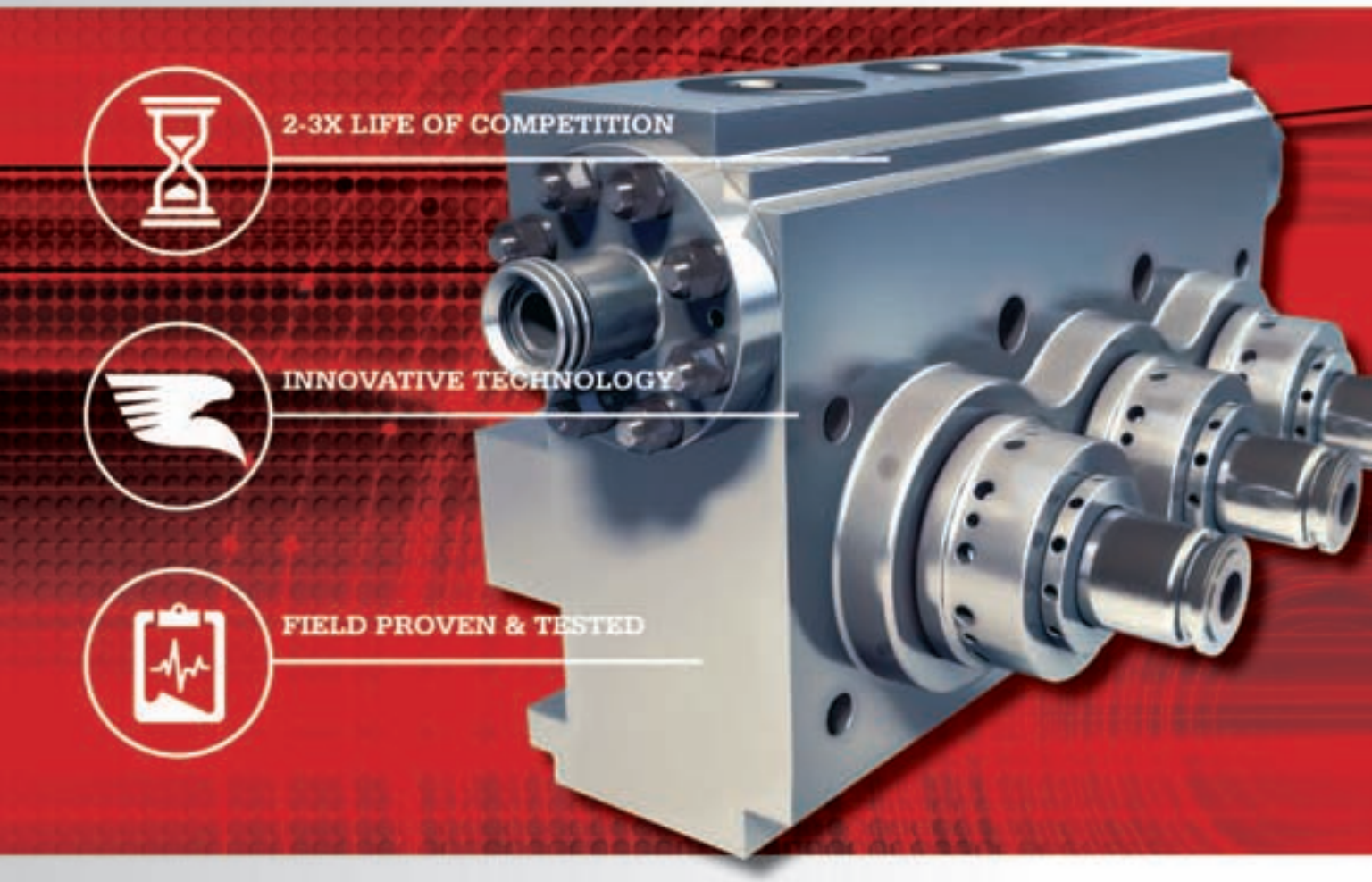

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TheRapidStart Initiator sleeve can be run in cemented or uncemented applications in horizontal and vertical wells as the first stage zone in a frac sleeve completion system such as the company's RapidStage or RapidFrac completion systems, or more popularly to enable more efficient plug and perf operations. *(Image courtesy of Halliburton)*

more value in touching more of the rock. They are not greatly increasing the amount of proppant being pumped, either."

The RapidStart Initiator sleeve is one of Halliburton's tools that has been gaining momentum in the Eagle Ford reservoir. "Operators have been moving away from running tubing conveyed perforating [TCP] systems for their first toe stage," Melton said. "Six to eight months ago I would say that this type of toe initiating was used in probably less than 10% of the wells, but in the past six months it is probably used in 30% to 35% of the wells."

The initiator sleeve can be run in cemented or uncemented applications in horizontal and vertical wells. It can be used as the first-stage zone in a frac sleeve completion system such as the company's RapidStage or RapidFrac completion systems, or more popularly to enable more efficient PNP operations.

The company's AccessFrac fracturing service typically incorporates one or more of the following: a chemical diverter system; a proppant coating technology; a polymer alloy proppant; and a special fluid and treatment design and pumping schedule. The services are appropriate for low-permeability formations, especially shales.

The particular service used in the Eagle Ford is the AccessFrac PD service, which is designed to improve proppant distribution in multizone completions and ensuring all perforation clusters are treated. The service addresses two challenges facing operators when producing from tight formations: rapid production declines following fracture treatments, and uneven proppant distribution in PNP operations due to most of the proppant going into the fractures nearest the downhole plug.

Case history

AccessFrac PD service saved a well and cut completion time in half. An Eagle Ford well had a cased 4,000-ft horizontal section. When the completion phase began, the operator was unable to insert isolation plugs through the heel section of the lateral. A caliper log indicated the casing had been narrowed, most likely due to tectonic movement. The well bore was perforated by using a smaller-than-normal TCP system; however, because isolation plugs could not be inserted, the operator faced the possibility of plugging and abandoning the well if another completion technique was not available.

AccessFrac PD service was used to provide isolation between individual fracturing stages. During the course of 21 hours of continuous pumping, 13 frac stages were placed along the lateral, treating a total of 780 perforations. Plug setting and drillout time was eliminated, resulting in completion time being reduced by over 50%. Production from the well is equal to production from offset wells.

Long-term flow-channel productivity

The first job for the Schlumberger HiWAY flow-channel hydraulic fracturing service was pumped in 2010 for Petrohawk in the Hawkville Field. The results from that well, and hundreds of subsequent wells completed in the Eagle Ford, have proven significantly higher initial production results while reducing water and proppant requirements, according to the company.


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The Eagle Ford Shale has generally been stimulated using multistage horizontal completions with high-rate slickwater treatments requiring millions of gallons of water and millions of pounds of proppant per well. The ongoing expansion of fracturing activity in the Eagle Ford constrains the availability of water and proppant.

Case history

According to a case study on the company website, one operator evaluated the flow-channel hydraulic fracturing service for the stimulation of wells in a four-well study in the Eagleville Field. Two wells were stimulated with the flow-channel hydraulic fracturing service; the other two wells were stimulated simultaneously with the conventional method. The wells treated with the service had been drilled from a single pad, in opposite directions. The other two wells had also been drilled in opposite directions from a single pad located 3,500 ft away and parallel to the first two wells. The average lateral length for each pair of wells differed by only 1%.

During the first 60 days after stimulation, the wells treated with the flow-channel service produced an average of 26,535 bbl of condensate with 30.1 MMcf of associated gas. The wells treated conventionally produced an average of 18,555 bbl of condensate with 18.7 MMcf of associated gas. The average wellhead flowing pressure for the wells treated with the HiWAY service was 2,156 psi versus 1,916 psi for the conventional wells. The flow-channel service increased condensate and gas production by 43% and 61%, respectively, while delivering higher flowing pressures. These results were obtained while reducing the amount of water and proppant used per well by 58% and 35%, respectively. The operator saved more than 10,000,000 gal of water and 2,600,000 lb of proppant in the two wells stimulated with the flow-channel fracturing method.

Now, after about two years since the first flow-channel stimulation service was used in Eagle Ford, the company says that operators are experiencing signifi-

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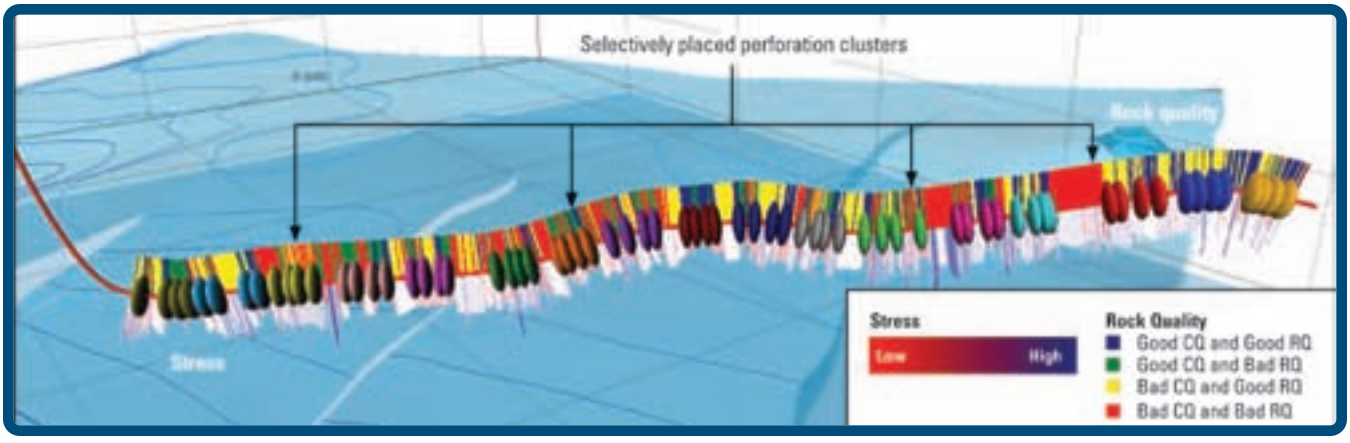

The Mangrove software creates engineered completion design with selectively placed perforation clusters using *in situ* stress, reservoir quality (RQ), and completion quality (CQ). *(Image courtesy of Schlumberger)*

cantly improved long-term production rates in addition to higher initial flow rates. "The decline rate in HiWAY wells is not as steep as in conventional wells," said Alejandro Peña, Schlumberger portfolio manager, Well Production Services Chemistry and Materials. "That is leading to the growing differential in productivity over time."

