Major Phases in an Oil and Natural Gas Development

Lifecyle of an Onshore Oil and Natural Gas Project

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2. **Drilling**
3. **Completion & Testing**
4. **Production**
5. **Seismic Testing**
6. **Abandonment & Reclamation**
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Why Eagle Ford?
The Eagle Ford Shale in Texas has become a world-class resource play for oil and natural gas

As oil and gas companies continue to search for additional resources to address the country’s energy needs, the Eagle Ford Shale in Texas has become a focus of exploration and production activity in North America. The Eagle Ford Shale formation is considered by many to be the most significant new opportunity for unconventional hydrocarbons — both oil and natural gas — in the United States. According to the Texas Railroad Commission, 2010 production in the Eagle Ford Shale exceeded 3.5 million barrels of oil and will increase over the next few years.

Those potential resources are classified as “unconventional” because the hydrocarbons are trapped in formations of shale — a fine-grained, sedimentary rock — and require innovative technologies to extract. Advancements in two of those technologies — horizontal drilling and hydraulic fracturing — have made production of hydrocarbons from these unconventional resources commercially viable in some areas and greatly increased U.S. energy supplies.

The Eagle Ford Shale has been identified as a premier play in North America and is expected to provide energy resources for decades to come. Geologic studies in the Eagle Ford, which spans over 400 miles in south Texas, have revealed the potential for large quantities of hydrocarbons; and energy companies have obtained the rights to explore for and produce hydrocarbons on significant amounts of acreage stretching across the area.

The full extent of the Eagle Ford Shale’s possible role as a major hydrocarbon resource is not yet known, and full-scale production could be several years away. Many challenges remain, including environmental concerns and the lack of infrastructure to support production. However, the successful development of the Eagle Ford, and other shale plays across the U.S., presents many benefits, including potentially reducing oil and gas imports from foreign sources.

The oil and gas drilling in the Eagle Ford Shale will not only help the U.S. on its path to energy security, but will also create tens of thousands of jobs in the region.
Modern Oil and Gas Exploration
Finding new reservoirs of oil and natural gas has become more challenging and complex

The potential of the Eagle Ford Shale’s natural resources has created considerable interest in the area. The Eagle Ford has an abundance of oil and natural gas trapped within the shale formation, making these resources “unconventional.” Extracting these unconventional resources safely requires both technology and experience.

Oil from conventional formations is easier to produce because it’s typically trapped in more permeable reservoir rocks such as sandstone or limestone that allow it to flow more freely. Conversely, unconventional reservoirs, like those in the Eagle Ford Shale, are characterized by tight formations that trap the hydrocarbons and require stimulation techniques to allow them to flow. This typically makes production from unconventional reservoirs more costly and technologically challenging.

“Shale oil” is the terminology used simply to indicate that the reservoir rock containing the oil is shale. The oil itself is the same as oil found in conventional formations.

Likewise, the term “shale gas” is commonly used to identify natural gas produced from shale reservoirs. Again, there is no difference between this natural gas and natural gas produced from conventional reservoirs.

Finding Hydrocarbons
Exploration and production companies explore for hydrocarbon deposits by using complex technologies to identify prospective drilling locations. Teams of geologists, geophysicists and engineers methodically identify, characterize and examine geologic prospects that hold the promise of yielding commercial quantities of oil and natural gas. Before a drill touches the earth, a variety of advanced technologies are used to pinpoint – with a high degree of certainty – exactly where that drill should go. Modern drilling is less intrusive and more precise, and the entire process is designed to minimize disturbances to land, vegetation, water, air, natural habitats and surrounding communities.

The actual process of finding hydrocarbons consists of three phases.
- The exploration phase involves drilling wells to evaluate whether a reservoir has sufficient hydrocarbons to make development economically viable.
- In the second phase, additional wells are drilled in smaller, more contained areas to appraise the reservoir and try to confirm the assumption that hydrocarbons can be extracted economically.
If the appraisal program indicates the project is viable, it moves to the third phase — production. This would entail a much higher level of drilling activity, and production from these wells could last for several decades, providing clean energy to the marketplace.