In a public 50-well study by Petrohawk (now BHP), average cumulative production after 90 days from 12 flow channel-stimulated wells in the Hawkville Field was 32% higher than eight wells stimulated with conventional hybrid fluid systems and 67% higher than 30 wells stimulated with conventional slickwater systems. After 250 days, average cumulative production from 12 flow channel-stimulated wells was 37% higher than the wells stimulated with conventional hybrid fluid systems and 87% higher than the wells stimulated with conventional slickwater systems. The wells stimulated with the flow-channel service used significantly less fracture fluids and proppant than the wells stimulated with the other methods.

"With a more subtle decline rate in production, the operator can increase estimated ultimate recovery and extend the time necessary to return to the well and invest to restimulate the well," Peña said.

Since the company performed its first Eagle Ford flow-channel stimulation in October 2010 to June 2012, 260 wells equaling 4,200 stages were stimulated with the flow-channel method with zero screenouts and significant savings in water and proppant, reducing the environmental footprint. From the company's figures, 300,000 tons of conventional proppant were saved as was 4 million bbl of water. In the Eagle Ford Basin, the flow-channel hydraulic fracturing service resulted in about 23,000 water and proppant truck trips avoided with 230,000 gal of diesel fuel saved, according to the company.

"The HiWAY service requires about 40% less proppant than a conventional fracturing treatment," Peña said, "and in many cases about 25% less water on average. Using less water also leads to less wastewater that must be handled at the surface."

The company continues to expand the flow-channel stimulation method's capabilities, including using its Mangrove reservoir-centric stimulation design software for unconventional wells to design HiWAY-stimulated wells. The company has extended its pump rates from 50 to 60 bbl/min to 90 bbl/min "as we seek further proppant placement in the formation," Peña said.

Hydraulic fracture design

The Schlumberger Mangrove reservoir-centric stimulation design software is a plug-in for its Petrel E&P software platform that integrates fit-for-purpose hydraulic fracture models and specialized completion algorithms with measurements relevant for unconventional reservoirs. The software enables an integrated workflow that is rooted in reservoir characterization to comprehend the unconventional reservoir heterogenity. The completion and stimulation models can be calibrated using microseismic measurements in the context of local geology and struc-

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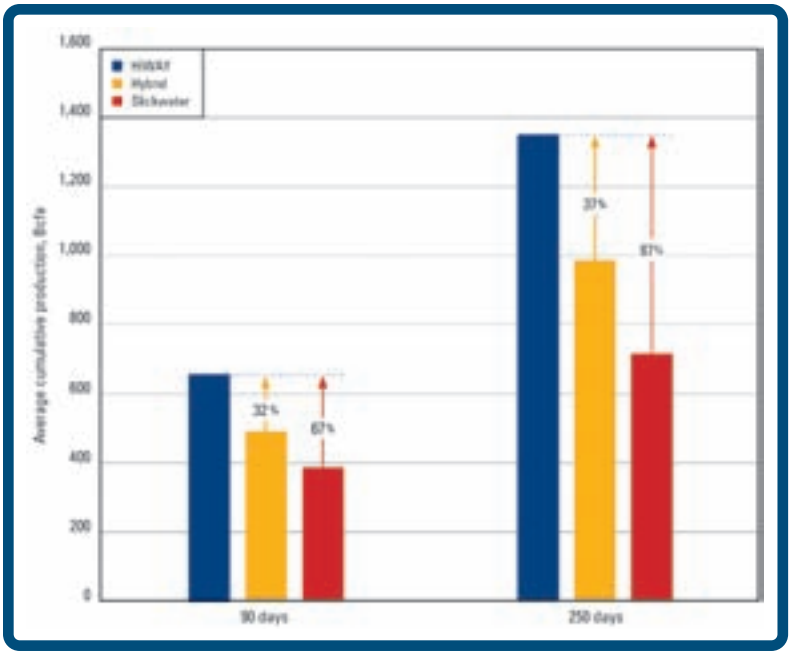
	Basic completion data (Average per well)				KPIs - 90 days			KPIs - 250 days			
Fracturing technique	Lateral length, ft	Frac fluid, Mbbl	Proppant, Mlbm	Average cum. production, MMcfe	Production/ 1000 ft Lateral	Production/ Mbbl Frac Fluid	Production/ Mlbm proppant	Average cum. production, MMcfe	Production/ 1000 ft Lateral	Production/ Mbbl Frac Fluid	Production/ Mlbm proppant
HiWAY (12 wells)	5,755	87	3,668	659	115	7.6	0.18	1,341	233	15.4	0.37
Hybrid (8 wells)	5,382	99	5,470	497	92	5.0	0.09	979	182	9.9	0.18
Slickwater (30 wells)	4,403	176	3,890	392	89	2.2	0.10	717	163	4.1	0.18

The 90-day and 250-day average performance of wells stimulated with HiWAY are compared with hybrid and slickwater systems in the Eagle Ford reservoir.



The average cumulative production of HiWAY stimulated wells is compared with hybrid and slickwater stimulation methods in the Eagle Ford reservoir. *(Images courtesy of Schlumberger)*

ture. The calibrated model then is represented in a production model for forecasting and optimization. Field production data is used to calibrate the production model.

"The fundamental gap we had in the past is that the data we gathered from measurements, core and prior treatments never had the opportunity to be converted into information," said Utpal Ganguly, Schlumberger's Global Stimulation Software portfolio manager. "This was a result of the absence of designing and modeling capabilities in the industry for unconventional reservoirs.

"The challenge was how to pull all of the information together in one platform to enable a step-by-step workflow to increase production and ultimate recovery while minimizing cost," Ganguly explained. "An operator can have an optimal number of perforation clusters, fewer stages if the right spot to frac is determined, and the right size job rather than going for the biggest job possible."

The software also can work efficiently if an operator does not want to change the number of stages. In one example in the Eagle Ford reservoir, an operator wanted to pick the perforations at the best spots and keep the initial number of stages, yet gain improvement in production. "We were constrained by having to maintain the same number of stages," Ganguly said. "We applied the Mangrove workflow to pick the sweet spots for perforating."

The software's workflow was applied to three new wells. Compared with six offset wells completed with conventional geometric staging, the operator saw a 33% increase in the three-month average cumulative barrels of oil equivalent production in the wells using the process.

"Based on a study of more than 100 wells in different shale plays over a period of time, we have learned that only about one-third of the perforation is contributing to 70% of the production, and that is happening because we are not contacting the sweet spots with the geometric staging technique that is widely used in the industry," said Ganguly. "One of the key elements of Mangrove is the completion advisor that provides an optimal way of placing the perforation and grouping them in a stage."

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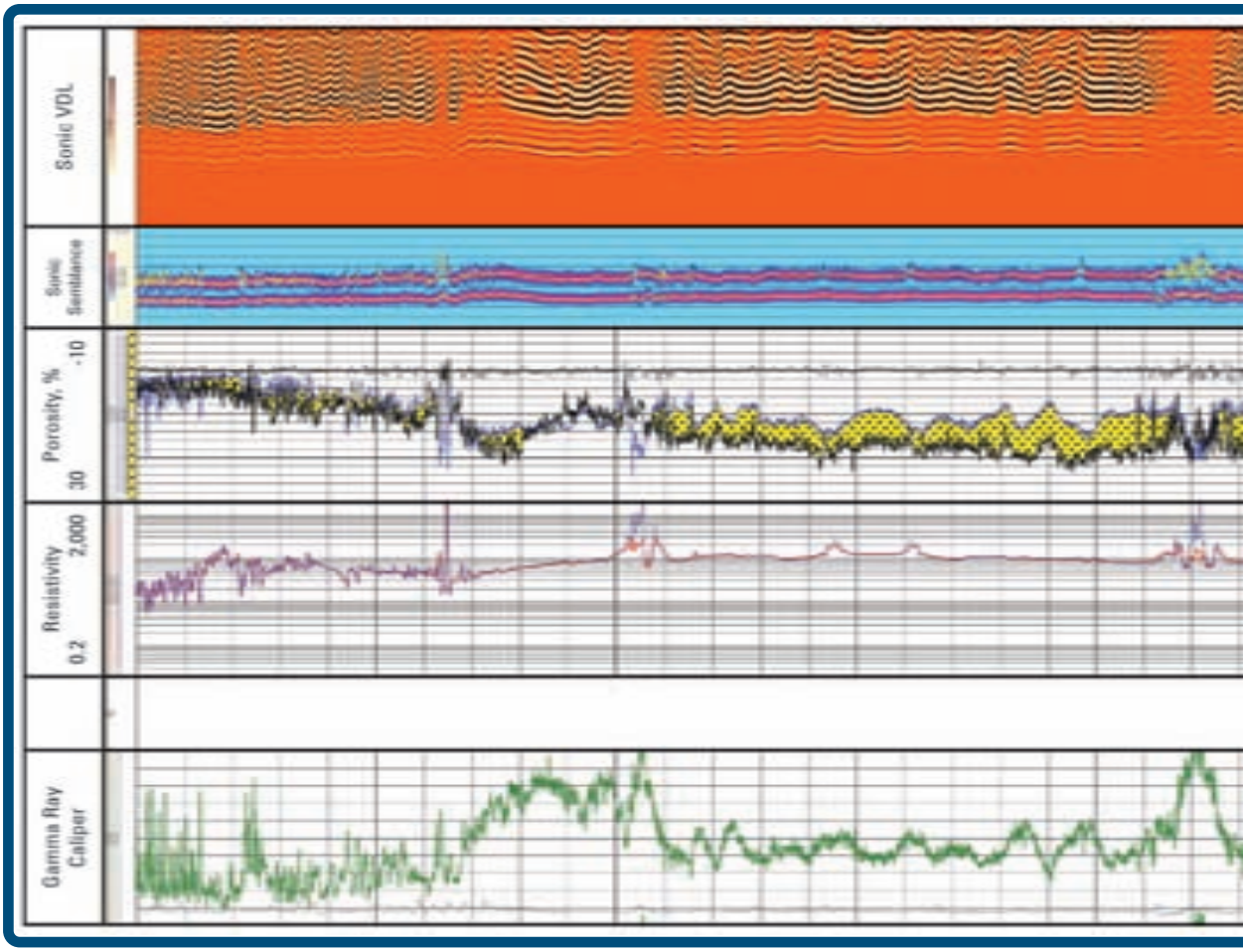
The completion advisor provides automated workflows for specific well orientation and has separate advisors for tight sands and shale respectively. Both advisors have been validated with improved production for the operators and minimizing the completion cost by reducing the number of treatments required, according to the company.

The Mangrove software provides rigorous and repeatable solutions for optimizing staging and perforation design, the company said. The staging algorithms are linked to fit-for-purpose hydraulic fracture models ranging from Pseudo3D to newly developed complex fracture models, the UFM unconventional fracture model and Wiremesh. The complex fracture models are specifically developed for simulating non-planar complex fractures applicable in naturally fractured reservoirs as is common in shale.

ThruBit, a company recently acquired by Schlumberger, specializes in logging horizontal wells with a specially designed set of slimhole logging tools that are conveyed through drillpipe and the ThruBit Portal Bit. Logging measurements for openhole include resistivity, density and neutron porosities, gamma ray, caliper, and compressional and shear wave sonic. These data can aid in the completion design and provide a better way to see variation in rock properties beyond what can be obtained with MWD-Gamma Ray curve from the directional driller, according to the company.

In the Eagle Ford, some operators are seeing variations in production from adjacent horizontal wells in the same vicinity. These inconsistent production results indicate the need for more data to better understand changes in rock quality and to better tailor completion strategies. The ThruBit system fills the data gaps and provides critical inputs for the Mangrove software to further enhance stimulation and completion design.



Schlumberger's ThruBit recorded this suite of openhole logs in a horizontal Eagle Ford well in South Texas, with the SureLog tools conveyed through the drillpipe and Portal Bit. The section shown traverses approximately 5,000 ft and shows considerable variation in rock properties along its length. This data was used to compute a rock stress profile, which along with the reservoir data, determined the placement of the stages in the stimulation design. *(Image courtesy of Schlumberger)*

Zone-specific customized treatments

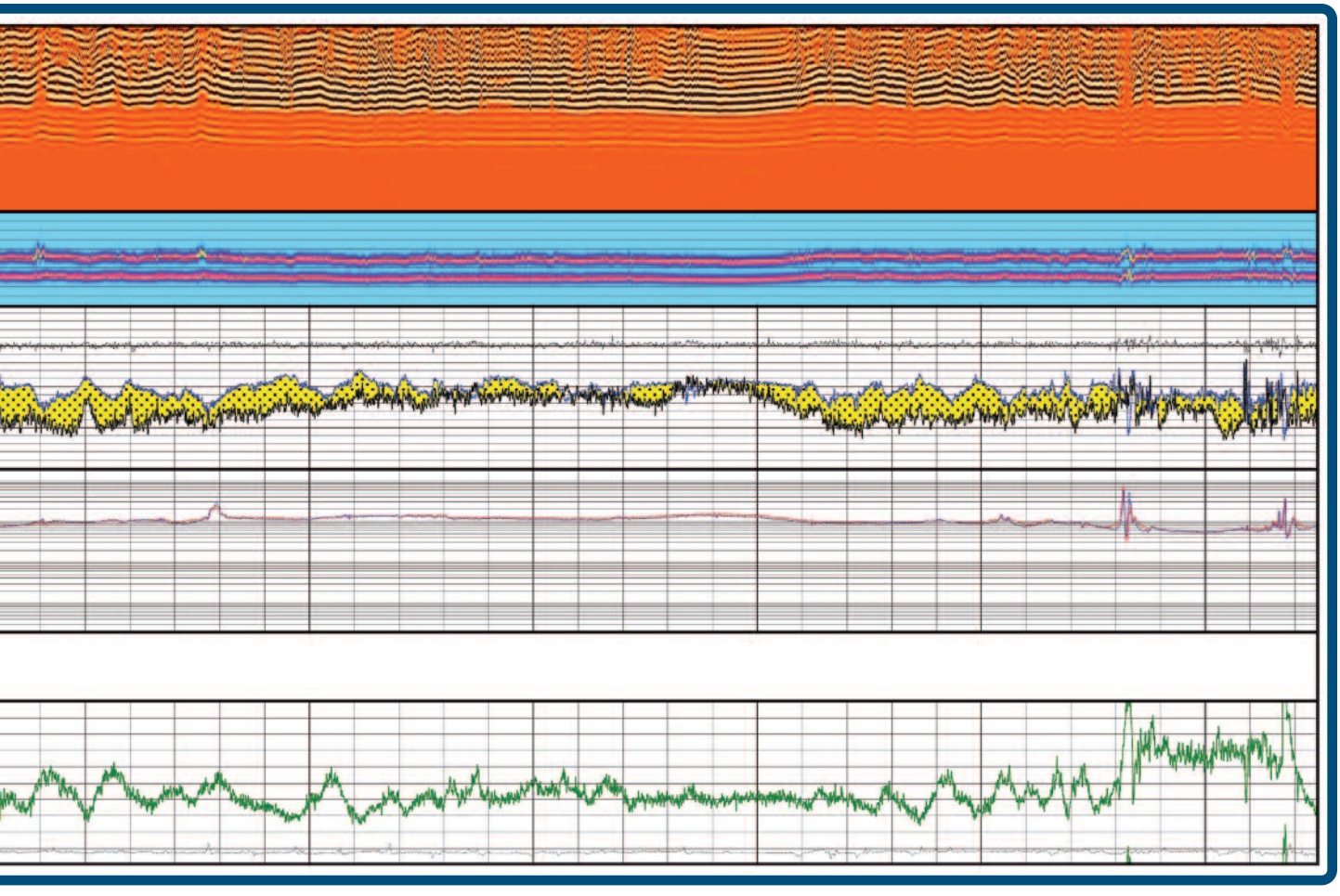
Among the completion tools and systems for shales and tights sands offered by Weatherford are its Frac-Sure Multi-Zone Stimulation Technology (MZST) licensed by ExxonMobil, and the ZoneSelect suite of tools and completion methods. Weatherford is the most recent to be licensed by ExxonMobil Upstream Research to use MZST.

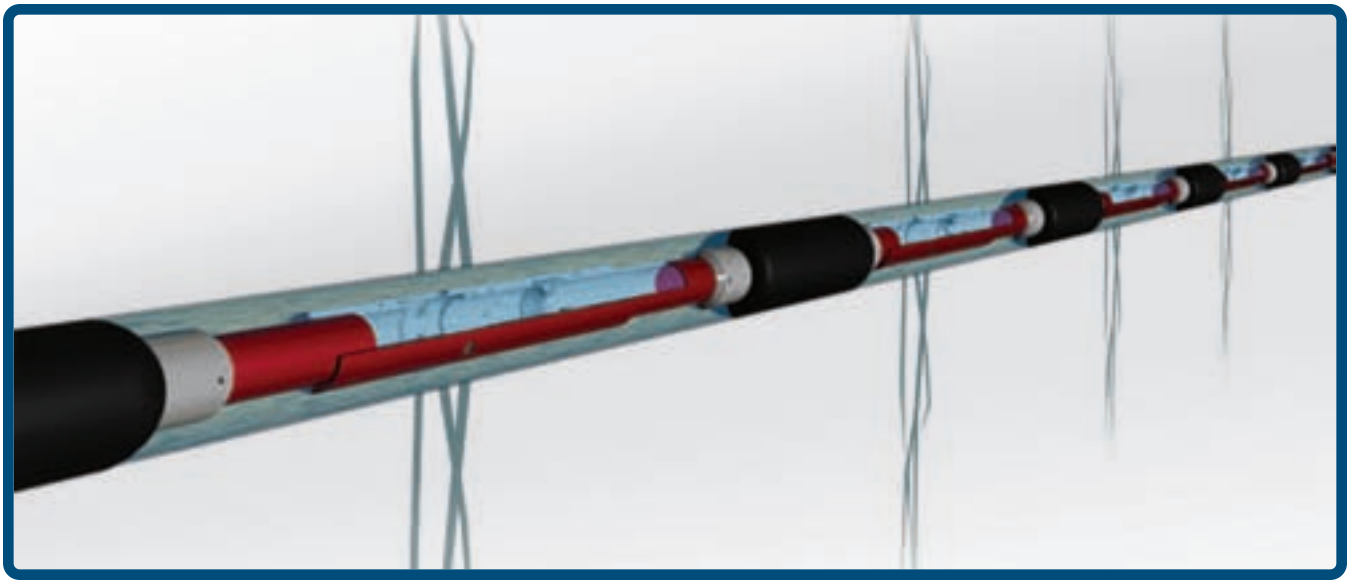
The two MZST methods, Just-in-Time Perforating (JITP) and Annular Coiled-Tubing Fracturing (ACT-Frac), can each provide 40 or more zone-specific customized treatments in a single well, according to the company.

The process enables multizone stimulation in a vertical, deviated, or horizontal well section using ball sealers for diversion between the frac stages. "With JITP, a plug is set, you back up a bit with the wireline, and you frac around the wireline after you set off the first perforating gun," said Robert Fulks, director, Unconventional Projects, for Weatherford. "You drop sealer balls to plug the perforations and then you pump the treatment, pull up the hole, and prepare to fire the guns again.

"JITP can be mixed with other stimulation methods," Fulks said. "You can run a standard plug and perf on the bottom, JITP in the middle, and sliding sleeves in the upper section of the completion."

The ACT-Frac method involves frac treatments pumped down the annulus to facilitate the stimulation. This procedure, like the JITP method, involves repeating each perforation and frac treatment and enables stimulation of multiple zones with one trip. The tool assembly is conveyed on wireline in vertical wells and on coiled tubing in a horizontal section. The system sets an inflatable packer, and frac fluid is pumped down the casing annulus to the frac zone, perforating the zone. The packer is released, the tool moves up the horizontal section to the next zone, and the process is repeated as many times as necessary.





Weatherford's ZoneSelect modular completion system enables operators to choose from a variety of sleeve actuation options and zonal isolation methods to create the right completion for the particular formation. The completion method uses sliding sleeves that can be ball-drop actuated, mechanically shifted, or pressure activated in the case of the toe sleeve. Zonal isolation is achieved with either swellable or openhole packers or cement. *(Image courtesy of Weatherford)*

The company's ZoneSelect modular completion system enables operators to choose from a variety of sleeve actuation options and zonal isolation methods to create the right completion for their particular formation. The completion method uses sliding sleeves that can be ball-drop actuated, mechanically shifted, or pressure activated in the case of the toe sleeve. Zonal isolation is achieved with either swellable or openhole packers or cement.

The system's sleeves feature up to 40 drop-ball sizes that allow fracturing up to 41 zones in 5½-in. casing. The additional zone can be added by using a pressure-activated toe sleeve. A unique feature of the sleeves is that they use shear rings rather than shear screws or pins, which provides more precise opening pressures and clearer opening pressure indications, according to the company.

The completion system also is available with Multiple Array Stimulation System (MASS) sleeves in which multiple sleeves can be opened with a single ball size. The MASS sleeve allows operators to have multiple points of entry for the frac within the zone, similar to PNP. Port diffusers installed in the sleeves allow preferential flow in the isolated zone during frac initiation to improve the uniformity of the pressure across the interval.

Case history

In one well in the San Miguel Formation in Dimmit County, Texas, an operator wanted to complete multiple fracture stages in a horizontal section without having to perform rigging or wireline operations on the wellhead that would expose personnel to LPG fracture fluid. The operator also wanted to be able to perform continuous fracture treatment to eliminate the need to purge the LPG from the piping systems between the fractures. Weatherford recommended using the ZoneSelect single shot sliding sleeve and ARES hydraulic openhole packers in the 6¼-in. section with 4½-in. casing liner. The extra-long packing element increases sealing capability while requiring lower packoff force, resulting in reduced stress on the formation.