**Hydraulic Fracturing and Horizontal Drilling**

Production from hydrocarbon-rich shale formations is one of the most rapidly expanding trends in oil and gas exploration and production.

The term “shale” refers to the sedimentary rock that’s predominantly comprised of mud, stones and organic material. Its low permeability means that hydrocarbons trapped in shale cannot move easily within the rock except over geologic expanses of time (millions of years).

A key element in the emergence of shale production has been the cost-effective refinement of two technologies — horizontal drilling and a process known as hydraulic fracturing.

Horizontal drilling provides more contact to a reservoir formation than a vertical well and allows more hydrocarbons to be produced from a given wellbore. For example, six to eight horizontal wells drilled from one location, or well pad, can access the same reservoir volume as 16 vertical wells. Using multi-well pads can significantly reduce the overall number of well pads, access roads, pipeline routes and production facilities, minimizing habitat disturbance, impacts to the public and the overall environmental footprint.

The other key to economically developing shale formations is hydraulic fracturing, which involves pumping a mixture of mostly water and sand, and a small percentage of additives, under high pressure into the reservoir to create fractures, or cracks, in the target rock formation. The main purpose of hydraulic fracturing is to increase both the production rate and the ultimate recovery of oil and natural gas from a well.

During the past decade, both of these technologies — horizontal drilling and hydraulic fracturing — have been safely applied in combination to allow the economic development of oil and gas shale reservoirs.

Moving into the next decade, these concepts and techniques are being applied around the world in an attempt to produce more energy and help meet growing global energy demand.
Marathon’s commitment to safety is straightforward and a responsibility shared by our employees, executives, contractors and everyone involved in our operations. Protecting the health and safety of all workers and the surrounding community is a core value for the Company. We will not move forward with any job until we know it can be done safely.

The Company recognizes that the ability to do business in any community is a privilege. High standards of health, environmental, safety and security (HES&S) performance underpin a culture of continuous improvement, and includes:

- A comprehensive HES&S policy and associated performance principles
- A broad Corporate Social Responsibility (CSR) policy that affirms a continuing commitment to our core values and which promotes sustainable social, environmental and economic benefits wherever Marathon operates
- Use of integrated HES&S Management Systems to drive continuous improvement throughout the Company.

Safety is embedded into everything the Company does. Marathon is committed to creating a safe work environment and works diligently to achieve a 100 percent accident-free workplace. Employees strive for continuous improvement through near-miss recognition and investigation, on-the-job safety programs, health programs, safety training and awareness, and programs designed to ensure compliance with applicable regulations and industry standards.

Preventing safety accidents involves designing appropriate systems into both processes and equipment, operating according to established procedures, applying safe work controls and properly maintaining equipment.

The Company systematically identifies potential hazards, assesses their significance and develops measures to make sure any risks are properly addressed.

Management System Drives Continuous Improvement

Marathon uses a management system aligned with international standards to manage HES&S performance, and its effectiveness has been proven around the world. Called the Global Performance System, it promotes a consistent approach for conducting business across all global operations and provides the framework for setting targets, implementing actions to achieve them, measuring performance and reporting results. The system is aligned with the basic continuous improvement cycle of Plan-Do-Check/Adjust. The elements are recognized as key components of best practice management systems that drive business excellence.

The Global Performance System proactively identifies and addresses potential impacts to people, the environment and company assets. It also addresses the full life cycle of any asset, from project design to construction, operation and maintenance.

Regardless of size, location, range of issues or degree of regulation, Marathon can then assess and manage HES&S and social impacts within a common framework and integrate this stewardship into all aspects of operations.
Across the globe, Marathon is striving to reduce its environmental impacts, while expanding its operations to meet growing energy demand. Efforts include decreasing operational use of natural resources, reducing emissions through energy efficiency improvements and investing in new technologies and renewable energy resources.

We implement four main initiatives to protect the environment.

- **We will live by our core principles:**
  Protecting the environment in which we work is a core value for Marathon. If a job can’t be done in a safe and environmentally conscious manner, we won’t proceed until we can do so in a responsible way.

- **We will always implement the appropriate management systems:**
  We’re committed to developing customized procedures, procuring equipment as necessary and using best practices and lessons learned from around the world. All workers will communicate daily about the operation and identify potential hazards. If an unforeseen event occurs, we will report the incident, clean it up properly, work diligently to determine why it happened and identify what we will do to prevent re-occurrence. We will also conduct baseline water testing as a best practice.

- **We will ensure that the wellbore is structurally sound and that no leaks exist:**
  Wellbore fluids will be isolated from groundwater by casing and cement, and the casing will be pressure-tested prior to any fracture stimulation or hydrocarbon production. Casing integrity is ensured throughout the hydraulic fracturing process by continuous monitoring of annular pressure. Casing and cement also protect groundwater from oil and gas during the producing life of the well. These procedures ensure freshwater aquifers are protected from wellbore fluids.

- **We will implement surface fluid handling procedures at the wellsite:**
  Using lessons and procedures derived from our management systems, we will implement measures to prevent surface spills of fluids or chemicals. For example, drip pots and catch pans will be used on mobile equipment to prevent fluids from contacting the ground.

**KEY POINTS**

- Robust wellbore casing procedures ensure freshwater aquifers are always protected from wellbore fluids by at least two barriers of steel casing and cement.
- Chemical additives used in hydraulic fracturing fluid are similar to those found in household products.
- Any hydraulic fracturing fluids or produced water from wells will be reused for hydraulic fracturing or disposed of in accordance with environmental regulations.

Fracture treating the Eagle Ford formation through several horizontal stages. The depth of the Eagle Ford formation, as can be seen, ensures that the aquifer is not affected.

Casing strings protect the aquifer.
**Typical Chemical Additives Used in Hydraulic Fracturing Water**

There has been much debate about the fluids used in hydraulic fracturing. The table below indicates the additives that are mixed with the sand and water in the hydraulic fracturing process. Many of the additives are similar to those found in household chemicals.

All chemicals or additives used at a wellsite must have a corresponding material safety data sheet, or MSDS, for use by both the workforce and emergency services personnel. We participate in a website (www.fracfocus.org) that publicly discloses frac fluid components in specific wells.

<table>
<thead>
<tr>
<th>COMPOUND</th>
<th>PURPOSE</th>
<th>COMMON APPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acids</td>
<td>Helps dissolve minerals and initiate fissure in rock (pre-fracture)</td>
<td>Swimming pool cleaner</td>
</tr>
<tr>
<td>Sodium Chloride</td>
<td>Allows a delayed breakdown of the gel polymer chains</td>
<td>Table salt</td>
</tr>
<tr>
<td>Polyacrylamide</td>
<td>Minimizes the friction between fluid and pipe</td>
<td>Water treatment, soil conditioner</td>
</tr>
<tr>
<td>Ethylene Glycol</td>
<td>Prevents scale deposits in the pipe</td>
<td>Automotive anti-freeze, deicing agent, household cleaners</td>
</tr>
<tr>
<td>Sodium/Potassium Carbonate</td>
<td>Maintains effectiveness of other components, such as crosslinkers</td>
<td>Washing soda, detergent, soap, water softener, glass, ceramics</td>
</tr>
<tr>
<td>Glutaraldehyde</td>
<td>Eliminates bacteria in the water</td>
<td>Disinfectant, sterilization of medical and dental equipment</td>
</tr>
<tr>
<td>Guar Gum</td>
<td>Thickens the water to suspend the sand</td>
<td>Thickener in cosmetics, baked goods, ice cream, toothpaste, sauces</td>
</tr>
<tr>
<td>Citric Acid</td>
<td>Prevents precipitation of metal oxides</td>
<td>Food additive, food and beverages, lemon juice</td>
</tr>
<tr>
<td>Isopropanol</td>
<td>Used to increase the viscosity of the fracture fluid</td>
<td>Glass cleaner, antiperspirant, hair color</td>
</tr>
</tbody>
</table>