The completion system was deployed to TD and the operator was able to pump the LPG frac treatment continuously with a closed system without the need for wellhead rigging operations or coiled tubing. The operator did not need to purge the LPG from the lines to fracture the next zone, which could have taken several hours, resulting in improved efficiency, reduced rig time, and lower associated costs, according to the company. ■

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Infrastructure Supports South Texas Plays

Successful development in several distinct unconventional resource areas has led to regional midstream infrastructure modifications, facilities integration, and newbuild implementations.

By Skip Simmons
Contributing Editor

By far the largest and most complex area in terms of infrastructure requirements, the Eagle Ford Shale play spans 400 miles from the Mexican border to as far north as some eastern Texas counties. The South Texas portion has been the primary focus, and operators have determined that the Eagle Ford has three distinct development windows for oil, condensate, and dry gas corresponding to the shallow, intermediate, and deeper parts of the play, respectively. Currently, most activity has been deferred in areas where dry gas would be the targeted product in favor of development in the condensate-rich and the oil-prone areas. This focus is primarily due to the returns that producers can realize for oil, condensate, and NGL relative to their dry natural gas counterpart. This development trend in the liquids areas is expected to continue for some time due to the midterm overall US natural gas supply/demand balance forecasts and resultant forward natural gas price path. It also should be assumed that, for the most part, major infrastructure developments associated with Eagle Ford efforts will be of such scale as to provide for access of any other products developed in South Texas geological plays.

Oil development has spawned activity

Existing South Texas area oil gathering and transportation systems were the first to support regional development activities. Trucking also has been a very important part of early development activity, whether for gathering at lease or delivering into existing area oil pipelines. It became apparent rather quickly, however, that the volumes of oil and condensate expected from the various regional development areas would require significant new midstream infrastructure facilities. Many of these major facilities are just beginning to be placed into operation after several years of planning and development.

Crude oil from conventional resources has been gathered and distributed in South Texas for many years. These facilities had provided for routing the crude oil to local regional refineries or into the greater Houston area. With the significant increase in regional crude oil availability from unconventional resource development, shippers have elected several different market options, as outlined below.

Continue to route to existing area refinery capacity and/or expanded capabilities

Several gathering and transportation projects have been implemented to gather crude into Valero's Three Rivers, Texas, refinery. Those projects facilitate displacing volumes of imported heavy foreign crude used by the facility and have enabled an expansion to a daily refining capacity of 100,000 b/d. Crude available but in excess to these daily requirements can be diverted via existing area pipelines into the Corpus Christi area.

Valero Energy and Harvest Pipeline have participated in building a crude-gathering pipeline

from Atascosa and Live Oak counties into the Valero Three Rivers, Texas, refinery. Capacity of the pipeline is 100,000 b/d.

TexStar Midstream Services LP is implementing a new 70-mile crude gathering capability in Frio, LaSalle, and McMullen counties in Texas, and will subsequently route 100,000 b/d of crude/condensate via a lease of transportation capacity on NuStar's existing pipeline into Corpus Christi. Facilities include a new regional crude oil terminal to be developed at/or near Oakville, near Three Rivers.

A number of other existing area crude pipeline projects and terminals have been reconfigured and/or optimized and provide for gathering of crude and transportation into the Corpus Christi refining and storage terminal market. Specifically, Koch Pipeline has expanded and enhanced its existing crude gathering facilities in the Pettus area by adding 120,000 b/d of additional capability as well as leasing a reactivated pipeline from NuStar that provides for up to 50,000 b/d of capacity into the Corpus Christi area. Newbuild projects into the Corpus Christi area are discussed separately herein.

Export crude from the region into the greater Houston area

One facility currently routing its initial crude volumes into the greater Houston area is the Phase 1 of Enterprise Products' Eagle Ford Oil Pipeline. This 360,000-b/d facility, which gathers crude along its route via a number of laterals and gathering system interconnections, includes a number of temporary storage and truck uploading facilities. The Eagle Ford Oil Pipeline routes northward to an expanded Rancho Pipeline at Sealy, Texas, and then onward to storage and distribution facilities at a new Enterprise Crude Houston (ECHO) terminal in southeast Houston. The ECHO terminal was expected to be in service in July 2012 and will distribute further into a potential market of more than 4 million b/d of refining capacity in the greater Houston area. Phase 2 of the Enterprise Eagle Ford Oil Pipeline system consists of an additional 80-mile extension southwestward along the oilier portion of the play and could gather up to 500,000 b/d of crude from a central delivery point/hub in the Gardendale, Texas, area; this seg-

High liquids production from the Eagle Ford Shale requires multiple tanks to hold production between visits from tanker trucks that haul oil to refineries. *(Photo courtesy of Marathon Oil Corp.)*

ment is expected to be in service by 1Q 2013.

Another liquids transportation facility into the greater Houston area and recently placed in service is the Kinder Morgan Energy Partners Crude/Condensate Pipeline, a 300,000-b/d facility. This facility consists of 65 miles of newbuild pipeline as well as 113 miles of converted natural gas pipeline facilities from KM-Texas and KM-Tejas intrastate gas pipelines. Initially, crude and/or condensate volumes are being delivered into existing terminals that feed refineries in the Houston area. Kinder Morgan is also developing a new condensate processing facility near its existing Galena Park terminal on the Houston Ship Channel with initial capacity of 50,000 b/d; projected in-service date for such is 1Q 2014. BP has announced that it has contracted to provide up to 40,000 b/d into the condensate processing facility from various sources and will lease 750,000 bbl of storage space at the KMEP Galena Park facility.

Route the crude into either the Corpus Christi area for use by existing refineries or to nearby marine terminals for barge transportation to other Gulf Coast areas

Arrowhead Pipeline is expanding its existing Pearsall Pipeline into the Cotulla, Texas, area to access new crude oil volumes. Via a joint tariff arrangement with Koch Pipeline, up to 50,000 b/d will be routed to Corpus Christi.

In addition to several existing crude oil pipelines into and terminals within the Corpus Christi area, several new projects are also being implemented. Plains All-American Pipeline LP is implementing a new 300,000 b/d pipeline from the Gardendale, Texas, area/hub into Corpus Christi. The current timeline would have the facility in service by 1Q 2013. Plains has recently acquired 120 miles of crude oil and condensate gathering pipeline (capacity 150,000 b/d) and storage systems (185,000 bbl) in the Gardendale, Texas, and Catarina, Texas, areas. In addition, Plains is providing 150,000 bbl of condensate storage at Corpus Christi and implementing/expanding marine terminal access.

Other area facilities are focused to South Texas regional condensate and are being implemented into the Corpus Christi area. The first facility consisting of a 140-mile liquids pipeline from the Gardendale hub into Corpus Christi and expanded terminal and marine facilities is being implemented by a joint venture between Harvest Pipeline and Martin Midstream. These facilities are expected to come online by May 2012. Martin Midstream also is adding 300,000 bbl of storage at its existing Corpus Christi terminal and is implementing a new marine docking capability.

A second project, referred to as Double Eagle Pipeline LLC, involves a joint venture wherein Copano Energy and Magellan Midstream are implementing a 100,000 b/d capability to deliver condensate to Magellan's existing Corpus Christi liquids terminal and attached marine terminal. This project includes an additional 500,000 bbl of storage capability at the Magellan liquids terminal.

Use rail transportation to export crude from the region into other Gulf Coast markets

With significant crude volumes available from the region and transportation-to-market options not yet available in some areas, transportation of crude volumes by rail is being used in the South Texas region. Gardendale Railroad, a short-line carrier with connections to the Union Pacific railroad network has, in addition to providing services for incoming pipe and other materials, implemented additional rail facilities to provide unit train (100-car) crude oil transportation from the Gardendale area. US Development Group LLC has implemented the Eagle Ford Crude Terminal, capable of handling up to 40,000 b/d of crude/condensate. Both of these capabilities have been effectively used since export pipeline facilities were not yet available. Rail transport also allowed access to other refinery markets and crude pricing scenarios which, even with a higher transportation cost for rail, proved to be a desirable option for producers.

A crude oil and condensate terminal/aggregation hub has developed in the Gardendale, Texas, area where a number of midstream operators and transporters have implemented facilities. Table 1 reflects these parties and their respective facilities.

NGL value spearheading significant activity

In additional to oil and condensate, portions of the Eagle Ford trend contain hydrocarbon-rich natural

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Facilities	Operator	Origin	Terminus	Capacity (bbls/d)	In service
Phase 2: 80-mile crude pipeline	Enterprise Products Partners	Gardendale Hub	Phase 1: Lyssy station, Wilson County, TX	200,000	Q1, 2013
Phase 2: Crude oil terminal and storage	Enterprise Products Partners	Various	Gardendale Hub	500,000 bbl (storage)	Q1, 2013
Arrowhead Pipeline extension to Cotulla,TX, and joint tariff arrangement with Koch Pipeline	Harvest Pipeline	Cotulla, TX	Fowlerton, TX	50,000	In service
Arrowhead (Pearsall) Pipeline existing/expansion	Harvest Pipeline	Fowlerton,TX	Corpus Christi	80,000	In service
140-mile crude/condensate pipeline	JV: Harvest Pipeline & Martin Midstream	Gardendale Hub	Martin Midstream terminal at Corpus Christi	150,000	Q3, 2012
Expand liquids storage capability	Martin Midstream		Martin Midstream terminal at Corpus Christi	300,000 bbl (storage)	Q3, 2013
Build new marine terminal and connecting pipeline	JV: Harvest Pipeline & Martin Midstream	Martin Midstream terminal at Corpus Christi	Port of Corpus Christi	15,000 bbls/hr	Q3, 2012
(Proposed) 70-mile 12-in. condensate pipeline	NuStar Energy/TexStar Midstream Services LP	Gardendale Hub	(new) Oakville/Three Rivers, TX area storage terminal with connection to NuStar's existing 16-in., 200,000 b/d pipeline to its Corpus Christi North Beach terminal	100,000	In service
Truck Terminal, 15,000 bbl (storage) and Catarina Pipeline	Plains Eagle Ford Pipeline (from Velocity Midstream)	Catarina Terminal	Gardendale Hub	50,000	In service
65-miles of 12-in. condensate gathering Pipeline	Plains Eagle Ford Pipeline (from Velocity Midstream)	Webb & Dimmit Counties	Gardendale Hub, consisting of trucking, rail, and pipeline connections, and 100,000+ bbls of crude/condensate storage	150,000	In service
130-mile crude oil/condensate pipeline	Plains Eagle Ford Pipeline	Gardendale Hub	(new) Corpus Christi terminal with 800,000 bbl storage	300,000	Q1, 2013
Enhance Viola dock/marine facilities and provide liquids storage	Plains Eagle Ford Pipeline	Port of Corpus Christi	(new) marine terminal expansion to 600,000 bbl storage	600,000 bbl (storage)	In service/ partial
Rail loading facilities	Gardendale Railroad	Gardendale Hub	Various locations by rail, including St. James, La.	varies	In service
Rail loading facilities	US Development Group	Gardendale Hub	Various locations by rail, including St. James, La.	40,000	In service