**Typical Shale Fracturing Mixture Makeup**

- **WATER**: 90%
- **SAND**: 9.5%
- **CHEMICAL**: 0.5%
Seismic testing, which has been performed safely by the oil and gas industry for decades, involves sending vibrations through the earth and recording the reflected waves as they come back to the surface. Collecting the data requires equipment that includes a vibration, or vibe, truck and recording devices known as geophones. The data recorded will ultimately provide information about the earth’s properties and allow Marathon to create maps of major layers of the subsurface.

**The Process**

In areas that require seismic, introductions with landowners will be conducted and agreements signed to grant access so crews can conduct the testing. A team of surveyors will scout a targeted area and walk the actual lines where the geophones will be placed. Prior to testing, acquisition crews will lay out lines of cables with geophones attached. The cables will be connected to a recording truck, where technicians with computers will record data during acquisition operations.

To create the subsurface waves, three to four vibe trucks will travel to a specific location where the lines of geophones have been installed. The trucks lower a large plate to the ground that vibrates and creates the waves of energy.

While the trucks generate some noise, the vibrations are typically not enough to cause more than a ripple in a container of water. Additionally, a monitoring instrument called a peak particle velocity meter is used to measure the amount of energy reaching a nearby structure. This allows the energy output of the vibrators to be adjusted to prevent any damage to existing buildings. Seismic acquisition at any given location typically takes only a few hours.

The reflected signals are recorded and reviewed for completeness in the recording truck. The vibe truck may move slightly and repeat the process if necessary. Once a line has been completed, the crew will pick up the geophones and cables and move to the next location.
Seismic crew deploying the cables in the field

The vibration truck

Vibration plate lowered into position on ground

Geophones are manually placed into the earth

Geophone recording device inserted into the ground
Drill Pad Construction
Preparing the land for the arrival of the drilling rig is an important part of the project

**Construction process**

Once the wellsite has been identified and an access agreement has been signed, an area of land is cleared so that drilling, construction and production traffic can enter the site. This may require upgrading roads and, in some cases, erecting power lines to connect the site to the local electrical supply. The impacted area for drilling is typically less than 500 feet by 500 feet. The drilling pad itself is usually 350 feet by 400 feet.

As part of the clearing process, topsoil is removed and typically stored on site for use in the reclamation of the pad at a later date. Rocks may be removed and reused elsewhere. As part of the construction phase, a number of factors are taken into consideration, including safety, proximity to water sources, buildings and other public places. Additionally, measures are taken during construction to ensure that surrounding land is preserved and protected. This may include using rocks or other material to control water runoff from the pad.

**Drilling**

A drilling rig moves on site and carefully drills deep into the earth over several weeks

Once a site has been prepared, the drilling rig moves in, a process that will require numerous trucks carrying various parts of the rig. Once assembled, the rig will be both visible and audible as drilling operations take place around the clock for approximately three to four weeks for each well. In some cases, more than one well will be drilled at the same location. Noise-reduction equipment will be used where possible, and lights will be used at night to ensure the safety of the workers.

**Drilling Process**

Once the operation begins, the drill bit is lowered into the hole by adding sections of drill pipe at the surface. This pipe is pumped full of drilling fluid, or “mud,” which travels down the pipe, through the bit, and back to the surface, carrying rock pieces, called cuttings. The mud has several functions. As it passes out of the drill bit, it lubricates the cutting surface, reduces friction and wear and keeps the drill bit cooler. Additionally, it carries rock cuttings away from the drill bit and back to the surface for separation and disposal. While traveling back up the hole, the mud also provides pressure to prevent the hole from caving in on itself.
Casing Creates Physical Barriers

Drilling will be stopped at certain depths to place steel casing into the ground to protect the hole as well as surrounding rock layers and underground aquifers. The casing is fixed in place by pumping cement down the inside of the casing and up the outside between the steel casing and the surrounding rock. Drilling operations are halted until the cement hardens. The quality and integrity of the cement job is then checked with a logging tool.

The casing and cement create a physical barrier between the external formation and the inside of the pipe to stop external fluids and rock from entering the wellbore during drilling. It also keeps production fluids and natural gas from escaping the wellbore in the production phase.

Once the hole has been drilled to the target depth, workers remove the drill pipe and run tools into the well to evaluate the target rock layer. Once that evaluation is complete, a final casing segment is installed and cemented in place. Additional cement plugs are left inside the casing for added protection.

To finish the drilling process, a stack of valves is placed on top of the wellhead at the surface. These valves allow access to the wellbore in the future and will be the main feature visible once the drilling rig leaves.
Completion & Testing
Hydraulic fracturing is the stimulation process required to make shale plays economic

KEY POINTS
- Hydraulic fracturing is the well stimulation process required to make shale reservoirs economically viable
- The fluid used contains 99.5 percent sand and water with 0.5 percent additives, many of which are found in household products
- Freshwater aquifers are protected by at least two barriers of steel casing and cement

After the drilling rig has left the location, well completion will start. The timing could vary from days to months, but will again result in increased activity.

The Process
The well completion process starts by removing any temporary plugs that were placed in the wellbore. The casing is pressure tested to ensure integrity, i.e., that no leak paths exist. The wellbore is then perforated by sending down a tool referred to as a perforating gun, which contains numerous individual shot charges that are fired into the casing at the designed depth. Once the charges go off, they create a hole through the casing and cement into the rock formation. This will allow the oil and natural gas to flow from the rock formation into the well. The tool is used at such great depths that nothing is heard or felt on the surface when the gun is fired.

As noted previously, to enhance productivity, a well stimulation process known as hydraulic fracturing is used to create small cracks in the underground geologic formations that in turn allow fluids and natural gas to flow more easily into the well and up to the surface. The process involves pumping a stimulation fluid (see page 7) into the shale formation at high pressures to create the small fractures a few millimeters wide, up to 500 feet in height toward the surface, and up to approximately 2,000 feet in length. When the pressure is released, the fractures attempt to close but the sand contained in the fluid keeps the fracture open, making an easy path for oil and gas to flow into the well.

The volume of water required for the stimulation fluid can only be determined once the data received from the drilling operation has been analyzed, but can be estimated at up to 4 to 8 million gallons (or 100,000 to 200,000 barrels) of water for a horizontal well. Marathon is working to optimize the use of non-potable brackish water on fracking programs to limit use of fresh water.

During the hydraulic fracturing process, the pressure on the outside of the casing is continuously monitored and, if a problem occurs, the job is stopped immediately.

During the past 60 years, the oil and gas industry has conducted fracture stimulations in more than 1 million wells worldwide.

Once the stimulation is complete, production from the well typically will be monitored for a few weeks to evaluate its performance. Once the testing has been completed, all equipment will be removed and the only thing remaining on the site will be the valves on top of the wellbore itself.
Production
The production phase could last for several decades

In the production phase, activity levels are initially very high as the Company substantially increases the number of wells drilled. In any one region Marathon may have multiple drilling and completion rigs in operation simultaneously.

In some cases, drilling pads can be designed to house multiple wells per pad. The well would be connected to production facilities, which are then connected to pipelines.

Most sites will have equipment to separate the oil, gas and water produced from the well into distinct flow paths. Separate storage tanks will be required to collect oil and water until trucks can visit the site. The trucks will then haul water to another site for re-use or proper disposal, and the oil will be transported to a sales point. Most surface equipment will have some form of lined secondary containment to protect the surrounding environment in the unlikely event of a leak. The most notable will be containment walls placed around tanks and catch pans for mobile equipment to prevent any material from getting offsite.