Table 1. Crude/condensate facilities, Gardendale, Texas, area

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Facilities	Operator	Origin	Terminus	Capacity (bbls/d)	In service
Double Eagle Pipeline (condensate)	JV: Copano Energy LLC/ Magellan Midstream Partners	Three Rivers, TX: pipeline receipts from Gardendale Hub (west) and Karnes & Dewitt counties (east). Truck off-loading terminal.	Magellan terminal - Corpus Christi, TX	100,000	Q2, 2013
Condensate storage and dock delivery pipeline	Magellan Midstream Partners	Three Rivers,TX	Magellan terminal - Corpus Christi, TX	500,000 bbls (storage)	Q2, 2013
Crude oil gathering system	Harvest Pipeline/ Valero refining	Live Oak & Atascosa counties	Valero Three Rivers refinery	50,000	In service
24-mile 16-in. crude pipeline	Koch Pipeline	Karnes and DeWitt counties,TX	Pettus, TX	120,000	In service
Pettus to Corpus Christi (existing)	Koch Pipeline	Pettus, TX	Corpus Christi,TX	120,000	In service
Pettus to Corpus Christi (new 20-in. pipeline)	Koch Pipeline	Pettus, TX	Corpus Christi,TX	250,000	Q3, 2012
NuStar - Pettus South Pipeline re-activation/ lease to Koch Pipeline	Koch Pipeline	Pettus, TX	Corpus Christi,TX	30,000 /50,000 max	In service
NuStar - existing crude oil pipeline	NuStar Energy	Pettus, TX	NuStar North Beach terminal Corpus Christi, TX	200,000	In service
55-mile 12-in. pipeline to Valero refinery (crude and feedstocks)	NuStar Energy	Corpus Christi	Valero Three Rivers refinery	50,000 (ext)	Q3,2012
NuStar - reversal of 8-in. products pipeline to Valero refinery	NuStar Energy	Three Rivers, TX	NuStar North Beach terminal Corpus Christi, TX	50,000 (est)	In service
NuStar - reversal of 16-in. crude pipeline to Valero refinery	NuStar Energy	Three Rivers, TX	NuStar North Beach terminal Corpus Christi, TX	120,000	In service
Increase marine storage	NuStar Energy	Oakville, TX	Port of Corpus Christi	400,000 bbl (storage)	Q3 2012
Storage and truck off-loading facilities including Oakville terminal	NuStar Energy/ TexStar Midstream Services LP	Frio, LaSalle, and McMullen counties, TX	Oakville, TX	up to 1,000,000 bbl (storage)	Q3,2012
110-mile crude/ condensate pipeline	TexStar Midstream Services	Frio, LaSalle, and McMullen counties, TX	Oakville, TX	100,000	Q3,2012

Table 2. Crude/condensate facilities, Pettus/Oakville/Three Rivers, Texas, area.

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gas. This gas can be processed NGL that can be used in various industrial and petrochemical operations. These NGL price comparative to crude oil in many of their applications and uses; thus, with today's higher oil prices and lower natural gas prices, the BTUs associated with those hydrocarbons provide higher value when sold as NGL products rather than as natural gas. Producers are then able to realize better overall economics (i.e., netback) when participating in the NGL market.

The natural gas processing and gathering space in South Texas is occupied by a number of major players. Generally, producer's gas is committed by contract to a gathering and/or transportation system and/or to a specific plant or plants. Commercial terms are negotiated and may involve a fee-for-services structure, a percent of overall sales proceeds structure, or some combinations thereof. Residue gas (dry) at the processing plant tailgate is sold into traditional gas markets.

Boardwalk Field Services LLC operates a gathering and processing system in South Texas that is integrated with the former Boardwalk Pipeline Partners Gulf South Pipeline mainline system. To provide services to producers in the rich gas fairway of the Eagle Ford play, Boardwalk has constructed a 55-mile lateral (300 MMcf/d) westward from its current system. In addition, Boardwalk is implementing a 150 MMcf/d Flag City gas processing plant near Edna, Texas (1Q 2013). NGL removed will use third-party NGL transportation pipelines to access downstream fractionation.

Copano Energy LLC has retained capacity at its Houston central processing plant to be used for volumes that it gathers independently in the South Texas area. In addition to several other existing gathering systems it operates in South Texas, Copano's 96-mile DK (DeWitt Karnes) Pipeline currently provides for regional gas gathering capability in the heart of the Eagle Ford Shale. This facility is being extended 65 miles further along the rich gas play into McMullen County, Texas (2Q 2013). This extension will parallel a portion of the proposed Double Eagle liquids pipeline that is being implemented to aggregate and transport condensate to Corpus Christi from these same areas.

Separately, Copano Energy LLC and Kinder Morgan Energy Partners (KMEP) have entered into a multifaceted joint venture arrangement that gathers upstream gas from producers and routes it via new and existing pipeline facilities to Copano's Houston central gas processing plant near Sheridan, Texas, and to two other area processing plants where Copano has contracted for added capability and flexibility. The overall joint venture, Eagle Ford Gathering LLC (EFG), will contract for all of the transportation capacity and the various processing plant and fractionation capacities. Using the existing KM Texas Laredo-to-Katy pipeline, the overall EFG gas transportation system will provide the ability to transport up to 600 MMcf/d of processible Eagle Ford gas, with 375 MMcf/d routed northward to the Houston central plant and another 225 MMcf/d routed eastward to the KM Tejas Agua Dulce-to-Markham pipeline, a portion of which has recently been converted from dry gas to rich gas service. From the KM Tejas system, a portion of the rich gas stream can then be routed to additional EFG-contracted processing plant capacity at Williams Partners' Markham processing plant (capacity of 100 MMcf/d) or to Formosa Hydrocarbons' processing and fractionation plant (200 MMcf/d). The nearby Formosa Plastics plant is a potential consuming market for some of the NGL produced while other NGL products access existing NGL pipelines nearby.

DCP Midstream LLC has been an active gatherer and processor in South Texas for many years, as well. To support future processing and gathering operations, DCP contracted for 100% of the available capacity on a portion of Trunkline Gas' existing pipeline system that has been converted to rich gas service. This new rich gas gathering header runs north and south through portions of the rich gas play and connects to five existing DCP area processing plants. DCP is adding a sixth plant, a 200 MMcf/d facility (Eagle), in Edna, Texas (3Q 2012), and will have total processing capacity of over 1.0 Bcf/d. The DCP gathering header system provides the ability to process gas selectively at individual plants or collectively. To provide for NGL disposition, DCP has existing operative NGL pipelines in

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The natural gas processing and gathering space in South Texas is occupied by a number of major players. Generally, producer's gas is committed by contract to a gathering and/or transportation system and/or to a specific plant or plants.

the area and the proposed Sand Hills NGL pipeline (3Q 2012) is under construction. Sand Hills will aggregate NGL in the Permian Basin and collect additional NGL from the new DCP header plants enroute to Mont Belvieu, Texas, fractionators.

Energy Transfer Partners (ETP) LP is another active gatherer and processor in South Texas. Early on, ETC implemented several connecting laterals to provide for interim processing capability at existing area facilities while it began planning and construction on its long-term facilities. ETC continues operation of the Chisholm pipeline that sources Eagle Ford gas into its existing processing plant at LaGrange, Texas (capacity of 300 MMcf/d), as well as implementation and phased expansions of its Rich Eagle Ford Mainline Pipeline in Jackson County, Texas, (initial capacity of 600 MMcf/d, expandable in subsequent phases to 1.0 Bcf/d). ETP has implemented an NGL pipeline from the Jackson County plant to its fractionation capability at Mont Belvieu, Texas. At Mont Belvieu, Lone Star NGL LLC, a joint venture between ETP and Regency Energy Partners LP, is constructing a 100,000 b/d fractionator to assist in NGL product extraction. Recent announcements include the implementation of a new gas processing plant in Karnes County, Texas, with capacity of 200 MMcf/d (4Q 2012), and the addition of an additional 100,000 b/d fractionator at Mont Belvieu (1Q 2014).

Enterprise Products Partners (EPD) LP is one of the largest gatherers and processors in South Texas and for many years has had an integrated network of gas gathering and processing capabilities. With increasingly available rich gas development, EPD is expanding its capabilities to meet customer demand. In addition to enhancements and additions to its existing gas processing network, EPD is implementing a major south-to-north gathering pipeline system in several phases that would provide up to 900 MMcf/d of gas to a new processing plant to be located in Yoakum, Texas. This overall effort also includes additional NGL pipeline implementation from the plant to Mont Belvieu, Texas, and the construction and implementation of an additional 150,000 b/d (two phases) of NGL fractionation capability there. Recent announcements also have EPD adding an additional NGL pipeline from the Yoakum plant to Western Gas Resources' LaSalle County processing plant (2Q 2013) as well as adding an additional 150,000 b/d of fractionation capability at Mont Belvieu (4Q 2013).

Southcross Energy operates an existing gathering, processing, and NGL systems in South Texas and is expanding and integrating such into a larger network capability. In addition to its enhanced 135 MMcf/d Gregory, Texas, gas processing plant and fractionator, Southcross is implementing an additional 200 MMcf/d plant at Woodsboro, Texas, and an additional fractionator (initial capacity 11,500 b/d) nearby. These new facilities are scheduled to be in service by 3Q 2012. Recently announced, the Bonnie View fractionator will be expanded to 22,500 b/d by 1Q 2013, yielding a total area NGL fractionation capability of 27,300 b/d. The Bonnie View fractionator will connect to the existing Seadrift ethane and propane product pipelines and will accommodate truck loading and off-loading capabilities as well.

TEAK Midstream LLC, an existing area gatherer, has announced that it will build and operate new gas gathering and processing facilities supporting area development activity in LaSalle and Karnes counties, Texas. In addition to implementing two gathering laterals with combined capacity of 1.0 Bcf/d, TEAK will construct the 200 MMcf/d Silver Oak gas processing plant (3Q 2012). A 51-mile residue gas pipeline is also being built to transport dry gas into area interstate pipelines as well as an NGL pipeline that would connect the plant output to DCP's Sand Hills NGL pipeline for downstream fractionation at Mont Belvieu, Texas. ■

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South Texas Shales Still Sizzling

Several formations allow operators to focus their assets on oil, condensate/NGL, or dry gas windows.

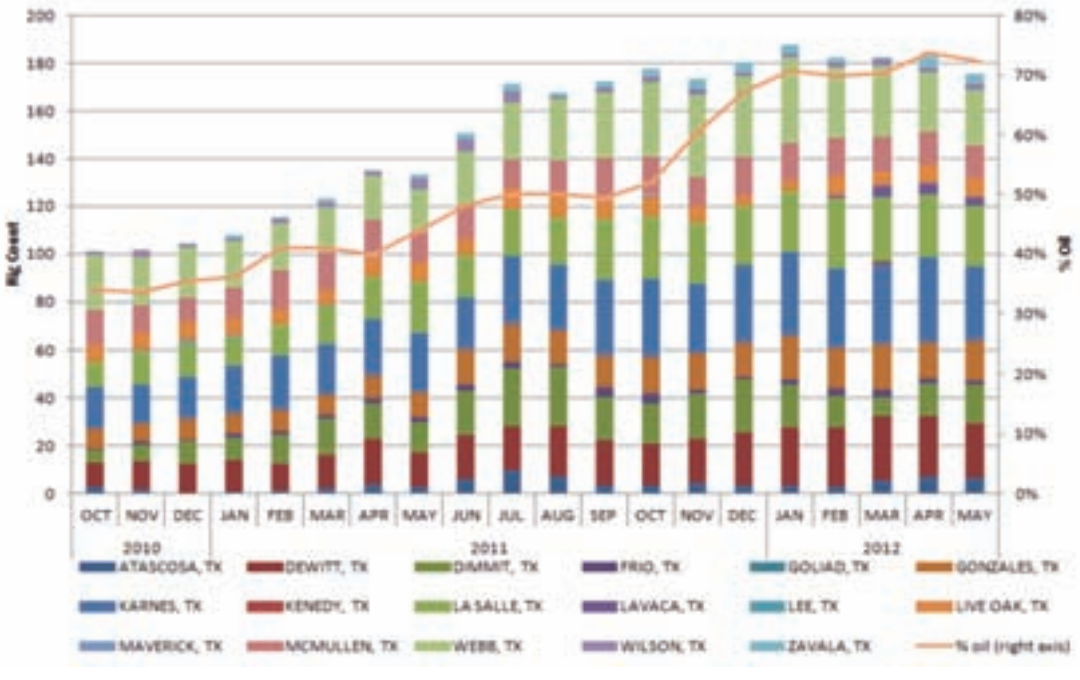
By Mike Warren
Executive Director of Research
Hart Energy

South Texas will remain an investor hot spot as several formations allow operators to focus their assets on oil, condensate/NGL, or dry gas windows that move from northwest to southeast across 28 Texas counties. Given widely fluctuating prices for oil and gas, knowing what type of hydrocarbon volumes the plays will produce is an important consideration when allocating capital.

Looking back a year: industry activity

In August 2011, the Henry Hub natural gas price averaged roughly $4.75/MMBtu and West Texas Intermediate (WTI) crude oil price at Cushing averaged $88/bbl. BHP Billiton Ltd. had bought Petrohawk Energy Corp. for $15.1 billion earlier, in midyear, and there were several subsequent acquisitions that solidified South Texas as the hot shale spot in North America.

Eagle Ford Rig Count by County



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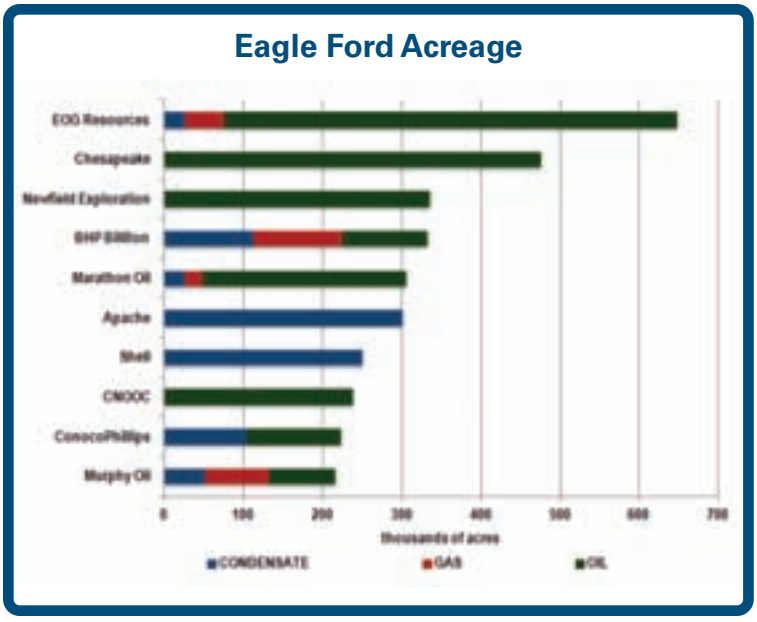
CALENDAR OF EVENTS

EVENT	DATE	LOCATION	DESCRIPTION
WORLD REFINING & FUEL CONFERENCES	October 9, 2012	**Rio de Janeiro, Brazil** Hotel Royal Tulip Rio de Janeiro	• Fuels, Policy & Outlook • Executives, Engineers & Analysts **wrfconferences.com/rio**
DEVELOPING UNCONVENTIONALS DUG EAGLE FORD	October 14-16, 2012	**San Antonio, TX** Henry B. Gonzalez Convention Center	• All Eagle Ford/South Texas Plays • Executives, Engineers & Analysts **dugeagleford.com**
DEVELOPING UNCONVENTIONALS DUG EAST	November 13-15, 2012	**Pittsburgh, PA** David L. Lawrence Convention Center	• Appalachian Basin Developments • Executives, Engineers & Analysts **dugeast.com**
Rockies Midstream CONFERENCE	December 6, 2012	**Denver, CO** Colorado Convention Center	• Bakken & Niobrara Infrastructure • Executives, Engineers & Analysts **rockiesmidstream.com**
MARCELLUS-UTICA MIDSTREAM CONFERENCE & EXHIBITION	January 29-31, 2013	**Pittsburgh, PA** David L. Lawrence Convention Center	• Infrastructure in the Northeast • Executives, Engineers & Analysts **marcellusmidstream.com**
DEVELOPING UNCONVENTIONALS DUG CANADA	Feburary 24-27, 2013	**Calgary, AB, Canada** TELUS Convention Centre	• Tight Oil & Canadian Activity • Executives, Engineers & Analysts **dugcanada.com**
DEVELOPING UNCONVENTIONALS DUG	April 2-4, 2013	**Fort Worth, TX** Fort Worth Convention Center	• Producing the Permian Basin • Executives, Engineers & Analysts **dugconference.com**
DEVELOPING UNCONVENTIONALS DUO RESERVOIRS	May 29-31, 2013	**Denver, CO** Colorado Convention Center	• Unconventional Oil Production • Executives, Engineers & Analysts **hartduo.com**
energycapital CONFERENCE	June 17-18, 2013	**Houston, TX** Omni Hotel	• Upstream, Economic, Financial • E&P Executives & Capital Providers **energycapitalconference.com**
A&D STRATEGIES AND OPPORTUNITIES	September 4-5, 2013	**Dallas, TX** Ritz-Carlton Hotel	• Asset-oriented, Financial • BD Executives in the E&P sector **adstrategiesconference.com**



Fast forward one year and Henry Hub natural gas prices dropped below $2/MMBtu in April 2012 and have averaged $2.90 over the last 12 months due mostly to an oversupply situation in North America. The WTI crude oil price at Cushing was volatile, falling below $80/bbl twice in October 2011 and June 2012 because of fears of a global economic contagion from Europe's fiscal morass. WTI also rose above $100/bbl for three consecutive months last year; it has averaged $94/bbl over the past twelve months

While oil prices provided some relief from low natural gas prices, 2Q 2012 write-downs in shale assets due to low natural gas prices announced by several companies that had bought into South Texas – BHP Billiton, Talisman Energy Inc., CNOOC Ltd., and Statoil ASA to name a few – may seem to have dampened investors' enthusiasm for South Texas acreage if deal flow is the main metric of measurement.

Although South Texas has not seen as big a deal as the midyear 2011 BHP Billiton acquisition of Petrohawk Energy, there has been significant activity. For example, 75,000 net Eagle Ford acres changed hands when Apollo Global Management LLC, private equity firm Riverstone Holdings LLC, and Access Industries Inc. picked up all of El Paso E&P North America's assets for $7.1 billion in February 2012. Also earlier this year, Marubeni picked up 18,000 South Texas net acres in Lavaca and Gonzalez counties from Hunt Oil with a 35% working interest for $1.3 billion (Marubeni also purchased privately held Gavilon LLC for $3.6 billion; Gavilon has extensive logistical assets that service North American shale plays).

Another Japanese company, a subsidiary of Osaka Gas Co. Ltd., plans to buy a 35% nonoperated working interest in the Pearsall Shale in Atascosa, Frio, La Salle, and Zavala counties from Cabot Oil & Gas Corp. in approximately 50,000 net acres in South Texas for $250 million in cash and carry. Under the agreement, Osaka Gas will pay $125 million to Cabot at closing and will pay an additional $125 million to carry 85% of Cabot's share of future drilling costs in the Pearsall Shale. The drilling carry is expected to be fully utilized by year-end 2013.

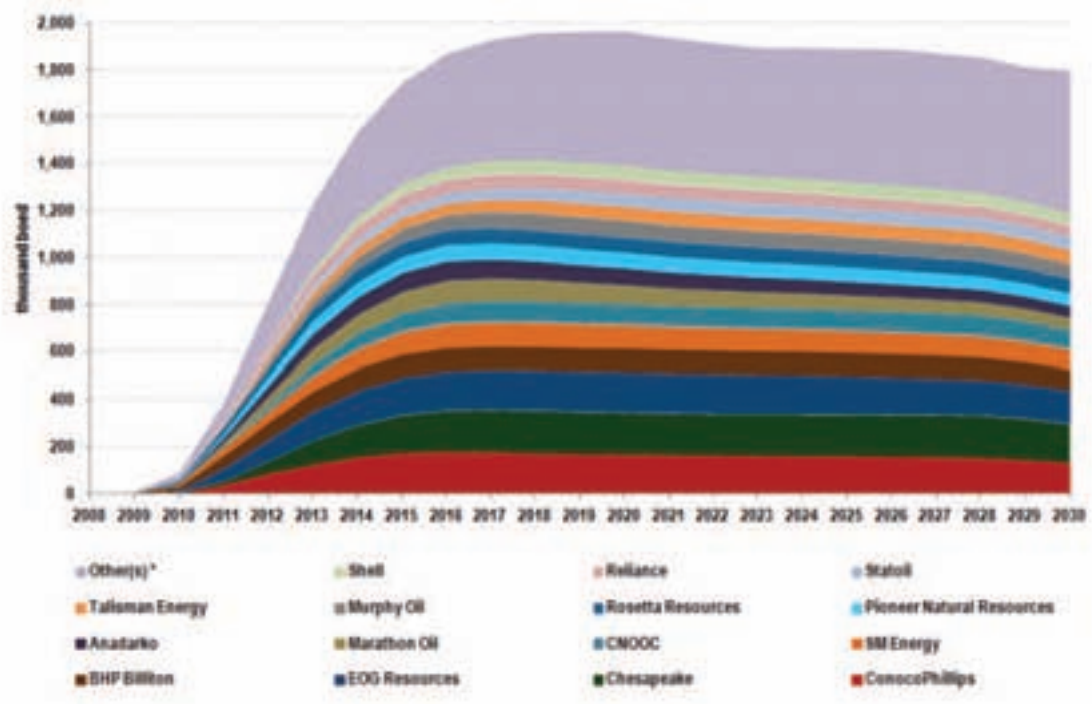
Marathon Oil Corp. plans to acquire 17,000 net acres from privately held Paloma Partners II LLC for $750 million in cash in the 3Q 2012. The acreage is primarily in Karnes and Live Oak counties, Texas.