Operators will monitor production sites on a routine basis to check tank volumes and ensure everything is operating correctly. In addition, electronic monitors and alarms are designed to immediately notify our personnel of any irregularity.

Ultimately, the production phase may last up to 30 years. On occasion, Marathon will need to bring equipment to the site to perform maintenance on the wellbores and processing equipment.

KEY POINTS
- Economic well rates must be observed in both the exploration and appraisal phases before moving into the production phase
- This phase could last up to 30 years and result in the drilling of hundreds of wells
- Each well must be fracture stimulated; some of the water necessary for these stimulations can be used in multiple wells
- In some cases, drilling pads can be designed to house multiple wells per pad
- Production facilities, storage tanks and compressors may be added to sites
- Trucks may be required to collect any liquids produced
Abandonment & Reclamation
Once a field has been depleted, the goal is to leave the land the way it was found

KEY POINTS
- Reclamation will leave the site the way it was originally found
- All surface equipment will be removed
- Wells will be filled with cement and pipes cut-off below plow level
- All pads will be filled in with dirt or replanted

Once a field has been deemed depleted or uneconomic, it will be shut in and abandoned.

Again, vehicle activity will increase as crews move around the well site and remove equipment. Permanent plugs and cement will be set in the wellbores, in accordance with State and Federal regulations, to ensure full isolation from the reservoir and to prevent any leaks. The wellheads will be physically cut off from below the surface. Cement will be placed on top of the cut pipe as a final barrier. The well will then be buried with dirt. The pad will be filled and the land will be turned back to the owner.

A Marathon well that was drilled in the Shoshone National Forest in Wyoming, (left photo). All equipment was removed from the site later the same year (right photo).
Glossary

Cementing — To prepare and pump cement into place in a wellbore. Cement is used for a variety of uses such as creating physical barriers on the outside of casing strings or inside the casing as a plug that can be used in several ways.

Completion — A generic term to describe the preparation of a wellbore for safe and efficient production.

Derrick — A steel structure mounted over the borehole to support the drill pipe and other equipment that is lowered and raised during drilling operations.

Directional Drilling — A technique that enables drilling at an angle to reach a particular underground formation.

Drill bit — Tool used in drilling to break up rock mechanically in order to penetrate the subsoil. The bit drills a circular hole.

Drill Pad — The area constructed on the surface from which a drilling rig will drill wells.

Drill Rig — The derrick, pumps, tanks, hoisting system and other equipment collectively utilized to drill a wellbore.

Exploration — The process of searching for minerals such as oil and gas that enables an oil and gas company to determine whether to proceed with appraisal and production.

Geophone — A device used in surface seismic acquisition that detects ground velocity produced by seismic waves and transforms the motion into electrical impulses.

Horizontal Drilling — An advanced form of directional drilling in which the well is drilled horizontally through the reservoir.

Hydraulic fracturing — The pumping of water, chemicals and a proppant into a reservoir with such force that the reservoir rock is cracked and results in greater flow of oil or gas from the reservoir.

Land Professional — The individual in an oil and gas company or agent who negotiates leases with surface owners.

Material Safety Data Sheet (MSDS) — A document that shows important physical and chemical characteristics of a chemical or product to alert a user, transporter or other interested party to potential safety hazards that may be associated with the material. The MSDS also contains treatments for exposure or ingestion as well as the type of equipment needed for safe handling. An MSDS is a legal requirement in most countries for all aspects of commerce involving chemicals.

Mud — Fluid used in drilling operations to cool the bit, lift drill cuttings to the surface, and balance the pressure of exposed rock formations. Mud typically consists of a base-fluid and chemical additives such as clay.

Natural Gas — A naturally occurring mixture of hydrocarbon and non-hydrocarbon gases found in porous rock formations. Its principal component is methane.

Operator — The party responsible for exploration, development and production of an oil or gas project.