Also in the second quarter, Halcon Resources Corp. and Aurora Oil & Gas Corp. each made two deals for acreage in South Texas. Halcon picked up nearly 40,000 net acres in the Woodbine and Eagle Ford plays for close to $700 million. Aurora paid $106.5 million for roughly 8,000 net acres targeting the Eagle Ford in Karnes, Fayette, Burleson, and Washington counties.

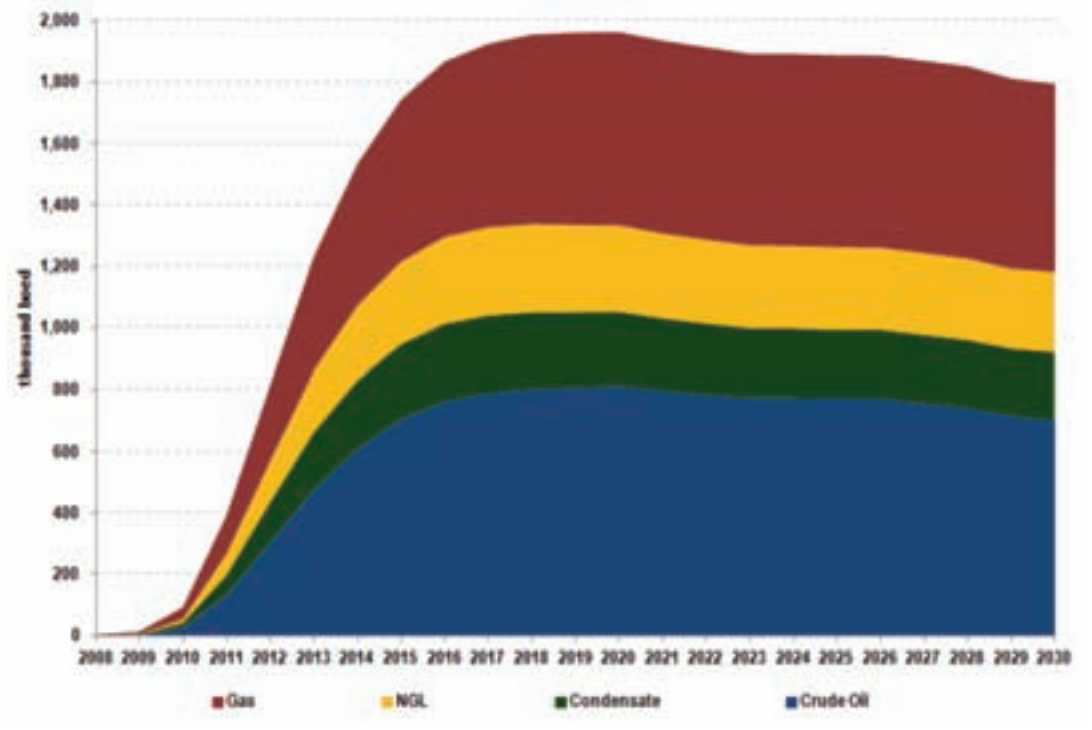
Despite low natural gas prices and less deal flow going into South Texas in comparison to last year, the number of permits continues to rise dramatically. Year on year, permits still have a chance of doubling in the Eagle Ford and surrounding south Texas plays.

Outside of the Eagle Ford Shale play permits, the Olmos Formation has the most permits with Lewis Petro Properties, Escondido Resources, Swift Energy, and Laredo Petroleum leading the way. Of special note is Lewis Petro Properties. It has been drilling in several south Texas formations for 25 years and is also working in Colombia and Mexico. In fact, it was from a Lewis Petro Properties hole that Pemex completed its first shale well (Emergente #1) across the Rio Grande river from Webb

Eagle Ford Production Forecast (2008-2030) thousand boe/d



Eagle Ford Production Forecast (2008-2030) thousand boe/d by HC



Eagle Ford Economic Analysis

Play	Case Name	30-day IP (boe/d)	30 Year - EUR (Mboe)	Dry Gas (%)	Net Acreage (acres)	Well Spacing (acres/well)	CAPEX ($mm)	Type Well NPV ($mm)	Breakeven gas price ($/mcfe)	Breakeven oil price ($/boe)
Eagle Ford Shale	Anadarko/KNOC (Joint Venture)	534	450	35%	300,000	80	5.8	4.2	3.4	26.2
Eagle Ford Shale	BHP Billiton (Black Hawk)	1973	1067	28%	58,300	90-100	9.9	16.0	2.5	21.0
Eagle Ford Shale	BHP Billiton (Hawkville Dry Gas)	1193	1030	80%	112,000	90 - 100	9.6	2.9	4.7	-
Eagle Ford Shale	BHP Billiton (Hawkville Gas-Condensate)	1150	855	48%	112,000	90-100	8.8	5.7	3.7	-
Eagle Ford Shale	Chesapeake	632	543	25%	475,000	80	7.5	5.3	3.4	36.7
Eagle Ford Shale	ConocoPhillips (Oil Rich Area)	1416	878	20%	120,000	80	8.5	12.4	2.5	22.1
Eagle Ford Shale	El Paso (Central Area)	683	562	10%	77,350	80	8.2	7.6	3.0	39.6
Eagle Ford Shale	Hess/ ZaZa Energy (Joint Venture)	501	437	20%	121,300	160	10.0	2.0	4.8	66.9
Eagle Ford Shale	Murphy Oil (Karnes Area)	681	568	20%	14,440	80	8.3	8.4	2.9	38.2
Eagle Ford Shale	Plains E&P	765	435	16%	60,000	80	8.2	4.5	3.7	49.8
Eagle Ford Shale	Rosetta Resources (Gates Ranch Area)	1318	1277	45%	26,500	50-100	8.0	11.4	2.8	-
Eagle Ford Shale	SM Energy	1126	817	56%	149,000	110	7.2	6.6	3.3	-
Eagle Ford Shale	Talisman/Statoil (Joint Venture, Liquids Rich Area)	1167	662	50%	96,000	90	9.0	4.9	3.8	24.7

The expected net present value is calculated with a 7.5% real discount rate (at constant prices) of a single type well at "standard economic conditions." Crude oil, condensate, NGLs, and natural gas price assumptions are: $15/Mcfe (crude oil), $15/Mcfe (condensate), $7/Mcfe (NGL), and $6/Mcfe (gas). Operating expenses are set to $1.5/Mcfe. Royalty and tax rates are set to 20% and 35%, respectively. Units are in millions of US dollars.

County. Subsequently, Lewis Petro Properties is drilling and completing horizontal wells in Mexico with a 15-year lease. In 2008, Lewis Petro Properties also signed a $200 million deal with BP to develop 80,000 gross Eagle Ford acres.

Closely behind the Olmos Formation is the Austin Chalk Formation northeast of the Eagle Ford. Several major independents, such as Marathon Oil, have led the surge into that formation. Of a total of 289 permits year to date (January-July), 26% of all the permits were in Webb County and 78% of all the permits were for horizontal drilling.

Although not covered in Hart Energy's South Texas rig count, Brazos and Madison counties have seen heightened drilling activity in the Woodbine as privately held Vess Oil Corp. and Woodbine Production Corp. step up their activity. The Austin Chalk in Zavala County also has seen an uptick in drilling activity, followed by the Buda in Brazos County, and the Olmos in Atascosa County. Given the recent joint venture between Osaka Gas Co. and Cabot Oil & Gas Corp., Hart Energy Research expects to see an uptick in the Pearsall Shale as well going into Atascosa, Frio, La Salle, and Zavala counties.

The rig count has topped out at roughly 175 since October 2011. Rigs have moved to oiler parts of the South Texas plays, surpassing the 50% mark in September 2011. The top four counties are Karnes, Las Salle, Webb, and Dewitt.

Company activity in South Texas: Change is good

Last year, Hart Energy Research highlighted the acreage positions of the top 10 operators in the Eagle Ford play. Revisiting that list with this year's top 10 provides a quick look at which companies are adding acreage positions and which companies have marginally lowered their exposure to the Eagle Ford play. The 2Q 2012 North American Shale Quarterly publication divided the acreage between joint ventures instead of listing it as one entity. Hence, the Anadarko/state-owned Korea National Oil Co. joint venture did not make the top 10 when compared to last year. More visibility by Apache Corp. brought the company into the top 10 prospective Eagle Ford list when it publicized its joint venture acreage positions acquired from Enervest and EV Energy Partners in September 2007.

EOG Resources Inc., Marathon Oil, Murphy Oil Corp., and Chesapeake Energy Corp. all increased their acreage positions in the Eagle Ford. Meanwhile, acreage estimates reveal that ConocoPhillips and BHP Billiton slightly lowered their exposure to the play. Overall, there was not much movement in

the top 10. Some privately owned companies, such as Lewis Petro Properties, reportedly own as much as 450,000 gross acres and would be considered in the top 10. There are several other privately held companies that have acreage positions that could place them in our top 10 list.

While the top 10 acreage positions remained somewhat unchanged, the same cannot be said about the production forecast. Hart Energy's production forecast has increased by 75% since last year, as all companies increased production across the board, except for BHP Billiton. Last year's forecast took into consideration Petrohawk's guidance and drilling program, which has been cut back by the Australian mineral giant. Yet, the biggest increase in production occurred with the non-top 10 players – it doubled. Simply put, wildcatters and privately owned companies dot the Texas landscape with a much higher density than the states of Ohio or North Dakota, and they have roots in South Texas that run deep. These companies, coupled with more and more joint venture carries looking for liquids-rich formations, will keep the South Texas region hot for the rest of the decade. Consequently, Hart Energy's Eagle Ford's production forecast can still be considered conservative.

In regards to production by hydrocarbon type, it is only natural that the dry gas production forecast did not keep up with the projected increases in oil, condensate, and NGL production. While there remains more natural gas production than previously forecasted, an increase of 44% by 2020, much of this increase comes from associated gas in the liquids-rich part of the Eagle Ford.

The production forecast now extends to 2030. Given the longer time horizon in Hart Energy's projections, it appears the peak production period will be in 2020, with the volumes slowly declining through the forecast period.

Play economics: South Texas is very competitive

Play economics have been a key driver of Eagle Ford investment decisions because operators can genuinely decide what type of hydrocarbon volumes they would like to develop. Also, adequate area infrastructure allowed South Texas plays to ramp up quicker than other North America plays outside of Texas. The infrastructure connection to the massive PADD 3 Gulf Coast refinery complex has allowed Eagle Ford crude to fetch higher oil prices than the Bakken/Three Forks play. Looking specifically at break-even prices at the wellhead, the analysis also will have to include gas production from the play. The more gaseous the play, the higher the breakeven prices are due to the lower revenue generated from subdued natural gas prices. Most liquids-rich plays have breakeven prices in the $40 range; these half cycle costs do not include transportation or leasing costs.

Compared with production costs from new heavy crude oil projects in Canada and Brazilian presalt (deepwater) production, shale oil breakeven costs are very competitive across the board, according to Hart Energy Research's Heavy Crude Oil study.

Of course, not all acreage holders in South Texas are created equal. Companies with the majority of the acreage in the dry gas section of the Eagle Ford have dramatically reduced rig counts and, in some cases, capped production, according to data from the Texas Railroad Commission.

Looking specifically at individual companies, BHP Billiton, ConocoPhillips, and Talisman Energy have the best breakeven prices for oil in their respective parcels in the Eagle Ford Shale play. Production records suggest these companies hold valuable acreage in the play when measuring net present valuation, estimated ultimate recovery, and break-even prices. As Hart Energy had mentioned last year, BHP Billiton may have been criticized in the financial press for paying too much for its acquisition of Petrohawk, but our analysis suggests that at least for the Eagle Ford, their positions were highly rated.

Across the board, break-even costs for South Texas have been falling as more information gleaned by the operators are yielding higher hydrocarbon volumes. Countering the positive of falling break-even costs, several operators have cited rising cost inflation associated with Eagle Ford production. Still the Eagle Ford offers high margins with oil prices over $90/bbl and decades of production yet to come. ■

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Additional Information on South Texas Plays

For more details, consult the selected sources below.

By Chandler Lusardi
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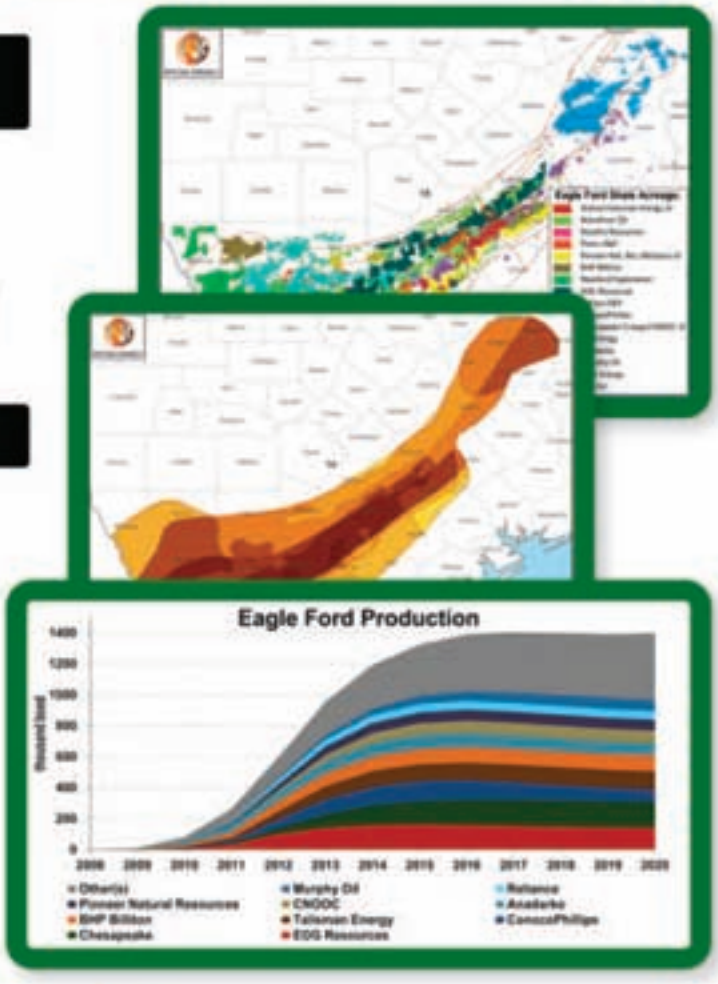

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Schlumberger performs a HiWAY fracture stimulation job on one of BHP Billiton's Eagle Ford wells. *(Photo courtesy of BHP Billiton)*

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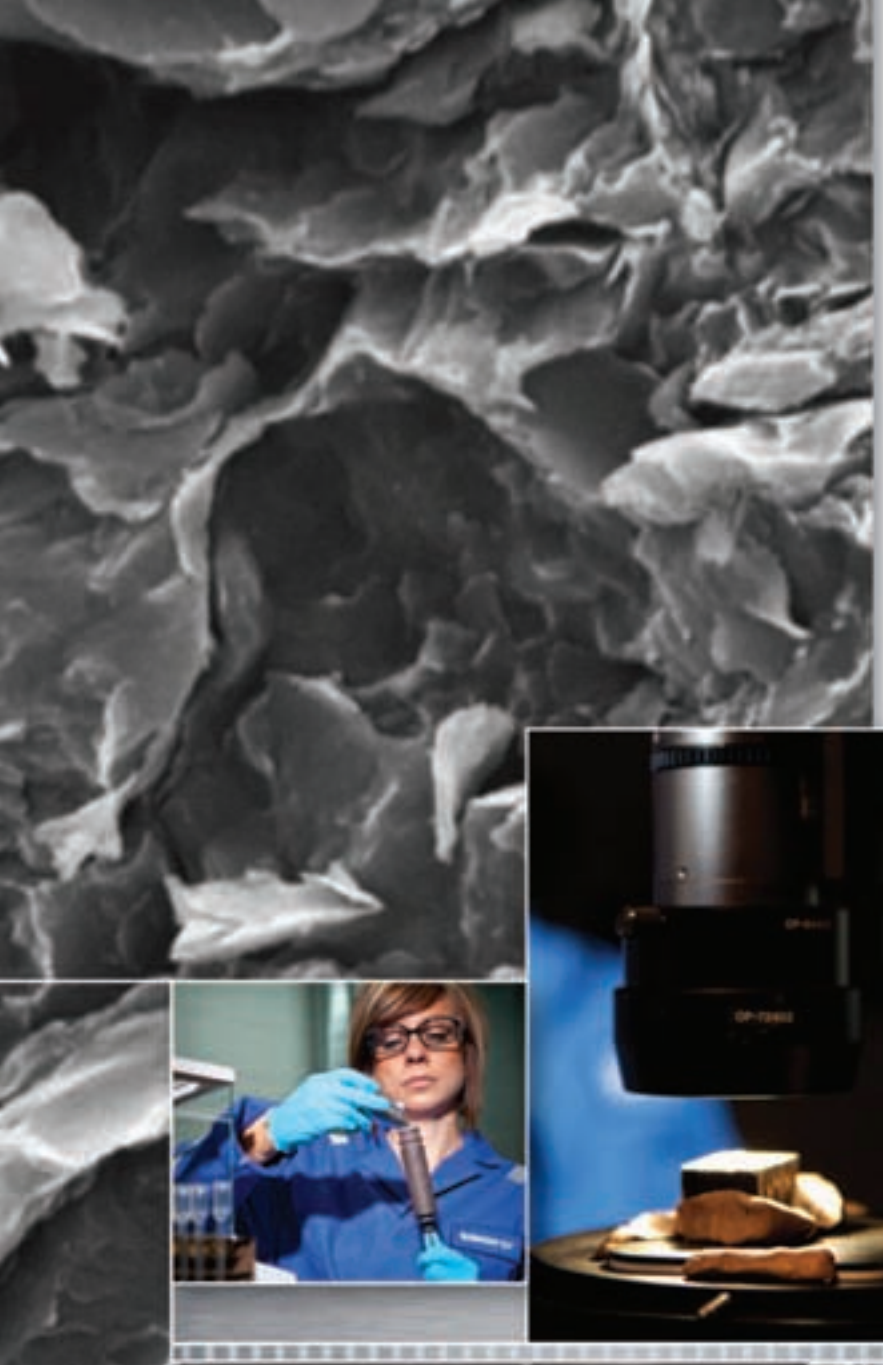

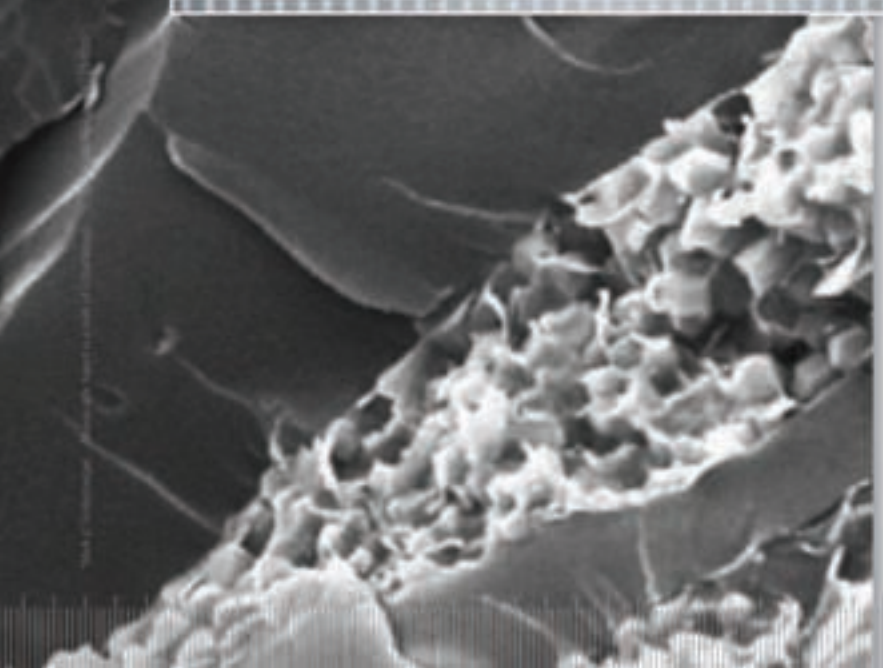

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