Permeability — A measure of the ease with which water, oil or natural gas can move through a rock.

Pipeline — A string of interconnected pipe providing a route for natural gas to travel from the wellhead to market.

Plug — A barrier, usually cement or a purpose-built mechanical device, set in a borehole to block the flow of fluids, to isolate sections of the well or to permanently abandon a dry hole or depleted well.

Porosity — The open space within a rock, similar to pores in a sponge.

Processing — The separation of oil, gas and natural gas liquids and the removal of impurities.

Production — A generic industry term that refers to operations and activities involved in bringing oil and gas to the earth’s surface, as well as initial processing.

Proppant — Naturally-occurring or man-made particles similar to sand which are part of a hydraulic fracturing stimulation. The proppant is necessary to prevent the fracture, which has been created during a stimulation treatment, from closing when pump pressure is removed. The proppant particles “prop” the fracture open.

Reservoir — A subsurface volume of rock that stores the oil and gas being targeted.

Seismic — A computer-assisted process that maps sedimentary structures to assist in planning drilling programs. Acoustic waves are generated at the Earth’s surface, and their reflection from subsurface rock formations are measured to generate the map.

Shales — A type of sedimentary rock containing very small particles of minerals. Because of this small particle size, the permeability of shale is extremely low.
Glossary

Shut In Well — A well capable of producing but that is not actively being produced at a given time. Reasons for wells being shut in may be lack of pipeline access to market or economically unfavorable market prices.

Sound Barrier — A wall or other device sometimes erected in order to reduce the noise emitted from a particular operation.

Stimulation Fluid — A liquid pumped into the reservoir rock in order to create a fracture, which enables hydrocarbons to flow from the reservoir into the wellbore. The stimulation fluid also transports the proppant into the fracture. Stimulation fluid is water-based with chemical additives.

Vibration Plate — The metal plate that creates the energy waves used in seismic operations. The plate is lowered to the ground and is mechanically vibrated which in turn send waves of energy into the earth.

Waste Water — Water that has been used in the exploration and production process, has returned to the surface from the wellbore, and will be disposed of according to relevant environmental regulations.

Well — A hole drilled through rock and cased with steel pipe, which is then cemented in place. The well is the conduit for hydrocarbons to be produced from the reservoir to the surface.

Wellhead — The control equipment fitted to the top of the well, consisting of outlets and valves.

Notes

Sources: American Petroleum Institute; U.S. Department of Energy, Office of Fossil Energy, National Energy Technology Laboratory; Schlumberger Oilfield Glossary
Marathon Oil Corporation (NYSE: MRO) is an international energy company engaged in exploration and production, oil sands mining and integrated gas.

Based in Houston, Texas, the Company has a strong portfolio of assets delivering defined growth leveraged to crude oil production with exploration upside. The Company’s operations are located in the United States, Angola, Canada, Equatorial Guinea, Iraqi Kurdistan Region, Libya, Norway, Poland and the United Kingdom.

**Exploration and Production**
Marathon’s exploration activities are focused on adding profitable production to existing core areas and developing potential new core areas. Marathon’s production operations supply liquid hydrocarbons and natural gas to the growing world energy markets. Worldwide production operations are currently focused in North America, Africa and Europe. The Company also holds ownership interests in both operated and outside-operated oil sands leases in Canada that could be developed using in-situ methods of extraction.

**Oil Sands Mining**
Marathon owns a 20 percent outside-operated interest in the Athabasca Oil Sands Project (AOSP), which includes the existing Muskeg River and Jackpine mines, the Scotford Upgrader, and additional prospective acreage in Alberta, Canada. These assets give Marathon access to stable, long-life Organisation for Economic Cooperation and Development (OECD) production.

**Integrated Gas**
Marathon’s integrated gas business adds value through the development of opportunities created by demand for natural gas. This business complements the Company’s exploration and production operations and opens a wide array of investment opportunities designed to add sustainable value growth.